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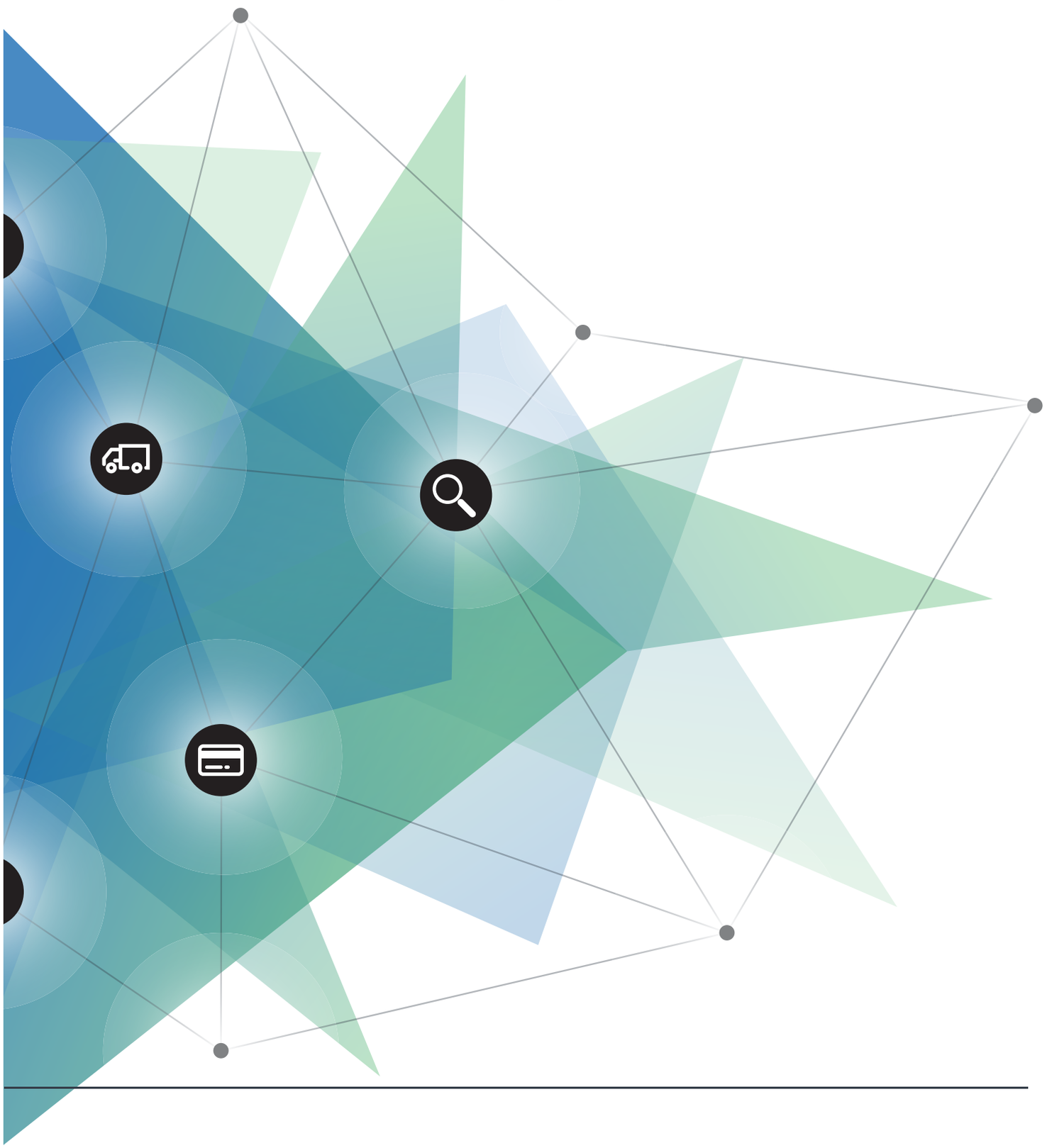
capacitación e investigación

Foresight in Educommunication
and Emerging Sociocultural Expressions



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Guayaquil - Ecuador
www.grupocompas.com
http://repositorio.grupocompas.com
First edition, 2026

ISBN: 978-9942-53-157-5
DOI: 10.31876/9789942531575
Online distribution
Open access

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Preface

It is an honor and a profound exercise in intellectual reflection to present this collective compendium, a work that not only captures the pulse of contemporary research in our region but also dares to navigate the blurred boundaries where cutting-edge technology, territory, and the human condition intertwine in ways that are inherently complex. As a researcher who has dedicated my academic career to unraveling the subtle threads of social change and the dynamics of knowledge, I find in this book an indispensable roadmap for understanding the structural transformations of our time. The richness of this compilation lies in its transdisciplinary perspective, an approach that embraces the analytical rigor of artificial intelligence, data analytics, and mathematical models without ever losing sight of the ethical sensitivity demanded by contexts of exclusion, historical memory, and the tireless pursuit of cognitive justice.

The first major thread running through this conceptual fabric confronts us directly with the disruption caused by algorithms and digitization in classrooms and higher education institutions. We find ourselves at a turning point where traditional pedagogical notions prove insufficient to address the complexity of contemporary interactions; it is here that the construction of new categories such as "distant learning" and "distant writing" comes into play, notions that demystify the false dichotomy between activity and passivity by selectively delegating cognitive effort to machines. This algorithmic mediation is clearly evident when evaluating the trajectories of programming students and their gradual transition from an initial high level of technical dependence in mobile environments toward a reflective and metacognitive autonomy capable of self-managing error. Similarly, in the field of social communication, online journalism workshops incorporate simulated interviews through interfaces operated by language models—an experimental practice that reveals students' ability to structure clear guidelines by formulating specific instructions, while also exposing the intrinsic biases of these devices. Complementarily, quantitative research based on cross-sectional designs provides us with a rigorous diagnosis of the adoption of these technological tools in medium-sized urban settings, confirming the high willingness of school stakeholders to receive specialized training in the face of evident infrastructure asymmetries. Faced with this imperative for innovation, the analytical examination in this book warns us against uncritical enthusiasm; drawing on Andrew Feenberg's critical theory of technology, it deconstructs the normative framework of digital pedagogical knowledge and denounces the excessive use of notions of efficiency or mere safe usage, reminding us that a theoretical understanding of the political and socioeconomic underpinnings of technology must necessarily precede its instrumental application in the classroom.

Beyond technological devices, this treatise delves into the raw wounds of social exclusion and the imperatives of recognition. Attention to diversity and the pursuit of equity unfold in these pages not as ideal abstractions, but as urgent empirical assessments that reveal the gap between national legal frameworks and the daily reality of peripheral public schools, where teachers' professional isolation and the scarcity of adapted materials shape ambiguous perceptions of institutional support. In this context, neurodiversity in higher education calls for a profound transformation of traditional teaching structures; design and architectural environments become

laboratories for the implementation of Universal Design for Learning (UDL) and user-centered approaches, demonstrating that the creative and spatial strengths of students with diverse cognitive profiles—including cases of dual and triple exceptionality—must be valued as assets for innovation rather than through deficit-based models. This demand for cultural justice requires rethinking assessment practices in intercultural classrooms; research reveals how the state's formal curriculum often masks monocultural and even racist attitudes that devalue the educational trajectories of Indigenous students, in response to which a transformative assessment paradigm grounded in participatory parity and mutual recognition is proposed. A notable example of the technical implementation of this inclusive approach is the intelligent tutoring software DUA-Math, a prototype that combines the principles of linguistic accessibility and adaptive voice feedback to autonomously guide students with low vision toward a deep understanding of linear functions.

This concern for equity extends organically to the territorial and community dimensions, where the public university assumes its social responsibility as an ethical and epistemic project. Self-managed and established spaces such as the Barrio U social practice laboratory demonstrate that teaching, research, and outreach can be articulated through an ecology of knowledge that breaks down academic hierarchies and positions the affective and relational plane as the driving force behind transformative engagement in neighborhoods. In contrast to this dialogic model, the updating of institutional educational models driven by state regulations requires the implementation of forward-looking strategies—an anticipatory planning approach that mitigates risks of operational dispersion and ensures the internal coherence of curriculum design through consensus within the university community. The urgency of these reforms becomes evident when examining the structural gaps in the training of economic-administrative profiles, where students express a strong intention to participate in the Sustainable Development Goals but the formal curriculum remains anchored in declarative phases and isolated courses that fragment interdisciplinarity. To capture the complexity of these university ecosystems, the book introduces advanced analytical approaches; the use of statistical biplots allows for multivariate mapping of how sports discipline and social capital interact closely with family support and subjective satisfaction to mitigate dropout factors and enhance academic performance. Similarly, the landscape of social engagement in national systems such as Ecuador's is subjected to critique, revealing chronic inconsistencies between activities declared in regulations and the implementation reported in accountability reports, which perpetuates a welfare-oriented vision that neglects technology transfer and the incubation of social enterprises. In response to these management deficiencies, the MGTCCR interaction model focused on rural settings leverages fractal analysis and agile design tools to co-construct minimum viable portfolios of community services that validate local knowledge and promote endogenous development in the face of state neglect.

Initial teacher training and pedagogical specialization emerge in the latter section of the work as fields in constant dispute and reconfiguration in the face of 21st-century challenges. Practical immersion in classrooms with high socioeconomic vulnerability challenges the certainties of future elementary science teachers, transforming their conceptual frameworks toward an understanding of science as a situated tool of community resistance and ethical mediation. This professional development of teachers is lucidly examined through the trajectories of Chilean

rural micro-centers; by segmenting the data according to Christopher Day's professional life cycles, the study reveals a troubling crisis of identity and group disconnection during the advanced intermediate phase—a phenomenon of burnout that requires differentiated interventions and the systematic leveraging of the institutional maturity of veteran teachers. This need for relevance often clashes with secondary-level curriculum reform processes, where surveys of teachers reflect the persistence of a technical rationality and a top-down implementation that limits the genuine adoption of competency-based approaches and formative assessment. To subvert this inertia of transmission, inductive thematic analysis guides us toward models of sustainable and prospective feedback, a dialogical approach that employs the critical use of exemplars and peer review to train students in the formulation of evaluative judgments and the development of autonomous feedback literacy. Identity challenges become even more complex when exploring the subjectivity of non-native foreign language teachers in Andean societies; testimonies reveal how the historical cultural pressures of Marianism and discourses of linguistic whitening or hierarchization condition their professional self-esteem and tame dissent in job selection environments. Overcoming these didactic asymmetries requires solid methodological frameworks, such as Guy Brousseau's Theory of Didactic Situations applied through the Lesson Study methodology, demonstrating that the social construction of geometric knowledge in early childhood education is consolidated when children interact indirectly with a carefully designed environment. This rigor in argumentation reaches high levels of abstraction in the study of topological homotopies in higher education; through Toulmin's model, the analysis reveals that students' greatest difficulties lie in constructing the warrant component, requiring a precise articulation between analytical-structural and geometric-synthetic modes of thought to formally internalize the properties of the mathematical object. As an integrative response in engineering education, we present the design of a reference pedagogical model that unifies the agility of the EduScrumframework, the didactic inversion of the Flipped Classroom, and the authenticity of project-based learning, enabling students to externalize complex theoretical concepts of operations management by applying them directly to real-world problems.

The intersection between applied engineering, analytical modeling, and built environments finds a solid foundation for scientific and technological development in the intermediate chapters. The teaching of complex transport phenomena is enhanced through the design and validation of simulators programmed in MATLAB App Designer, a methodological approach that structures interactive cycles of experiential learning where students compare the theoretical predictions of the Ergun equation with experimental data recorded by digital sensors in fluidized beds of Nylon 66 and water, achieving high levels of precision and agreement. This drive toward the competencies of the future is consolidated in STEAMmethodologies, implemented through Hackathon structures and project-based learning; here, transdisciplinary teams use data mining, programming in multiple languages, and specialized software design to create prototypes and technological inventions ethically oriented toward solving the socio-ecological challenges of the 2030 Agenda. These participatory dynamics are even penetrating disciplines traditionally resistant to methodological change, such as Law; the application of flipped classrooms in criminal law courses reveals how prior research into case law and the formulation of case theories in the classroom enhance critical thinking and significantly improve students' quantitative performance compared to traditional rote memorization. Human behavior in response to the design of these environments is examined in the corporate sphere; the analysis of social representations

regarding open-plan offices reveals a spatial duality where neuroarchitecture and the removal of physical barriers optimize fluid communication and collective collaboration, yet simultaneously introduce significant tensions due to constant interruptions that disrupt individual concentration and complicate time management. To scientifically model the subjectivity inherent in these soft skills and neurolinguistic programming processes, this text introduces Mamdani-type fuzzy inference systems operated in computational environments, demonstrating that the use of triangular fuzzy numbers allows for the quantification, with mathematical precision, of qualitative linguistic ranges such as goal clarity and emotional management. The psychological cost of performance in these competitive environments is assessed using ruminative response scales, revealing that college students with tendencies toward cognitive rumination attempt to apply adaptive reappraisal strategies but often resort to expressive suppression mechanisms—a psychological vulnerability that varies according to gender, mode of study, and post-pandemic pressures.

The realm of territorial planning, architectural design, and transformations in productive sectors is addressed in this compendium from a deep understanding of resilience and sustainable development. Heritage urbanism finds a model for regenerative intervention in the restoration of Pre-Hispanic Urban Archaeological Monuments (MAPUs) such as the Huaca Chacupe in Chiclayo; through hodological analyses, visibility studies, and morphological modeling based on fractal geometry, the proposal transcends the static conservation approach to conceptualize neighborhood eco-educational corridors co-produced with local communities to mitigate insecurity and urban fragmentation. This convergence of parametric design and digital fabrication extends to long-span architectural structures; through visual programming in Grasshopper 3D, both top-down and bottom-up generative design logics are explored to resolve the geometric and structural complexity of the connecting node in three-dimensional systems of wooden beams and joints printed via additive manufacturing—a design-to-manufacturing workflow that has validated its pedagogical and artistic potential in international residencies. The commercial implications of these technological transitions are analyzed through entrepreneurship case studies in Latin America; algorithmic governance and the adoption of language models and predictive intelligence reduce operating costs and barriers to entry for small businesses in logistics and service sectors, requiring frameworks of ethical trust and cultural adaptability. To provide a stable analytical foundation for these business intelligence decisions, a predictive guide is formulated based on the taxonomy of decision trees, demonstrating how classification, regression, entropy, and stochastic algorithms minimize organizational risk by transforming large sets of qualitative and quantitative data into transparent and structured rules of action. This macrostructural view is complemented by modeling the cattle supply chain in Colombia following the global health crisis; using systems thinking and causal loop diagrams, the research uncovers bottlenecks and feedback loops between production expansion, deforestation, and greenhouse gas emissions, offering operational pathways aligned with the 2022–2050 Sustainable Cattle Farming Policy. The corporate and industrial landscape concludes its analytical cycle with an examination of the transition toward electromobility in the Mexican automotive sector; using Sanjaya Lall's taxonomy of national technological capabilities, the study correlates market trends to highlight an emerging structural shift and evaluates the articulation of green industrial policy through state-led macro-projects such as the Sonora Plan and the Olinia low-cost vehicle initiative.

The final section of the book delves deeply and movingly into the social factor, the human suffering resulting from armed conflicts, the dynamics of transnational migration, and public health from critical perspectives. The realities of child-rearing in the Colombian Pacific are revealed through a detailed case study of a displaced mother in Chocó, whose narrative illustrates how collective care structures and extended family networks serve as scaffolding for resilience in the face of the trauma of historical violence, forcing the adoption and transmission of absolute political neutrality as an indispensable parenting guideline to preserve the child's microsystem from the constant threat of illegal groups. This impact on childhood in conflict zones is subjected to a profound theoretical deconstruction under Johan Galtung's triangle of violence model and the trident of multiple forms of poverty from the theory of social exclusion, demonstrating that community intervention projects based on social pedagogy succeed in reversing the impacts of forced recruitment by providing children with safe spaces for aesthetic catharsis, the reconstruction of territorial bonds, and the exercise of child-led participation. These pacification efforts are closely linked to participatory action research in schools in marginal districts of Bogotá, where the use of problem-based pedagogies and case studies in the Peace Studies course provide sociocognitive tools to combat the individual mechanisms of moral disengagement that perpetuate the dynamics of aggression and bullying among adolescents. The methodological complexity of these migratory phenomena is addressed through Pareto analysis and hierarchical Euclidean distance classifications applied to Mexican transnational families in the context of the mixed migratory pressures of 2026, revealing that subjective well-being, the preservation of family support networks, and timely access to information on fundamental rights take precedence over purely material considerations in adaptation and resilience processes in the face of the constant threat of deportation and family separation. The physical and institutional cost of these dynamics is contextualized within the public health sphere through standardized SF-12 v2 surveys administered to various categories of informal workers in Cartagena de Indias, exposing a critical scenario where income instability, extreme environmental exposure, and severe delays in care from the subsidized health system create conditions of chronic labor precariousness that challenge traditional narratives of conformity or simple resilience and demand urgent social protection reforms by the State.

This dense empirical and social fabric finds a suggestive hermeneutic elevation in critical approaches from literary aesthetics, music, and cultural studies. The philosophical drama of Giacomo Puccini's opera Turandot is subjected to a spectral reading based on the logics of eroticism and ritual sacrifice developed by Georges Bataille and René Girard, arguing that the suicide of the faithful slave Liù functions as an indispensable sacrificial mechanism that introduces the sacred dimension into Beijing, dissolving the hatred and perversion of the Ice Princess through a tragic catharsis that Alfano sought to consummate musically by emulating Wagnerian transfigurations. This cartography of journey and uprooting expands transatlantically by analyzing the reception of the Odyssean myth in the Hispanic literary consciousness; through Hans Robert Jauss's reception theories and Julia Kristeva's intertextuality, the perennial dialectical tension between the nostos of the Homeric return and the Dantean curiositas of Canto XXVI of Inferno is examined, a mythical structure that authors of the Golden Age, modernists, Republican exile poets such as Luis Cernuda, and contemporary narrators of Latin America's postcolonial fragmentation have irreversibly reconfigured to articulate their own trajectories of exile, cultural hybridization, and existential questioning of power structures. This

symbolic and identity-based capital is analyzed in its transnational dimension through the processes of devotional reconfiguration of the Santo Niño de Atocha, tracing how a Castilian Marian devotion becomes independent in the mining sanctuary of Plateros, Zacatecas, acquiring the unique iconography of the "pilgrim child" of Santiago, whose attributes of bundle, staff, and gourd are reinterpreted by flows of undocumented migrants as symbols of protection during their journey, consolidating border parishes in Texas and missions in New Mexico that act as authentic hubs of community resistance and transnational cultural reaffirmation. The book concludes its theoretical framework by anchoring itself in a qualitative study of the contemporary populist presidential communication model inaugurated in Mexico by Andrés Manuel López Obrador and rigorously continued by his successor; drawing on frameworks by Ernesto Laclau and Pierre Rosanvallon, non-participant observation of the morning press conferences demonstrates the formation of a comprehensive system of communication and public discourse where the leader himself operates inseparably as the sender, the medium, and the message, polarizing the debate and using digital social media to engage in direct dialogue with the people, which reconfigures party agendas and relegates the traditional press to an involuntary role as a protective shield for the state's algorithmic and ideological model.

Ultimately, this book constitutes an indispensable invitation to critical reflection committed to the dilemmas of our contemporary world. Reading it warns us against simplistic explanations and compels us to confront phenomena from the perspective of their irreducible internal complexity. It reminds us, with profound humanistic lucidity, that any scientific advance, analytical management strategy, or educational innovation is meaningless if it disregards its fundamental ethical commitment: that of safeguarding dignity, documenting collective memory, and comprehensively transforming the living conditions of human beings in their own territories.

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Artificial intelligence and technologies applied to education

AI in Education: The Concept of "Distant Learning"

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Introduction

Research on learning patterns have evolved in different directions since it´s early formulation in the late 1970s and early 1980s (Vermunt & Donche, 2017). In the last decades, pedagogy and didactics have relied on the concept of active learning to describe methodologies that promote students' genuine appropriation of the learning process. In this context, active learning has been associated with student agency, collaboration, and reflection, and is widely seen as a response to the limitations of passive, transmission-based education.

The emergence of generative AI in academic contexts, however, reveals a conceptual gap in this active–passive binary. While student interactions with GenAI tools often appear "active"—involving prompting, iteration, and revision—they do not always result in deep understanding or cognitive appropriation. These interactions introduce new forms of agency: ones that involve epistemic choices about how and when to delegate cognition to machines. As Floridi (2025) suggests in his work on distant writing, these are not merely acts of execution, but of design and orchestration.

This paper adopts a conceptual and analytical methodology grounded in theoretical synthesis and comparative interpretation. Drawing on a wide range of recent empirical studies on the use of generative AI in higher education, it identifies emerging learning patterns of student engagement with AI, as well as conceptual gaps between these new patterns and the available frameworks. Based on Floridi's concept of *distant writing*, it constructs a new theoretical category—*distant learning*—that captures the cognitive mediation involved in AI-assisted learning processes.

The objective of this paper is to elaborate a new conceptual framework that extends and refines Floridi's distinction between *distant* and *close* engagement with technology. While Floridi's model effectively captures the epistemic reconfiguration introduced by generative AI in creative practices, it remains limited when applied to educational contexts, where learning involves not only production but also appropriation, reflection, and ethical positioning. This study therefore seeks to develop a broader framework—one that accounts for varying degrees of cognitive mediation and learner agency—to better explain how AI reshapes the conditions of authorship, activity, and understanding. By doing so, the paper moves beyond the binary logic of distance and proximity to propose a multidimensional model of *distant learning* capable of addressing the pedagogical, epistemic, and ethical complexities of AI-mediated education.

Rather than relying on experimental or quantitative data, the paper employs a hermeneutic approach that integrates philosophical reasoning with pedagogical analysis, aiming to clarify the epistemic and ethical implications of AI-mediated learning and to propose a refined framework for future research and educational practice.

Active Learning: Origins, Evolution, and Pedagogical Application

Active learning is based on the idea that students learn better when they actively participate in their educational process, rather than passively receiving information. While there is no universally accepted definition (Prieto Navarro, 2006, p.173), there is general consensus about its origins and core features. The concept is rooted in classical pedagogies: for instance, "learning by doing" notion (Dewey, 1916) shifted emphasis from mere content transmission to skill development and authentic student engagement—an idea reinforced by constructivist learning theories (Piaget, Vygotsky, Bruner) throughout the early 20th century: learning was seen as an active construction of knowledge, integrating prior ideas and collaborating with others. By the end of that same century, Bonwell and Eison (1991, p. 2) popularized the term *active learning* in the Anglophone world, defining it as "the carrying out of various activities by students accompanied by reflection on those actions". The metacognitive aspect then gained significant importance, as "student activity alone does not ensure that learning occurs" (Ramsden, 2003, p. 13).

Active classrooms have therefore always aimed to foster critical thinking, transforming students' roles from passive recipients to responsible participants (Bell Rodríguez *et al.*, 2024; Silva Quiroz & Maturana Castillo, 2017). Students must take ownership of their learning process, working in teams and managing both internal and external resources for personal development.

The effectiveness of active learning depends on a few key elements: meaningful student engagement through methods like case studies or flipped classrooms; hands-on practice, as seen in problem-based learning and fieldwork, that engages both intellect and emotion; teamwork that fosters mutual responsibility and peer learning; and integrated feedback that supports reflection, adjustment, and sustained progress.

In short, active learning involves reorganizing spaces and activities to center the process on the student.

Student Use of Generative AI

In recent years, the use of generative AI tools (GenAI), such as ChatGPT, Claude, Gemini, or GitHub Copilot, has become widespread in university settings. Various empirical studies published between 2024 and 2025 show how and why students integrate these technologies into their academic work.

A global report from the Digital Education Council found that 86% of university students use GenAI for educational purposes, 54% weekly, and nearly one in four daily. Students primarily use

GenAI to clarify concepts, generate ideas, and complete tasks (Sousa & Cardozo, 2025, pp. 8–10). A survey of 462 students (Chen *et al.*, 2025) found 94% use it mainly for text generation (76%), idea generation (52%), and summarization (57.9%), with some also using it for data analysis (24%) and bibliographies (16.6%). Another study of 500+ students and 170 faculty highlighted frequent use for personalized learning and assignment completion; faculty also noted its value in developing materials, assessments, and custom content (Alshamy *et al.*, 2025, p. 501).

Both students and educators recognize GenAI's potential to personalize learning and boost academic performance (Sharma et al., 2024; Su & Yang, 2023; Sullivan et al., 2023). Yet this engagement also raises concerns, especially among faculty (Pinkhart & Al-Obaydi, 2025, p. 9). Students themselves express worries about its impact on academic integrity, critical thinking, and creativity (Alshamy *et al.*, 2025, p. 11; Belkina *et al.*, 2025, p. 13). Still, many acknowledge its learning benefits and argue that GenAI should be treated as a tool—not a replacement—and that students continue to need substantive instruction and support (Stöhr *et al.*, 2024, p. 9).

In STEM fields, a study showed GenAI's main uses include conceptual explanations, topic exploration, and problem-solving via direct prompts. Over half the students used AI to receive complete solutions without intermediate steps—raising concerns about the development of essential cognitive skills:

> On one hand, students who rely on these tools to directly generate solutions for problems in their coursework may feel that they have learned how to solve the problem after studying AI-generated solutions with little mental effort. However, this approach bypasses deeper learning and hinders the development of STEM problem-solving competency, similar to how passive lectures can create a false sense of fluency yet lead to less actual learning. On the other hand, students who use GenAI as a scaffold must expend more mental efforts to solve problems on their own, but this process can help deepen their conceptual understanding and develop effective problem-solving skills, mirroring the benefits of active learning (Wang *et al.*, 2024, p.11).

This duality—expressed through metaphors like the "crutch and oar" (Bellomo, 2025, p. 162)—has drawn increasing attention. It's shaped discussions around terms like "cognitive debt" (Kosmyna *et al.*, 2025), "cognitive offloading" (Gerlich, 2025), or "cognitive laziness" (Fan *et al.*, 2025). What this duality uncovers is not just a tension around effective AI implementation in learning, but a deeper conceptual limitation in pedagogical paradigms that have guided teaching practice for decades.

Distant writing: A Shift in Interpretive Paradigm

Floridi (2025) introduces the concept of *distant writing* to describe a new mode of text production using generative AI. He draws inspiration from Moretti's concept of *distant reading* (Moretti, 2000, 2013), but gives it an entirely new twist:

> Franco Moretti's concept of *distant reading* introduced methodologies for examining vast corpora of literature, revealing macro-level patterns and structures through computational

> techniques that traditional close reading could hardly discern or not at all (…). However, while distant reading represents a computational turn in literary analysis, we are now witnessing the emergence of a parallel phenomenon on the production side: *distant writing* (Floridi, 2025, p. 2).

According to Floridi (2025, p. 2), the distant writing model—as opposed to close writing—enables a mode of creative activity that is not comparable to traditional writing and constitutes a new interpretive paradigm. The writer becomes an "architect of narrative possibilities," responsible for defining requirements, affordances, and constraints, and curating the LLM-generated content. This shift is not just technological but conceptual: a redefinition of what it means to author a text.

Distant writing is not equivalent to plagiarism. It constitutes a form of creative activity that is genuinely original, as it involves executive engagement in prompt design and iterative revisions. The operative logic of distant writing is essentially a design logic—or more precisely, a requirements logic (Floridi, 2017, p. 509). It unfolds through a methodological process with seven stages (Floridi, 2025, pp. 7–8) defined by orchestration– designing, prompting, refining, and curating. This methodology doesn't just apply to literary creation; it increasingly describes how students engage with GenAI across a wide range of learning contexts. Whether drafting an essay or solving a math problem, learners are now operating through iterative cycles of task setup, tool engagement, and critical evaluation. The role of the student is shifting from that of direct executor to meta-designer of the learning process.

Yet when we attempt to describe these mediated practices using the language of active learning, a conceptual gap emerges. Traditional active learning focuses on learner participation, collaboration, and reflection—but often presumes unmediated interaction with content and peers. In contrast, GenAI-mediated activity introduces a new mode of agency: one that includes a metacognitive layer, or epistemic decisions about when, how, and why to delegate cognitive labor to tools. The "activity" lies not just in doing, but in choosing how to do—what to offload, what to revise, and when to intervene.

To explore this new methodological space, we turn to Floridi's identification of "boundless narratives" as a central feature of distant writing (2025, p. 4). An analogous feature in learning might be what we call *boundless learning trajectories*: developmental arcs shaped not just by curricular goals, but by the learner's reflective decisions throughout the process. Each interaction with a tool—each prompt, revision, or resistance—becomes a cognitive branching path, a fork in the learner's epistemic journey where direction is shaped by intentional choice rather than instructional design.

As we can see, this mode of distant production—though original and unprecedented—shares many features we associate with active learning. So how do we explain the legitimate concern that use of GenAI may subvert learning due to cognitive debt, laziness, or offloading? To answer this, we need a more precise characterization of this new learning modality—its distinct traits, challenges, and opportunities—so its academic use can be more effectively leveraged.

Toward a New Category of Learning: Distant Learning

The widespread integration of generative AI into students' learning workflows reveals a conceptual blind spot in our existing pedagogical frameworks. While the active–passive learning patter has long served as a way to distinguish levels of student engagement, guiding research and teaching practices, it no longer suffices to explain the nuances of tool-mediated learning today. We propose the introduction of a new analytical axis—one that accounts for the degree and nature of cognitive mediation involved in learning. This axis spans what we might call close to distant learning, or instrumentally, prompt-based learning, in which generative tools are central to the orchestration, execution, and reflection involved in the learning process.

Distant learning built on a prompt-based methodology refers to a cognitively mediated learning modality in which the learner leverages increasingly sophisticated technology (especially AI) to orchestrate—not just execute—the learning process. Because AI systems are capable of mimicking not just recall or computation, but procedural reasoning and even reflection, these tools introduce a kind of cognitive distance between the learner and the learning task—not necessarily as a drawback, but as a dynamic that requires intentional orchestration. That distance can manifest at multiple levels: a student may use AI to complete a specific task, to design the structure of an assignment, or even to iteratively refine their learning strategy itself. In this way, distant learning is not just about the use of prompts, but about developing fluency in meta-prompting—using tools to learn how to better use tools. It is as much a form of literacy as it is a mode of delegation.

Thus, distant or prompt-based learning is not defined solely by the presence of AI assistance, but by the learner's positioning in relation to it. Are they simply offloading cognition, or are they engaged in shaping and evaluating the mediated process itself? This subsequently reintroduces the passive-active spectrum as a useful dimension that intersects with prompt mediation in the following way:

	Close (Low Mediation)	Distant (High Mediation)
Passive	Rote memorization, textbook replication, plagiarism	Copy-paste AI use, superficial prompting. Shallow understanding
Active	Self-driven inquiry, collaborative dialogue, Deep understanding	Strategic prompting, iterative refinement, Deep understanding

This framing allows us to distinguish nuances such as passive-distant learning (overreliance on AI to fulfill academic tasks without significant engagement and, hence, without true appropriation of knowledge) and active-distant learning (AI driven intellectual commitment with the task in a

way that student gains deep understanding not only in terms of conceptual framing but meta-cognitive development).

The distinction between passive and active distant learning reflects a tension between instrumental learning—developing skills to orchestrate tasks—and substantive learning that leads to "knowledge inside our heads" (Oakley *et al.*, 2025, p. 31). The latter involves the acquisition of knowledge and capabilities that foster deep understanding, as traditionally conceptualized the Learning for Understanding model (Perkins and Blythe, 1994; Perkins, 1995; Blythe, 1998). This divide is not clear-cut; the two dimensions interact. Achieving deep understanding depends in part on how it is orchestrated, and orchestration itself improves as deep understanding grows (Vermunt & Donche, 2017, p. 277).

In passive-distant learning, students actively manage the task—designing prompts, iterating—but rely too heavily on AI and fail to engage deeply with the underlying content (Pikhart & Al-Obaydi, 2025, p. 5). They may develop technical fluency in tool use (knowing how, when, and why to prompt), but this remains disconnected from the substantive learning that should anchor educational effort. Thus, passive-distant learning is active at the instrumental level but passive in substance. In contrast, active-distant learning engages both.

Conclusions and Future Research Guidelines

The traditional active–passive learning binary no longer captures the complexities of AI-mediated, prompt-based learning. Therefore, it no longer helps as a framework for research and teaching practice. The distinction between close and distant learning helps overcome this weakness: close learning involves direct, unmediated engagement, while distant learning unfolds through iterative prompting and interpretation of AI outputs. Rather than viewing this mediation as a loss, it may signal a shift toward meta-learning, where students act as designers of their own learning processes.

However, this new framework also fails to describe the complexity of student engagement with AI. While distant learning often reflects features of active learning—agency, iteration, collaboration, and metacognitive reflection—it doesn't always lead to deep or authentic understanding. Overreliance on AI can result in students mastering task orchestration without meaningfully engaging the underlying concepts.

Addressing this requires a broader framework that merges both conceptual models: not just a learner's activity level (pasive-active), but their proximity to the learning process (close-distant). The rise of prompt-mediated, active and passive distant learning introduces a qualitatively new set of challenges—pedagogical, epistemic, and ethical—that call into question long-held assumptions about authorship, assessment, and the role of educational institutions. These challenges constitute guidelines for future research.

First, recursive mimicry challenges the function of learning artifacts—what we traditionally consider assignments. Unlike earlier tools that automated routine tasks (e.g., calculators, search engines), GenAI simulates not only outputs but also the pedagogical reasoning behind them. It doesn't just generate artifacts; it mirrors the epistemic logic used to evaluate them. As Bastani

et al. (2024) observe, these tools can solve complex tasks with no fixed procedures, often outperforming humans in standardized domains. This recursive capability destabilizes the artifact-based classroom model.

If tools simulate both answer and rationale, artifacts can no longer reliably proxy internal development—especially for more autonomous learners, where real-time observation is limited. Close accompaniment—direct observation of process and outcome—may best ensure authentic learning. Yet this need for close supervision contradicts two key promises of AI in education: offloading routine teacher tasks and scaling high-quality pedagogy. The paradox is clear: as AI enables automation, it may also increase the demand for human presence in evaluating genuine learning. How can such accompaniment be ensured in tech-mediated contexts—and made scalable?

Second, restricting GenAI use reinforces the illusion that tools can be avoided. In contrast, AI-inclusive environments may foster greater student agency (Nurtanto *et al.*, 2025, p. 14). In this context, banning platforms or reverting to analog formats becomes increasingly untenable. The educator's role is no longer to police usage, but to cultivate ethical, intentional, and reflective tool engagement. Tool fluency—not tool abstinence—must become the new baseline.

Yet tool fluency without ethical commitment and intentionality can hinder learning. How can we ensure students develop a rooted ethical orientation? What pedagogical approaches best cultivate this ethos—and what role should AI play, or not play, in that process?

Third, as explored earlier in our discussion of distant writing, GenAI-mediated learning reframes students as meta-learners—those who curate, iterate, and oversee distributed processes. This model of meta-authorship complicates traditional notions of authorship and assessment by decoupling execution from design. Still, a sense of ownership is closely tied to one's level of engagement and the cognitive appropriation of outcomes (Doshi and Hauser, 2024, p. 6). Given the variability in authorship experience, can we define criteria that go beyond student subjectivity to ensure academic integrity?

Lastly, if instrumental learning is a valid aim of formal education, how should it be balanced with the development of substantive or deep understanding? What minimum degree of substantive appropriation is needed for instrumental skills to flourish—and to deepen learning in return?

Formal education stands at what we call the paradox of the crutch and the oar. On one hand, it cannot ignore the powerful role of GenAI in enabling active learning. Used as an oar within an active-distant paradigm—where the student orchestrates an iterative process with AI—it supports deep content engagement, skill development, and the growth of instrumental competencies. These, in turn, reinforce cognitive and metacognitive maturity, refining tool fluency and enabling learners to reach outcomes faster and further—sometimes beyond what close learning alone can deliver.

At the other end of the spectrum, passive-distant learning reveals a mode of AI use that undermines both deep understanding and instrumental growth. Offloading cognition to AI—as a crutch—diminishes learning across both domains. To realize AI's promise in education, we must

confront these challenges directly and generate evidence to guide more intentional, effective use.

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Analysis of the Skills Developed by Programmers Using AI-Based Code Generation

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Introduction

One of the key questions that employers may ask programmers in the future is: "Are you skilled at working with intelligent machines?" This idea aligns with Newport's (2022) argument that professionals who can effectively collaborate with AI systems will thrive in the evolving workforce.

Generative Artificial Intelligence (Gen AI) has emerged as a transformative tool for code generation, leveraging Large Language Models (LLMs) like GPT-3 (Brown *et al.*, 2020) and Claude (Anthropic, 2023) to produce source code across programming languages through deep learning algorithms.

The idea arose to create a methodology that allows programming students to use code generation through Gen AI. For this, we will review some aspects observed in a programming group across three subjects that were influenced by code generation in relation to the requirements dictated by the course instructor.

This research examines student interactions with LLMs across three programming courses, addressing the following questions: How do students use a LLM in programming tasks? What skills are necessary for effective LLM use? How do students achieve optimal results in programming exercises? How do they handle unexpected challenges? Can a methodological framework be established to guide LLM use in programming education? What happens when they face unexpected situations such as hallucinations, errors, or logic failures? What are the strong and weak skills among students that now need to be developed?

This study is grounded in three interconnected pillars: (1) core programming competencies, (2) cognitive theories of learning, and (3) the dual role of LLMs as both facilitators and disruptors in programming education.

Effective code generation with LLMs presupposes mastery of basic concepts: variables, algorithms, Object-Oriented Programming (OOP) (Downey *et al.*, 2002). However, novices often struggle with abstract syntax and debugging (Jenkins, 2002), creating a dependency risk when outsourcing these tasks to AI (Báez et al., 2025) (Kazemitabaar *et al.*, 2023).

Cognitive Scaffolding

Bloom's Taxonomy (Anderson & Krathwohl, 2001) provides a lens to analyse LLMs' impact: while they accelerate lower-order skills (e.g., remembering syntax), their effect on higher-order thinking (e.g., evaluating design trade-offs) remains contested (Denny *et al.*, 2022). Metacognition (Flavell, 1979) is critical to mitigate over-reliance, as students must self-monitor LLM-generated solutions.

Generative AI's Paradox

LLMs democratize access to code (Brown *et al.*, 2020) but introduce hallucinations and logic errors (Leinonen *et al.*, 2023). This duality necessitates a framework where LLMs act as critical thinking prompts rather than answer keys—a gap this study addresses.

Study Design

Three second-year students from the Software Development program of Instituto Superior Tecnológico San Antonio (Ecuador) were selected via purposive sampling (Patton, 2002).

Criteria included: completion of all three courses, no prior formal experience with LLMs and consent to participate in data collection.

Rationale for small sample size: enabled in-depth tracking of individual learning trajectories and aligned with exploratory case study methodology (Yin, 2018).

Research Objectives

The study addresses the following specific objectives, aligned with the research questions:

- To examine how students interact with LLMs in programming tasks, including the frequency, context, and types of queries (e.g., syntax, debugging, conceptual explanations).
- To identify the cognitive and technical skills required for effective LLM use, such as error detection, critical evaluation of AI outputs, and adaptation to project requirements.
- To develop a methodological framework for integrating LLMs into programming education, emphasizing best practices for guided use to enhance learning outcomes.

These objectives directly address the research questions by exploring interaction patterns, skill requirements, and pedagogical implications of LLM use. This study aims to: (1) explore how students interact with LLMs in programming tasks, (2) identify the skills required for effective LLM use, and (3) propose a methodological framework for integrating LLMs in programming education. The study was conducted within three consecutive courses in the Software Development and Programming Technology program, delivered virtually with two weekly sessions of two hours each:

- Android Programming with Kotlin (Introductory Level): Focused on foundational programming concepts (e.g., variables, control flow) using Kotlin, with LLM tasks integrated into weekly coding assignments.

- iOS Programming with Swift (Intermediate Level): Emphasized object-oriented programming and mobile app development, with LLMs used for debugging and conceptual clarification.

- Hybrid Programming with React Native (Advanced Level): Covered advanced topics like asynchronous operations and custom hooks, with LLMs supporting complex project development.

Each course included structured LLM activities (e.g., generating code snippets, resolving errors), designed to align with course learning outcomes and foster skill development.

Qualitative Data:

- Structured Questionnaires: Administered post-course via Google Forms. Focused on four areas:
    - Variable declaration (e.g., "How did the LLM assist in defining data types?").
    - Control flow (e.g., "Describe how the LLM explained loop structures").
    - Functions (e.g., "Did the LLM-generated functions match your needs?").
    - Classes (e.g., "What challenges arose when using LLMs for OOP?").
- Instructor Observations: Documented during virtual sessions in Zoom (e.g., types of LLM queries, error-handling strategies).

Quantitative Data:

- Task Completion Rates: Percentage of assignments completed with LLM assistance (logged weekly).

- Error Correction Frequency: Number of LLM-generated errors identified and fixed by students.

The qualitative longitudinal analysis of student interactions with Large Language Models (LLMs) in Kotlin, Swift, and React Native courses reveals consistent themes across programming languages. Students reported their experiences in five key areas: variable declaration, control flow, functions, classes, and mobile application development. The data, collected from three students per language, highlights the transformative role of LLMs as educational tools, with variations in their utility based on the programming context and students' prior experience.

Variable Declaration

Students across all three languages found LLMs helpful in understanding variable declaration, particularly during early learning stages. In Kotlin, students appreciated clear examples and best practices, with one noting the LLM's ability to clarify type inference and error identification. In Swift, LLMs provided concise examples, aiding students in grasping variable types despite environmental limitations like power outages. In React Native, LLMs were less critical for experienced JavaScript users but served as debugging tools, offering insights into useState and useRef.

Control Flow

LLMs were instrumental in simplifying complex control flow concepts. In Kotlin, students valued clear explanations of structures like if-else, for, and while loops, which helped maintain project organization. Swift learners, constrained by limited hands-on practice, relied on LLMs for detailed, step-by-step breakdowns of control flow logic. In React Native, LLMs supported understanding asynchronous operations like async/await and promises, although their role was less critical for students with prior experience in the Model-View-ViewModel (MVVM) architecture.

Functions

Across all languages, LLMs enhanced understanding of function-related concepts. Kotlin students benefited from examples of parameters and return types, with LLMs providing unsolicited but useful suggestions. In Swift, LLMs bridged gaps caused by abstract learning conditions, offering conceptual clarity on tuples and parameter naming. React Native students found LLMs crucial for mastering custom hooks and component lifecycles, addressing gaps in their conceptual understanding.

Classes

LLMs facilitated learning OOP concepts. In Kotlin, students received clear explanations of classes, objects, and polymorphism, with one exploring LLM limits via Claude. Swift students, despite limited practical exposure, used LLMs to understand classes, structures, and protocols. In React Native, where functional components dominate, LLMs provided insights into native APIs and compatibility issues, though their role was secondary to hooks and callbacks.

Mobile Application Development

LLMs were transformative in mobile app development, acting as collaborators. In Kotlin, students resolved dependency issues and adopted the MVVM, with LLMs suggesting relevant libraries. Swift learners relied on LLMs for structured code and explanations of synchronous/asynchronous operations, compensating for limited hands-on practice. In React Native, LLMs supported backend tasks like local SQL databases and provided customizable templates, though Java version issues caused minor setbacks.

Cross-Language Observations

While LLMs were universally valued, their impact varied. Kotlin and Swift students, often newer to programming, leaned heavily on LLMs for foundational understanding. React Native students, with prior JavaScript knowledge, used LLMs more for debugging and advanced concepts like hooks. Environmental constraints (e.g., power outages for Swift learners) amplified LLM reliance, underscoring their role as flexible, accessible learning aids.

Evolution of LLM Usage Patterns

The longitudinal analysis of student interactions with Large Language Models (LLMs) across Kotlin (first course), Swift (second course), and React Native (third course) reveals distinct patterns in five key areas:

- Evolution of Dependency: Students initially relied heavily on LLMs in Kotlin to grasp foundational concepts like variable declaration and control flow. In Swift, dependency became more selective, focusing on overcoming environmental constraints like limited hands-on practice. By React Native, LLM use was reduced and targeted, primarily for debugging and advanced concepts, reflecting increased student confidence and independence.

- Transformation of the LLM Role: In Kotlin, LLMs served as tutors, providing clear explanations and examples. In Swift, they acted as educational compensators, bridging gaps caused by external limitations. In React Native, LLMs became specialized tools, aiding with specific tasks like custom hooks and compatibility issues.

- Progression in Metacognitive Competencies: Students developed stronger metacognitive skills (Flavell, 1979) over time. In Kotlin, they relied on LLMs for basic understanding. In Swift, they began reflecting on code logic through LLM explanations. By React Native, students demonstrated improved self-regulation, using LLMs to refine their approach to complex problems.

- Change in the Type of Queries: Queries evolved from broad and foundational in Kotlin to more complex and specific in Swift, addressing language-specific nuances. In React Native, queries were highly targeted, focusing on advanced topics like asynchronous operations and library compatibility.

- Development of Technical Autonomy: Across the courses, students progressed from high LLM dependency to greater autonomy. In Kotlin, LLMs were essential for learning the basics. In Swift, students used LLMs to compensate for limited practice, gaining partial independence. By React Native, students managed most tasks independently, using LLMs for specialized support.

- Maturation in Error Handling: Error handling skills matured significantly. In Kotlin, students needed LLM guidance to identify and fix errors. In Swift, they used LLMs to understand error causes in abstract contexts. By React Native, students proactively

addressed errors, leveraging LLMs for optimized solutions.

Conclusions

This study demonstrates the transformative impact of Large Language Models (LLMs) in programming education, revealing a clear progression in student skill development across three courses (Kotlin, Swift, React Native). Students evolved from heavy reliance on LLMs for foundational tasks, such as variable declaration and control flow, to strategic, autonomous use for debugging and advanced concepts like asynchronous operations. This trajectory, supported by a longitudinal mixed-methods approach, aligns with Bloom's Taxonomy and Flavell's metacognitive theory (Flavell, 1979), highlighting how students transition from passive recipients to active evaluators of AI-generated code.

LLMs served as adaptive tools, compensating for environmental barriers like limited hands-on practice while introducing challenges such as hallucinations and logic errors. These limitations fostered critical competencies, including metacognitive awareness, error diagnosis, contextual adaptation, and ethical vigilance, essential for effective LLM use and preparation for AI-augmented workplaces. The study addresses its objectives by identifying these skills and mapping their development, emphasizing their relevance for future programmers collaborating with intelligent systems.

A proposed methodological framework for LLM integration advocates structured, guided activities aligned with course objectives to enhance learning while mitigating risks like over-reliance. By fostering iterative query refinement and error-handling strategies, the framework ensures LLMs support, rather than supplant, conceptual understanding. These findings offer a robust foundation for educators to integrate LLMs thoughtfully, equipping students with the skills needed to thrive in an AI-driven professional landscape.

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Artificial Intelligence at the University: Experiences of teachers and students in the field of Communication

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This article arises from the subjects of the Bachelor's Degree in Social Communication at the National University of La Matanza (UNLaM). It seeks to address the role of teaching in the teaching-learning process with AI. "IA, students, communication, multimedia, education"

Introduction

This article describes the teaching experience in designing and applying activities incorporating Artificial Intelligence (AI) as a pedagogical tool. The development of AI in the last three years has significantly changed how knowledge is generated, accessed, and disseminated. With the widespread use of platforms such as ChatGPT, DALL-E, or Copilot, AI is no longer a technology reserved for the technical or business sphere, but a familiar presence, even in the education sector. This phenomenon created new pedagogical opportunities, but at the same time raised urgent questions about the purpose, scope, and conditions of use of these tools in the classroom (UNESCO, 2022; Holmes & Miao, 2024).

At the university level, there are ambiguous positions on the incorporation of this type of technology. On the one hand, the capacity to support learning processes, improve writing, optimise repetitive tasks, and promote new ways of thinking is recognised (Lopezosa *et al.*, 2023). On the other hand, concerns emerge about the risk of substitution of human skills, the loss of authorship by learners, or the uncritical and automated use of information. Added to this tension is a structural component related to inequality of access and conditions of use. The disparity between those who can afford premium versions and those who must make do with free options promotes a new type of technological, pedagogical, and cultural digital divide.

Since 2023, the *Taller de Gráfica III* and the *Taller de Administración y Producción en Medios* of the Bachelor's Degree in Social Communication at the National University of La Matanza (UNLaM) have incorporated some tools related to Artificial Intelligence into their classes as an experiment and oriented towards certain specific activities. In these classroom spaces, students specialise in an area of journalism and communication by exploring digital resources in the production of written, audio, and audiovisual productions. In this paper, the proposals made by the teachers regarding written language (conducting a mock interview) are particularly addressed. These initiatives aim to generate significant learning and increase motivation within the framework of an inclusive, critical, and quality university education paradigm. However, the teachers had to overcome a series of challenges in the construction of teaching materials, theoretical content, and other resources for the classes, because the students have certain disparities in access to technologies and different levels of digital literacy, in addition to the lack of specific teacher training and the biases present in the tools used.

This paper aims to show a situated experience of teachers as a contribution to the wider debate on the pedagogical, ethical, and social challenges of AI in Higher Education in peripheral contexts. The focus is on analysing how teachers designed and brought concrete activities to the classroom that incorporated the use of artificial intelligence (AI) tools, where a series of possibilities, limitations, and challenges emerged. The aim is to understand how the integration of AI transforms pedagogical decisions and challenges the role of the teacher in contexts of increasing digital inequality (Holmes & Miao, 2024).

Theoretical Framework

In the *Guide to Generative Artificial Intelligence in Education and Research, generative AI* is defined as "a technology that automatically generates content in response to written prompts and can appear in a variety of formats that encompass all symbolic representations of human thought: written natural language texts; images, including photographs, digital paintings and cartoons; videos, music and software code" (Holmes & Miao, 2024: 8).

This description highlights the versatility of AI and the ability to produce multimedia content, making it a tool with enormous possibilities within the field of communication and education. Through this dynamic, the system feeds back and improves with each correction, suggestion, or request for reformulation of concepts by the human commanding the action. This interaction allows the AI to learn through trial and error. This adjustment process, known as machine learning, can take place in three main ways: in a supervised way, with labelled data; in an unsupervised way, without the use of labels; and through reinforcement learning, which is based on receiving positive or negative feedback.

In supervised learning, the model is trained with known input and output data, allowing it to make predictions about new data sets. Unsupervised learning, on the other hand, allows the model to discover patterns and structures in previously unlabelled data on its own. Meanwhile, reinforcement learning focuses on how an agent interacts with its environment, learning from rewards or penalties it receives, which helps it to improve its performance (Kaelbling *et al.*, 1996).

Requests or questions, which are used to command an action, are known as "prompts". These statements act as triggers for the AI to produce coherent and ordered responses based on the context posed. For example, a prompt can take the form of a question, such as "What is artificial intelligence?", a specific instruction, such as "Write a summary of this text", or even a more complex task involving several conditions. The precision with which these prompts are formulated has a direct impact on the quality of the answers obtained. For this reason, mastering the ability to write them properly is an essential digital competence in today's workplace. According to Knoth *et al.* (2024), it can be argued that improving the quality of the prompt increases the rigour of the answers generated by language models, through elements such as specificity, context, and constraints. In addition, four fundamental pillars for designing effective prompts can be identified: clarity, context, detail, and precision.

Although Artificial Intelligence is often referred to in the media as a single phenomenon, in reality, there are different types or categories, depending on the level of autonomy, complexity,

and functionality. Broadly speaking, three main types can be distinguished: "weak" or "specific" AI, "general" AI, and "superintelligent" AI (Bostrom, 2014; Hintze, 2016). First, "weak" or "specific" Artificial Intelligence includes those systems created to perform specific tasks, such as image recognition, product recommendation, or language translation, among others. These systems cannot understand broader contexts. Examples of this category include ChatGPT, DALL-E, Siri, Alexa, Copilot, and Gemini, among others, which are considered generative AI, a subcategory of this type of "weak" AI. The massification of these products is based on the ability to generate new content with existing information. This variety of AI goes beyond the mere reproduction of data, as it transforms, condenses, and adapts it according to instructions provided by users. As a second category, there is "general", quasi-hypothetical AI, not yet fully developed, whose ability to reason, learn, and solve problems in a wide range of areas would imply a level of understanding similar to that of humans. According to some technology companies, this vision of AI is currently in the process of development, which generates various debates about the real scope and ethical implications Cárdesnas et al., (2025) and (Striker & Kavlakoglu, 2024). Thirdly, there is the so-called "superintelligent" AI, which is theoretical and the subject of speculation in the field of philosophy of technology and ethics. Authors such as Bostrom (2014) and Diéguez (2017) argue that this term refers to AI systems that would have the capacity to surpass the cognitive abilities of humans in almost all aspects, an issue that is debated because of the risks involved.

In recent years, academic articles have pointed to the exponential growth of technologies applied to learning and the use of AI as a pedagogical tool in the classroom. However, they also highlight the importance and need for teachers to be trained to transmit to students the necessary knowledge to make good use of AI technologies (Romero *et al.*, 2023). Some universities at the international level decided to design guides for teachers as an institutional policy in which they provide information on Artificial Intelligence and give advice for the "good usability" of the tool. The manual *Recommendations for teaching with Generative Artificial Intelligences* of the Carlos III University of Madrid (2023: 8) provides a clear idea on this point: "Any strategy based on limiting, preventing, or sanctioning the use of these tools is doomed to failure. We need a global awareness of our entire educational community: we are going to integrate them into our work, without falling into extremism, either by persecuting their use or by forcing their introduction. This process must be gradual, but also inexorable.

Among the consequences of the incorporation of AI tools in the university, the transformation in the production of theoretical content and practical materials for classes by teachers, as well as in the classroom and extra-curricular dynamics of students, stand out. For their part, there are some experiences of use in academic and administrative management. According to Rouabhia (2024), ChatGPT can be used to generate courses and produce high-quality educational content. In terms of students' interaction with study material and their participation in academic activities, AI has made a significant difference. Sánchez Rodríguez and Martínez Romero (2024) argue that teachers have defensive or proactive perceptions according to the trajectories, disciplines, and generational aspects, thus generating an ad hoc adaptation of AI. For this reason, it becomes essential to renew teaching methodologies to incorporate these technologies effectively and with clear objectives.

Although it is beyond the scope of this conceptual approach, the implementation of AI is reaching academic and administrative management, where it can be used to optimise various processes, such as timetabling, enrolment management, and student performance monitoring. García-Delgado *et al*. (2024) describe the positive impact of AI on university administration in terms of data-driven decision-making and improved operational efficiency. However, it should be noted that, in most cases, this is a craft strategy of the chairs, integrated into the so-called "hidden curriculum" (Jackson, 1968), where particular concerns or motivations arise at the behest of pressures from outside the educational field. For Bourdieu (1990), teaching practices not only respond to the internal dynamics of the educational system but are also influenced by external forces such as the labour market, the technology industry, and the media. In turn, the aforementioned hidden curriculum makes visible aspects of education that are often marginalised by the official educational discourse (Sacristán Lucas, 1987). In other words, teachers' decisions respond to personal motivations or external pressures rather than to a clear institutional policy. This situation allows teachers to innovate and adapt their practices to new technological realities, but it could also perpetuate pre-existing asymmetries.

Along the same line, the lack of training and spaces for reflection and/or exchange of experiences between departments leads to dissimilar positions on the importance of the tool in the teaching-learning processes, both in terms of rejection and uncritical incorporation of platforms with a particular artefactual agency, impregnated with values constructed by transnational companies, whose main objective is to make profits and advance the development of their products through the voluntary and free training of the tool by millions of users on a global scale (UNESCO, 2022). In this sense, universities find themselves in a dilemma as to how to integrate (if feasible and necessary) AI into the dynamics, first of all, of the chairs as the minimum units for the training of professionals, as well as in the rest of the institutional processes. Therefore, the problem arises at the pedagogical level, but also at the management level, since it alters some of the values established in the traditional functions of the university: teaching, research, and extension.

Artificial Intelligence (AI) has the potential to revolutionise Higher Education by optimising and personalising learning with efficiency in institutional processes. The "revolutionary" question includes the risks of undermining certain values of the University, be it autonomy or knowledge production. Therefore, the adoption of AI in this field entails important ethical considerations. The UNESCO report (2022) stresses that any implementation in education must be done with a firm respect for human rights and without neglecting the concepts of inclusion and equity.

About the teaching role, AI strongly alters the propaedeutic dimension in the training of professionals. Many of the didactic strategies, existing at least since the 19th century, are altered by the rupture with the memorisation of concepts, linear learning processes, and the sequential accumulation of knowledge on a subject within a disciplinary field. Nevertheless, propaedeutics can be key to the training of professionals, especially at the beginning of careers. AI is forcing the development of more personalised and adaptive learning. It is considered essential to focus on critical competencies and skills to solve complex problems.

This paradigm shift entails a reconfiguration of the teaching role. The teacher should adopt a guiding and facilitating role in the current educational environment. However, there is a latent danger that technology will be used superficially, without stopping to deeply consider the impact on the quality of education. In this framework, it is relevant to address the concept of "artefactual agency". Using Actor-Network Theory, Latour (2005) argues that technological artefacts have a type of agency that affects both human actions and the structure of social networks. This means that technologies go beyond being mere passive tools; in fact, they play an active role in shaping social and educational practices.

Case description

Gráfica III and *Gráfica IV* have a similar historical trajectory to the one mentioned in the previous section, with the difference that this subject corresponds to the second year of the degree course. At this stage, what was known as "News Agency" was taught, something which, after the return to on-site classes following the COVID-19 pandemic, mutated to "Web Writing" and "Scientific Journalism" as a process of curricular updating. For this reason, contents and practices had to be adapted to the new forms of journalistic production in the process of digital convergence (Salaverría, 2003), which involves business, content, format, and journalistic production dimensions. Multimodality and multitasking are the biggest transformations that print journalism has undergone.

Starting in 2023, it was decided to incorporate a series of modifications in the activities proposed in class, after detecting specific interests of the students in graphic and web design tools, as well as recently created platforms such as generative AIs, which in most cases produced texts with little rigour, plagued by grammatical errors and with clear deficiencies in the understanding of journalistic genres. Thus, the first activity was called "simulation with AI", where students reproduced a situation or context of a traditional journalistic interview, generally question and answer, through Chat GPT. The work aimed to familiarise them with the tool and to practice writing prompts. We also thought about the playful aspect and the possibility of exploration. From the beginning, always under certain general guidelines, ideas were allowed to be added to the development of the activity, even during its implementation.

In 2024, after evaluating the results of the previous year, the activity was improved by adding a delimitation of the characters chosen for the interview, as well as improving some of the instructions and the simulation process. This aroused the motivation of the students, who proposed extending the universe of characters to the world of history, literature, and cinema, among others. After the simulation, the students were asked to elaborate on a journalistic interview based on the texts or statements that emerged. For the 2025 academic year, modifications were made to the activity between the students of the morning and evening shifts. For example, we proposed narrative universes that arose from a current news item or a topic on the agenda, from scientific content such as the process of de-extinction of the terrible wolf, to the worldwide success of a series such as *El Eternauta*. In this way, students were better guided in the process of choosing a character to circumvent biases, incoherent answers, or plagiarism from the AI. In this third version of the proposal, the students were asked to write a simulated interview using a conversational artificial intelligence platform, not only GPT, but the one they

use most in their daily life, work, or other areas. If they did not use it, they were asked to log in with an email account (Google in general) or to create a user, only for the purposes of the activity. They also had the possibility of using the chat without creating an account.

At this stage of the teaching experience, more creative proposals were allowed. The character in question could come from reality or fiction, be alive or dead, drawn from the narrative binding universes. Through a specific prompt, participants were encouraged to bring the character to life in order to enrich the dialogue with relevant information gathered from multiple sources. This exercise required identifying and assembling the character's traits, opinions, and positions in a coherent and narratively logical manner. In other words, the AI training time was deepened. Therefore, the task demanded a meticulous process of research, analysis, and verification prior to the start of the journalistic interview.

The task continued with the conduct of the interview, which had to include at least ten questions and be transcribed in its entirety. This first step was not an end in itself, but served as material for creating the original, well-structured newspaper article with a title, a tagline, and at least five developed paragraphs. During the writing process, it was necessary to apply five methods of transcription or journalistic quotations learned in *Taller Gráfica I* and *Taller Gráfica II*. This requirement promoted the use of advanced narrative techniques to bring the testimonies to life and structure the story appropriately. In addition, the project required the inclusion of visual elements, using graphic design tools available online or familiar to the students, in order to assess not only linguistic and journalistic skills, but also aesthetic choice and the ability to handle digital technologies. The intention of this proposal was to integrate Artificial Intelligence as a creative tool with a deep reflection on the possibilities and limitations in the field of journalism.

The aim of this version 2025 was to improve the motivation of the group and the quality of the final products, with respect to the appropriation of journalistic language and the development of narrative strategies. The activity proposed a space for critical exploration of the use of AI, through experimentation with prompts and simulations. In the practice itself, the limits of AI in the construction of meaning, the reproduction of biases, and authorship became evident.

Conclusion

In the opinion of the author of this paper, it is necessary to confront the use of these tools and the uncritical inclusion or defensive postures that avoid the existing problem. Students are increasingly using AI in their daily lives, in their jobs, and in other fields related to psychic or medical therapies in general, something that arouses fears in public opinion due to the risks involved (García-Peñalvo, 2023). For their part, it is a fact that, as mentioned in the theoretical section, the mass media have already included AI in their production processes. If we look at the curriculum of the Bachelor's Degree in Social Communication, we can see the relevance of journalistic practice throughout the entire course of study. There are seven workshops spread over the estimated four years of the degree (UNLaM, 2008). In this sense, teachers should not be left out of the epistemological debates that are taking place around the use of AI in Higher Education.

Throughout this paper, an attempt was made to reflect on certain concepts and situated practices linked to the incorporation of Artificial Intelligence (AI) tools in the university classroom, with a particular interest in the field of journalism and social communication. As is evident from the theoretical framework, the integration of these technologies requires technical skills, as well as the creation of a solid conceptual apparatus to question both the benefits and limitations. According to UNESCO (2022), the educational application of AI should be based on principles of equity, inclusion, and human rights. There is a risk of both uncritical enthusiasm and unjustified rejection regarding these technologies. Understanding how they work, from artificial neural networks to the logic of reinforcement learning, is essential for critical appropriation.

The use of generative tools in the subjects *Taller de Gráfica III* and *Taller de Gráfica IV* arose from decisions made by teachers who almost intuitively detected the real transformations in the communication ecosystem. Following Knoth *et al*. (2024), an attempt was made to enhance the students' experience of using AI in a concrete, situated activity through the appropriate formulation of prompts and the integration of pedagogical, technological, and narrative elements. This dynamic highlights the need to move towards more reflective teaching methods, which include moments of critical discussion about the assumptions that govern the functioning of AI, its artefactual agency (Latour, 2005), the biases it may carry, and the technical, economic, and political production conditions that support it (UNESCO, 2022).

The proposed path reveals that the integration of AI in concrete teaching-learning experiences has a notable impact on pedagogical practices. It is crucial, for example, to go deeper into the communicative pieces that students produce. In this context, as Nonaka and Takeuchi (1995) and Collins (2010) point out, genuine creativity is related to forms of tacit knowledge that cannot be replicated by computational models. At the institutional level, there is a need for protocols or normative frameworks to guide the pedagogical integration of AI.

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Educational innovation strategy based on the use of artificial intelligence for the improvement of teaching and learning processes

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This text originates within the framework of a UNIMINUTO project titled "Design of an Educational Innovation Strategy Based on the Use of Artificial Intelligence for the Improvement of Teaching and Learning Processes."

Introduction

In recent decades, education has undergone significant transformations due to the advancement of digital technologies. However, the emergence of artificial intelligence (AI) has introduced a new paradigm that is profoundly redefining the ways of teaching and learning. AI not only automates processes but also enables the adaptation of learning environments to the individual needs of students, facilitating richer, more efficient, and learner-centered educational experiences focused on meaningful learning. (Holmes & Reese, 2025).

Various studies have shown that AI is transforming traditional dynamics within educational institutions. Tools such as virtual assistants, automated assessment systems, adaptive platforms, and content generators are increasingly being integrated into learning environments (Zawacki-Richter et al., 2019). These resources help optimize repetitive teaching tasks, provide real-time diagnostics of student progress, and support the design of personalized instructional strategies. However, despite its vast potential, effective implementation requires more than just technological availability—it also demands teacher training, adequate infrastructure, and clear ethical frameworks (Abulibdeh & Salem, 2025).

In this regard, AI-based educational innovation should not be understood merely as a technological shift, but rather as a pedagogical and organizational transformation. The aim is not to replace the teacher, but to enhance their capabilities through intelligent tools that support diversity, inclusion, and student autonomy (Gómez Cano et al., 2025). Recent studies have shown that educators who integrate AI tools into their practice report improvements in academic monitoring, student engagement, and the design of more effective learning experiences (Eras Guaman et al., 2024).

However, there are also significant challenges. On the one hand, the lack of teacher training for the pedagogical use of AI limits its impact. On the other hand, ethical concerns persist regarding data privacy, algorithmic decision-making, and equity in access to technology (Ogunleye et al., 2024). Despite these issues, the willingness of educational stakeholders to adopt AI appears to be high. In the present study, which includes findings from a survey conducted with teachers and students in Bucaramanga, 75% of participants reported having used AI tools, and 90% believe these technologies can improve educational processes—though they also expressed a strong need for specialized training.

Considering this context, there is a clear need to design educational innovation strategies that incorporate artificial intelligence from a pedagogical and contextualized perspective. Rather than adopting isolated technological solutions, it is essential to construct pathways for integrating AI that respond to real needs within school environments, connecting theory, practice, and empirical evidence. In line with this premise, the project presented here aims to design an educational innovation strategy based on the use of AI to improve teaching and learning processes. This proposal is grounded in a mixed-methods approach, with a descriptive emphasis, that combines the analysis of scientific literature with first-hand data collection, enabling a comprehensive understanding of the factors that influence the effective integration of these technologies in school settings (Bernal, 2010).

It is also important to recognize that the advancement of AI in education does not occur in a vacuum, but within an educational system that faces multiple challenges: access gaps, digital inequality, student disengagement, and rigid curricula. In this framework, AI should not be viewed as a magical solution, but rather as a tool that supports continuous improvement, equity, and educational quality. For this reason, this study not only explores the current use of these technologies but also proposes a strategic roadmap for their transformative integration, considering institutional capacities, the perceptions of educational stakeholders, and best practices identified in scientific literature.

Ultimately, this article presents a concrete proposal for an educational innovation strategy that links the pedagogical use of artificial intelligence to the improvement of teaching and learning processes, addressing both the opportunities offered by this technology and the real conditions of the school contexts where its implementation is intended.

The present study adopted a mixed-methods approach with a descriptive scope, aiming to achieve a comprehensive understanding of the perceptions, uses, and needs associated with the integration of artificial intelligence (AI) in teaching and learning processes. This approach enables the combination of quantitative and qualitative data to obtain a more holistic view of the phenomenon under investigation. According to Creswell and Creswell (2023), mixed-methods research facilitates data triangulation and strengthens the validity of findings by integrating statistical measurements with qualitative interpretations.

In this same line, Kuckartz (2023) points out that mixed-method designs are particularly suitable for contemporary educational studies, as they make it possible to link the objective measurement of variables with the subjective understanding of participants' experiences. Thus, the methodology employed in this research allowed for the articulation of quantitative and qualitative data collection, enabling not only the measurement of structured variables but also the interpretation of meaningful perceptions and experiences (Bernal, 2010; Creswell & Creswell, 2023; Kuckartz, 2023).

The research is framed within a descriptive, cross-sectional design, aimed at characterizing teachers' and students' practices and perceptions regarding the use of artificial intelligence tools in educational contexts at a given point in time. This type of design allows for the analysis of reality at a specific temporal moment and the description of existing relationships between

variables without manipulating them. According to Bernal (2010), descriptive studies seek to specify the properties, characteristics, and profiles of individuals, groups, or communities, which is relevant for identifying the factors that support the design of an AI-based educational innovation strategy. Creswell and Creswell (2023) also emphasize that descriptive designs within mixed methods contribute to a comprehensive understanding by combining objective measurement with the interpretation of qualitative perceptions, thus reinforcing the validity of the results.

The study population consisted of teachers and students from educational institutions in Bucaramanga, Santander (Colombia). The sample was selected through non-probabilistic convenience sampling, considering participants' accessibility and availability to respond to the instrument. Data were collected from a total of 32 individuals, including 20 students and 12 teachers, which ensured a balanced representation of both educational roles and provided a complementary understanding of the topic addressed.

For data collection, a structured online survey was used, consisting of closed and open-ended questions organized into five thematic blocks: (a) sociodemographic characteristics, (b) knowledge of the concept of artificial intelligence, (c) use of AI tools in educational environments, (d) perception of AI's impact on teaching and learning, and (e) willingness to receive specialized training. The design of the instrument ensured clarity, relevance, and consistency with the study objectives, in accordance with the methodological rigor principles proposed by Kuckartz (2023) for mixed-method educational research designs.

The questionnaire was administered through digital platforms, ensuring accessibility and convenience for participants. The closed-ended structure of the instrument enabled the collection of quantifiable data, while the open-ended questions provided interpretative insights that enriched the qualitative analysis and contributed to deeper explanatory understanding.

The quantitative data were analyzed using descriptive statistical techniques, such as absolute frequencies, percentages, and distribution tables, with Microsoft Excel® used to organize and graphically represent the results. Meanwhile, open-ended responses were analyzed through basic thematic coding, which allowed for the identification of patterns and trends in participants' perceptions regarding the usefulness and challenges of using AI in education.

Overall, this mixed-methods approach facilitated the triangulation of empirical results with a review of specialized literature, providing robust support for the proposal of an innovative pedagogical strategy mediated by artificial intelligence. The approach integrated both objective data analysis and interpretive understanding of the educational actors' experiences (Bernal, 2010; Creswell & Creswell, 2023; Kuckartz, 2023).

Artificial intelligence (AI) has emerged as one of the most impactful emerging technologies in contemporary education. Numerous studies highlight its potential to process large volumes of information, generate content automatically, and personalize teaching processes according to the characteristics of each student (Zawacki-Richter et al., 2019; Holmes & Reese, 2025).

However, the effectiveness of its integration in real pedagogical contexts depends on multiple factors, including the conceptual familiarity of educational stakeholders, the available technological infrastructure, institutional attitudes, and, above all, the willingness of teachers and students to adopt these tools in a meaningful way.

Several studies have emphasized the urgent need to design educational strategies that go beyond the instrumental use of technology and instead promote true pedagogical innovation—focused on active, personalized, and reflective learning (Gómez et al., 2025; Abulibdeh & Salem, 2025). This innovation must consider both the opportunities offered by AI—such as task automation, progress monitoring, and real-time feedback—and the risks associated with its uncritical implementation, including the dehumanization of the educational process or excessive dependence on automated systems (Morales, 2025) and (Ogunleye et al., 2024).

In this context, the findings of the present study are particularly relevant, as they allow for a diagnosis of the current state of knowledge, usage, and perceptions of AI among teachers and students in a mid-sized city like Bucaramanga. These empirical insights not only reveal the level of technological adoption but also help identify training gaps and improvement opportunities in the design of AI-based educational innovation strategies.

Based on the analysis of data collected through a structured survey, the following results are presented, organized into four dimensions: knowledge of the concept of artificial intelligence, use of AI tools in educational contexts, perception of its pedagogical impact, and willingness to receive specialized training. These categories enable the connection of empirical evidence with theoretical contributions, thus supporting the design of a relevant, feasible, and context-sensitive AI-mediated educational innovation strategy.

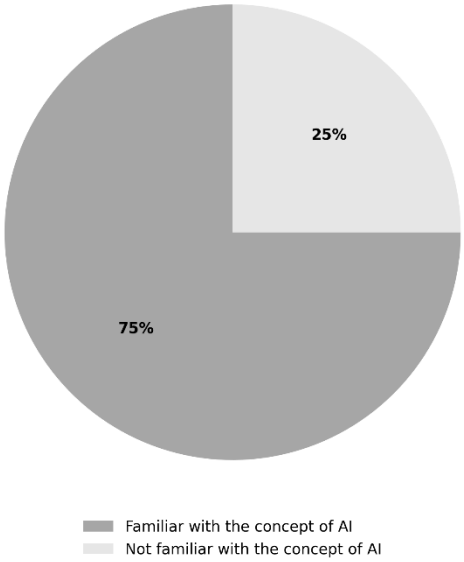
What follows is a presentation of the survey results from 32 participants (20 students and 12 teachers), integrating empirical findings with theoretical insights from recent research. The results are structured into four dimensions: knowledge of the concept of artificial intelligence, use of AI tools, perception of their educational impact, and willingness to undergo training.

Knowledge of the concept of artificial intelligence

Prior knowledge of the concept of artificial intelligence constitutes a fundamental starting point for understanding the degree of appropriation of this technology in educational contexts. Exploring how familiar teachers and students are with AI makes it possible to establish a foundation for designing training strategies that align with their needs and levels of understanding. Below are the results obtained for this dimension.

Figure 1

Knowledge of the Concept of Artificial Intelligence among Teachers and Students



Note. The figure shows the percentage of participants who reported being familiar or unfamiliar with the concept of artificial intelligence. Own elaboration (2025).

A total of 75% of respondents reported being familiar with the concept of artificial intelligence, while 25% indicated they were not. This result reflects a high level of basic digital literacy among the sample, although it does not necessarily imply technical or pedagogical mastery of the topic.

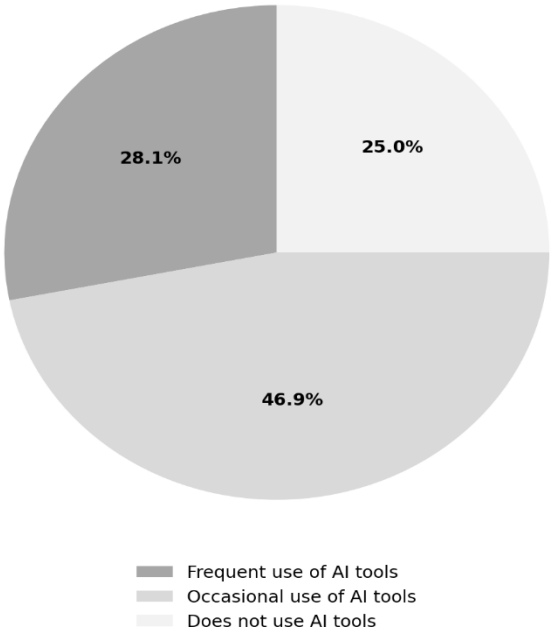
This trend aligns with Zawacki-Richter et al. (2019), who found that educational stakeholders recognize the term AI but demonstrate limitations when applying it in teaching contexts. This highlights a need for training that not only addresses technical aspects but also the pedagogical and ethical dimensions of using these technologies.

Use of AI tools in educational contexts

Beyond conceptual knowledge of artificial intelligence, it is essential to explore whether teachers and students have had practical experiences with AI-based tools in their academic environments. This dimension helps identify the level of technological adoption in everyday educational practice and assess whether there are real conditions for its meaningful integration. The following are the findings related to the use of these tools in educational contexts.

Figure 2

Use of Artificial Intelligence Tools in Educational Contexts



Note. *The figure shows the frequency with which participants use artificial intelligence tools in educational settings. Own elaboration (2025).*

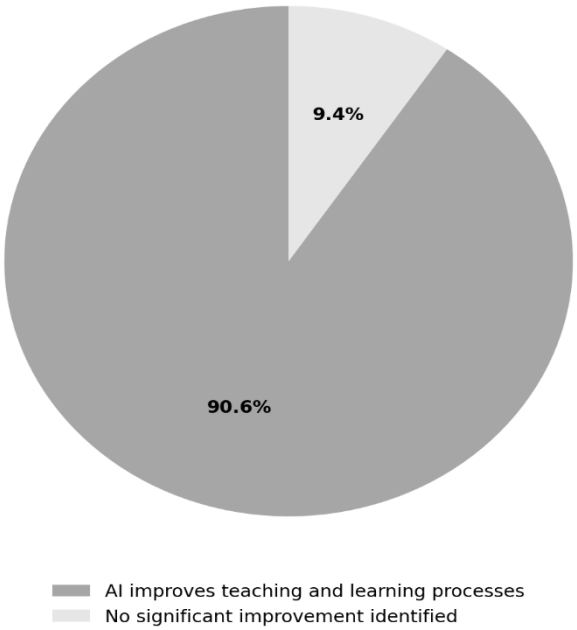
Seventy-five percent (75%) of participants have used AI tools in their educational settings. However, regular use remains limited: only 28.1% employ them frequently, indicating a gap between recognizing the potential of AI and its systematic integration into pedagogical practices.Authors such as Holmes and Reese (2025) argue that although AI tools are available, their effective incorporation requires a clear pedagogical strategy, appropriate technological infrastructure, and an institutional culture oriented toward innovation. In line with Gómez et al. (2025), it is noted that the mere presence of technology does not guarantee educational impact unless it is accompanied by critical appropriation.

Perception of the educational impact of AI

Understanding how teachers and students perceive the potential impact of artificial intelligence on teaching and learning processes helps identify the level of acceptance and the expectations regarding its implementation. This dimension reveals not only the enthusiasm for the pedagogical possibilities offered by AI, but also the ethical and instructional concerns that may arise during its application. The following are the results related to this perception.

Figure 3

Perception of the Educational Impact of Artificial Intelligence



Note. *The figure shows the proportion of participants who consider that the use of artificial intelligence contributes to improving teaching and learning processes. Own elaboration (2025).*

A total of 90.6% of participants believe that AI can improve teaching and learning processes. The main perceived advantages include personalized learning, automation of repetitive tasks, immediate feedback, and increased student motivation.

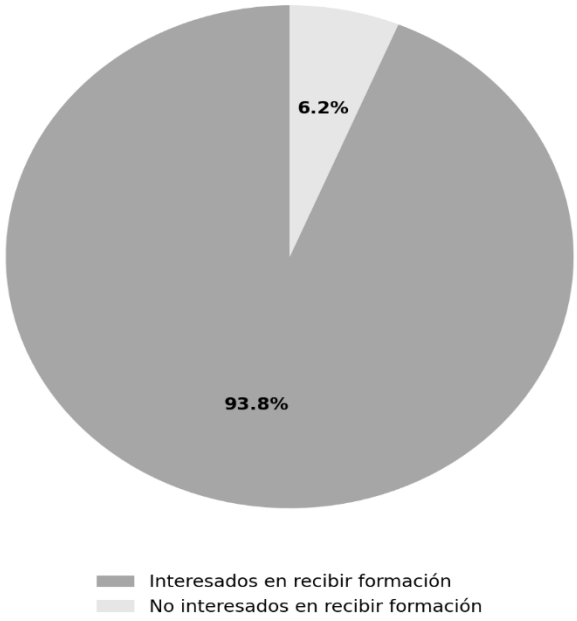
This finding is consistent with Abulibdeh and Salem (2025), who emphasize that AI can serve as a catalyst for educational innovation, if its use is contextualized and ethically grounded. However, a small group expressed concerns about the potential dehumanization of the teaching act and the loss of critical thinking.

Willingness to receive training on the educational use of AI

The effective integration of artificial intelligence (AI) in education requires not only technological infrastructure but also appropriate training for the stakeholders involved. Exploring the interest of teachers and students in being trained on the pedagogical use of AI allows us to anticipate the level of appropriation that future innovation strategies might achieve. This dimension is key to guiding institutional policies on professional development and technological sustainability. The following are the results related to this training disposition.

Figure 4

Willingness to Receive Training on the Educational Use of Artificial Intelligence



Note. *The figure shows the percentage of participants interested in receiving training on the pedagogical use of artificial intelligence. Own elaboration (2025).*

A total of 93.75% of respondents expressed interest in receiving training on the pedagogical use of artificial intelligence. This indicates a significant openness among both faculty and students toward the adoption of emerging technologies, representing an opportunity for educational institutions to implement training and professional development programs.

This need for training has already been identified as one of the main factors that determine the effective incorporation of AI in the classroom (Eras Guaman et al., 2024; Ogunleye et al., 2024). Furthermore, the data supports the design of institutional strategies that consider both the development of digital competencies and the strengthening of critical thinking in the face of technological advances.

Overall, the findings reflect a favourable outlook for the integration of artificial intelligence in educational processes. There is basic knowledge of the concept, a growing use of associated tools, and a positive perception of its impact. However, the low frequency of use and the clear need for specialized training suggest that institutions must implement educational innovation strategies that include training, support, and technological adaptation aligned with the pedagogical context and international best practices.

The results obtained in this study reflect a favourable scenario for the incorporation of artificial intelligence (AI) in educational processes, both in terms of stakeholder willingness and the

positive perception of its transformative potential. The widespread understanding of the concept of AI (75% of respondents) and the occasional use of associated tools (also 75%) reveals a foundation upon which to build training processes and technological appropriation. Nevertheless, the limited frequency of use suggests that AI has not yet become a structural part of pedagogical practices in the contexts analysed.

This gap between recognizing AI's potential and its systematic implementation has already been highlighted by Zawacki-Richter et al. (2019), who warn that the mere presence of technology does not guarantee educational innovation. The findings of this study reinforce that view, indicating the need for an institutional strategy that combines teacher training, technical support, and curricular alignment to achieve meaningful AI integration.

The positive perception of AI's impact on teaching and learning (90.6% approval) aligns with the arguments of Abulibdeh and Salem (2025), who emphasize the value of AI as a catalyst for pedagogical change, provided its implementation is ethical and context sensitive. This perspective is echoed by Holmes and Reese (2025), who point out that the greatest challenge is not the availability of tools, but the construction of solid pedagogical frameworks to guide their use.

Moreover, the broad willingness to receive training on the educational use of AI (93.75% of participants) confirms that both teachers and students are open to innovation, if clear opportunities for professional growth are provided. In this regard, authors such as Eras Guaman et al. (2024) and Ogunleye et al. (2024) agree that training is a determining factor in the success of any technological innovation strategy in education.

The results support the need to design an educational innovation strategy that goes beyond the technological component, encompassing formative, ethical, and pedagogical aspects. AI should not be seen as an isolated solution, but rather as part of an educational transformation ecosystem that requires institutional vision, teacher leadership, and active student participation.

Conclusions

The findings of this research show that artificial intelligence (AI) represents a real and valued opportunity by both teachers and students to transform teaching and learning processes. The diagnostic conducted revealed that a high percentage of educational stakeholders surveyed not only understand the concept of AI but have also had practical experiences with tools based on this technology, although such use remains occasional and limited. This confirms the assertions of Zawacki-Richter et al. (2019), who caution that the mere presence of technology in educational settings does not automatically result in meaningful innovation; rather, it requires pedagogical support and clear implementation strategies.

The project identified a broad willingness among participants to receive training in the educational use of AI, which represents a favourable starting point for the design of institutional interventions. In line with the proposals of Gómez, et al. (2025) and Abulibdeh and Salem (2025), it is concluded that teacher training and the development of digital competencies are enabling conditions for the effective and critical integration of AI in pedagogical contexts.

Likewise, the widespread positive perception of AI's impact—particularly in terms of personalized learning, process automation, and enhancement of the educational experience—reinforces the relevance of designing innovation strategies focused on these capabilities. However, challenges also emerge that should not be overlooked, such as the risk of dehumanizing the educational process, excessive dependence on automated systems, and the lack of ethical regulation, as noted by authors such as (Ogunleye et al., 2024).

Therefore, it is concluded that the design of an AI-based educational innovation strategy must consider not only the technological component but also the pedagogical, ethical, and formative dimensions. The strategy should promote student-centered practices, foster teacher autonomy, encourage interactive and meaningful learning environments, and ensure that technology use responds to the real contextual needs of each educational community.

Thus, AI should not be seen as an end, but to rethink pedagogical practice through innovation, inclusion, and continuous improvement. This study provides valuable inputs to advance in that direction, offering both a current characterization of AI use in education and concrete guidelines for its strategic and sustainable implementation.

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Analysis of the brazilian framework of digital teaching knowledge based on Andrew Feenberg's critical theory of technology

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Introduction

Digital information and communication technologies (DICTs) are part of society, permeating social, economic and cultural relations. The advancement of DICTs has been impactful, having repercussions on everyday school life. It is important to recognize that, in addition to access and use of DICTs, a critical understanding of digital technologies is necessary on the part of teachers and the school community.

The *UNESCO Global Education Monitoring Report 2023* (GEM Report UNESCO, 2023) analyzed the role of technology in education and asked some questions such as: Technology in education is a tool at the service of whom? Does technology democratize knowledge or does it threaten democracy by allowing only a few to have full access? Does it promote equality or exacerbate inequalities? The Report highlights that

> "Governments need to ensure the right conditions to enable equitable access to education for all, to regulate technology use so as to protect learners from its negative influences, and to prepare teachers" (GEM Report UNESCO, 2023, p.547)

In this way, the insertion of technologies is present in society and in schools. There is no school without technological instruments, from the most classic ones such as chalk, blackboards and books to the most contemporary ones such as: interactive digital whiteboards and interactive pens/brushes, applications and social networks. The school environment, defended here, is understood as a space to think and reflect critically on technologies and not only or necessarily use them. For example: the debate on the partial or total ban on the use of cell phones in schools and on the consequences for students' concentration and learning. In Brazil, Law No. 15.100/2025 prohibits the use of cell phones in schools and came into effect as of the 2025 school year[1].

In the society in question, with countless technological transformations, it is necessary to return to theories about technologies in order to critically understand the intentionality, presence and consequences of technological elements that are constructed in contemporary times. These

[1] The school year in Brazil starts in February

technological transformations and their consequences affect the school environment, thus, a legal basis for continuing teacher training in the area of digital technologies is necessary. Continuing teacher training in the area of technology is structured based on legal and scientific references that seek to guide both technical mastery and a reflective and pedagogical approach. The continuing teacher training proposed in these documents combines theory and practice, and is not merely technical.

In Brazil, the *Referencial de Saberes Digitais Docentes* (Ministério da Educação, 2024) is a document published by the Secretariat of Basic Education of the Ministry of Education (MEC) to instruct the use of digital technologies in teaching and learning in elementary and secondary education. According to the document, the reference can be used for: self-reflection, individual planning, integration into pedagogical practices, participation in learning communities and feedback on pedagogical practices, with emphasis on the guidance and planning of continuing education for teachers in the area of education and technology.

In this sense, the following article seeks to return to Feenberg's Critical Theory of Technology (2002) and identify which concepts, refuted and defended by Feenberg, are present in the Reference for Digital Teacher Knowledge (Brazil, 2024). The article has the following starting problem: How are the concepts of technological determinism, technological neutrality and technological democratization of Andrew Feenberg's Critical Theory of Technology present in the document Reference for Digital Teacher Knowledge of Brazil? This study is part of a broader doctoral research in education on a critical analysis of continuing education courses for teachers in education and technologies in Brazil.

General Objective - The study aims to analyze how the main elements of Andrew Feenberg's Critical Theory of Technology (2002) are present in the document R*eferencial de Saberes Digitais Docentes* (Brazil 2024).

Specific Objective - Identify and describe how the concepts of technological determinism, technological neutrality and technological democratization are present in the document.

Theoretical framework

In order to understand human social and educational practices, it is necessary to return to theories. As Paulo Freire (2013) argues, the relationship between theory and educational practice is a dialectical and inseparable one that continually feeds back into itself, in which practice can become a vehicle for transforming education. The critical analysis of practice must be made based on the theoretical precepts contained therein. In this sense, teacher training, when based on the articulation between practice and theory, implements the praxis advocated by Freire. The teacher is not only a transmitter of knowledge, but a critical intellectual capable of reflecting on his/her social context and practice and of constructing knowledge contextualized with the reality of the students.

Dermeval Saviani, a Brazilian educator, analyzes education from a historical and social perspective. In his approach (2021), he uses educational documents and policies to understand the role of education in society and to identify the power relations that permeate it. For the

author, by analyzing official documents related to education, it is possible to identify trends and conceptions regarding education within a historical-social context. Thus, by analyzing educational documents and policies, we can understand, reflect on, and identify pedagogical ideas present in the texts, as well as the presence and absence of which theories direct the intentionality, or not, of a more fair and democratic educational practice.

This article is based on Andrew Feenberg's Critical Theory of Technology (2002), which takes a philosophical and sociological approach to understanding technology within social, political and cultural structures. The theory in question is based on the Frankfurt School, especially on the works of Marcuse (1964), in which he criticizes technical rationality and shows how it helps to produce a one-dimensional culture and politics, limiting criticism and human emancipation. Feenberg (2002) argues that technology is not neutral, that it reinforces and reflects the interests of dominant groups. Technology is socially constructed, being shaped by the choices of these groups and propagating values from its conception. The design of any technological instrument is based on intentions that shape behaviors, and therefore, it is a decision about who controls and who benefits:

> Every technology points on one side to an operator and on the other to an object. Where both operator and object are human beings, technical action is an exercise of power. Where, further, society is organized around technology, technological power is the principal form of power in the society. It is realized through designs that narrow the range of interests and concerns that can be represented by the normal functioning of the technology and the institutions that depend on it. This narrowing distorts the structure of experience and causes human suffering and damage to the natural environment. (Feenberg, 2007, pp.81-82)

Andrew Feenberg's Critical Theory of Technology criticizes technological determinism and neutrality and advocates the democratization of technologies. In the logic of technological determinism, technological transformations are presented to society as inevitable innovations and their consequences are automatic and impartial. "Innovations", that is, technological instruments, would always lead to progress and it is up to society to adapt to them. In this logic, technology needs to provide enchantment, awe, in order to create the belief that through it we can advance and develop.

> A deterministic view of technology is commonplace in business and government, where it is often assumed that technical progress is an exogenous force influencing society rather than an expression of changes in culture and values. (Feenberg, 2007, p. 8)

The perspective of technological determinism is accompanied by the belief in technological neutrality. In technological neutrality, technological instruments are presented and understood socially as neutral tools and everyone must know how to use them, for good or for evil.

> "As pure means, the only value to which technology conforms is the formal value of efficiency. The neutrality thesis is familiar from the gun-control debate where it is

> expressed in the slogan "Guns don't kill people, people kill people." Guns are neutral, and values are in the heads of those who choose the targets." (Feenberg, 2007, p. 36)

As Marcuse (1964) argues, the argument for technological neutrality places it at the service of dominant social groups, and through the critical theory of technology it is intended to demonstrate that the technological system is inherently biased. The "formal bias" addressed by Feenberg (2007) aims to demonstrate how a technical, logical, well-designed and correctly operated system or device can, despite this, discriminate in a given social context. We can exemplify the logic of "formal bias" with the practice of facial recognition using technological devices. Facial recognition is a technology that can be used to identify suspects and investigate crimes. However, there are several debates about the use of technology in this type of activity. Santos et al (2023) argue that:

> "Explaining the non-neutrality of facial recognition is a condition for this to be possible. Even if it does not seem stable and solid in the operating modes of technological devices, it is necessary that we are able to make mistakes and negotiate in the tension of contradiction, which, in turn, can only be done in the midst of polyphony, in the midst of heterogeneity." (Santos et al., 2023, p.11)

The article "Facial recognition as an instrument to reinforce the state of unconstitutional affairs in Brazil" by Possan (2022) presents another study "conducted by researcher Joy Buolamwini through the Massachusetts Institute of Technology that identified an error rate of 0.8% in facial recognition systems for recognizing light-skinned men, while for black women the error rate was 34%". (Possan, 2022, p.138)

This example related to the use of technology for facial recognition reinforce Feenberg's (2002) idea that technology is neither decisive nor neutral. The technological democratization advocated by him involves citizens and social groups in the critical understanding of the creation of technologies, so that they serve human and ethical purposes and not just technical or economic interests.

In the concept of democratic instrumentalization, defended by Feenberg, users, workers and social groups affected by a technology must actively participate in its production, development, use and modification, and these groups must intervene in the technical process to make it more aligned with human and social values. Democratic instrumentalization is divided into primary and secondary. Primary instrumentalization concerns the technical design of the technology, such as its structure and functionality. Secondary instrumentalization relates to the social, political, and cultural meanings of technology, including the values it embodies and its social and environmental impacts.

> "Only the democratization of technology can help. This requires in the first instance shattering the illusion of transcendence by revealing the feedback loops to the technical actor. The spread of knowledge by itself is not enough to accomplish this. For knowledge to be taken seriously, the range of interests represented by the actor must be enlarged so as to make it more difficult to offload feedback from the object onto disempowered

> groups. But only a democratically constituted alliance of actors, embracing those very groups, is sufficiently exposed to the consequences its own actions to resist harmful projects and designs at the outset. Such a broadly constituted democratic technical alliance would take into account destructive effects of technology on the natural environment as well as on human beings." (Feenberg, 2005, p.55)

Brazilian author Vieira Pinto (2005) expresses principles that are in line with Feenberg's Critical Theory of Technology when, for example, he criticizes the use of the term "technological era", since, for him, man is a being who is always in a technological era, as he always creates technologies adapted or necessary to the present time. The author emphasizes that man, based on his capabilities, designs and produces his technologies, so it is a mistake to look exclusively at technology, since human production consists of the production of social relations, of forms of coexistence. In other words, if certain dominant groups design and create technologies, they do so with intention and insert them into their lives. Technology as ideology, a concept addressed by Viera Pinto (2005), reveals that economic interests and power relations dictate technological standards in society. These standards impact all aspects of social life and do not exclude the school environment.

The objective of this study is to analyze elements of the Critical Theory of Technology in the document *Referencial de Saberes Digitais Docentes* (2024). This work is characterized as an empirical study with a qualitative approach. Analyzing official documents on education is a relevant source for understanding public policies, institutional actions, and social and historical contexts (Saviani, 2021). Bardin's content analysis (2016) was used to analyze the document *Referencial brasileiro de Saberes Digitais Docentes*.

The document selected for analysis is the *Referencial de Saberes Digitais Docentes* (2024). The reference for analysis was chosen because it is an updated document, with national scope in Brazil, and its objective is to be a reference, a basis, for planning actions involving the continuing education of elementary and high school teachers in relation to TDICs in education. The document is available on the website of the Ministry of Education (MEC), with free access[2], and is part of the National Policy for Connected Schools. The National Strategy for Connected Schools is organized by the federal government, in collaboration with education systems, which aims to direct and guarantee connectivity for pedagogical purposes in all public basic education schools in Brazil.

Bardin's (2016) Content Analysis technique was used, opting for the thematic analysis type. Content analysis is used in social science research that aims to interpret communication content in a systematic way. The content analysis process consists of 3 phases, which are: pre-analysis; exploring the material; and processing of the results obtained and interpretation.

Based on the analysis of the Framework and the Critical Theory in question, three categories were created: two of them address concepts refuted in relation to the use of technologies by the

[2] https://www.gov.br/mec/pt-br/escolas-conectadas/20240822MatrizSaberesDigitais.pdf - Acess in 07 July 2025.

Critical Theory of Technology: technological determinism and technological neutrality. The other category is defended by Feenberg, which is technological democratization.

The first category, technological determinism, is related to the idea that technology follows its own logic of progress, innovation, and evolution, and that individuals adapt to it. The second category, technological neutrality, is based on the notion that technology is merely a neutral tool, its value is efficiency, and what matters is the use made of it by individuals. And the third category, technological democratization, which includes the primary and secondary instrumentalization of technology advocated by Feenberg, actively involves citizens and social groups in understanding and constructing technologies so that they serve human, ethical, and democratic purposes

The result of the analysis indicates that in the framework of digital teaching knowledge (Brazil, 2024), the use of digital technologies with pedagogical intentionality for teaching and learning carries the implicit logic of determinism and technological neutrality. However, it also presents aspects related to technological democratization, when it mainly addresses assistive technologies in education.

Within the framework of technological determinism, the document presents technologies as frequently associated with innovation and progress, arguing that education must adapt accordingly. The very idea of technology related to innovation, a term present in the title of the Connected Education Innovation Policy, linked to the knowledge framework, is related to technological determinism. Words such as innovate, adapt, integrate, incorporate and self-develop are related to the use of digital technologies in education within the deterministic bias. Examples present in the text are terms and expressions such as: "Innovation and technology policy in education" (Ministério da Educação, 2024, p.6); "adapt it to your teaching practice" (Ministério da Educação, 2024, p.6); "possibilities of incorporating technology" (Ministério da Educação, 2024, p.6); "teacher self-development" (Ministério da Educação, 2024, p.6); "teachers trained to integrate AI into their practices can develop innovative teaching methods" (Ministério da Educação, 2024, p.8); "integration of digital technologies into pedagogical practice." (Ministério da Educação, 2024, p.9); "digital technologies and virtual learning environments for continuing education and pedagogical innovation" (Ministério da Educação, 2024, p.11).

"Determinism also affirms that social institutions must adapt to the "imperatives" of the technological base". (Feenberg, 2007, p. 9). Feenberg states that in the logic of determinism, all social subjects must adapt to technological changes, and education is no different. Thus, according to this logic, teachers must adapt to the technological imperative, incorporate technologies, which are presented as innovations, and learn how to use them.

Within the technological neutrality category, the term "use" stands out in the Framework, present in different contexts, mainly within the dimension of digital citizenship, such as: "Ethical use" (Ministério da Educação, 2024, p.10); "Responsible use" (Ministério da Educação, 2024, p.26); "Safe use" (Ministério da Educação, 2024, p.27); "Critical use" (Ministério da Educação, 2024, p.27); "Teaching and learning with the use of technologies" (Ministério da Educação,

2024, p.12); "Use of technological resources for management" (Ministério da Educação, 2024, p.29) and "Use digital resources and sources in your continuing education process" (Ministério da Educação, 2024, p.11).

The emphasis on the term use indicates a neutral understanding of technology, with the social subjects being the teachers in question, who must make and teach the correct use, the good and ethical use of technologies. This logic is also present in the following terms: "Responsible use of digital technologies and respect for copyright and image rights" (Ministério da Educação, 2024, p.26) and "discussions on the impact of excessive use of digital technologies on mental health" (Ministério da Educação, 2024, p.26). The document advances in relation to the ethical and legal implications, with emphasis on the uses of technologies, which include issues of privacy, digital security and responsible online behavior. However, the reference does not address the ethical and legal implications inherent to technologies, and does not position them as historical-social constructions with intentionality, previously thought out and programmed.

In technological neutrality, only efficiency is considered a value. In other words, the technological instrument performs an effective function when it achieves the desired objective, which is related to the correct execution of the technological tool and thus obtains the desired results, with less time and resources. The document presents the integration of technologies considering this value in excerpts such as: "Creates and implements automated workflows that integrate multiple tools and platforms for efficient task management" (Ministério da Educação, 2024, p.29); "which can improve student engagement and facilitate personalized teaching" (Ministério da Educação, 2024, p.12); "promotes effective pedagogical practice" (Ministério da Educação, 2024, p.12) and "More dynamic and interactive approach" (Ministério da Educação, 2024, p.12).

Within the category of technological democratization, the use of assistive technologies in inclusive practices stands out, as can be seen, for example, in the following elements of the Framework: "Design learning strategies mediated by digital and assistive technologies, developing adapted and accessible content to ensure the full participation of all students" (Ministério da Educação, 2024, p.9); "Plan and implement learning strategies that integrate digital and assistive technologies to promote inclusion" (Ministério da Educação, 2024, p.25) and "Develop digital educational content adapted to the needs of students" (Ministério da Educação, 2024, p.25). In this sense, the technology was designed and thought for a certain group with the intention of including them in the educational process.

The document also presents aspects of technological democratization when it enables participation, debate and evaluation of technologies. These are the cases of the following excerpts from the document: "Use and create digital technologies and resources to promote the participation of online learning communities" (Ministério da Educação, 2024, p.11); "Identify tools, virtual learning environments, virtual communities and educational social networks" (Ministério da Educação, 2024, p.11); and "research and critically evaluate different technologies and technological trends for educational management" (Ministério da Educação, 2024, p.29).

Conclusion

Based on the analyses conducted and the theories and texts presented in this article, it is possible to observe that the Digital Knowledge Reference for Teachers emphasizes the pedagogical use of technology, aiming to contribute to the formation of digital citizens. However, this occurs within a perspective of technological neutrality, where instrumentalization is highlighted — understood as mere operational knowledge or "knowing how to use" pedagogical.

Terms and expressions related to technologies such as "prepared to use it" (Ministério da Educação, 2024, p.6) and "adapt it to your teaching practice" (Ministério da Educação, 2024, p.6) are used in the document and are related respectively to technological neutrality and technological determinism, the idea that professionals must be trained to adapt the use of ICTs in pedagogical practices.

The Framework is divided into 3 dimensions (Teaching and learning with the use of digital technologies; Digital citizenship; Professional development) and 12 areas of knowledge (pedagogical practice, curation and creation, data analysis, inclusive practice, responsible use, safe use, critical use, continuing education, communication and collaboration, use of digital resources for management). Each area of knowledge is described in terms of understanding and practice. Understanding refers to theoretical knowledge, i.e., theories and concepts related to the use of digital technologies in teaching and learning processes. Practice is related to the effective application of concepts, i.e., concrete educational actions involving the use of technologies. However, the document does not present a proposal for studies on theories related to technology and does not provide an understanding of technology within social, cultural and economic contexts, although it includes terms such as critical use of technology.

The difference between the "critical use of technologies" (Ministério da Educação, 2024, p.27), addressed in the document, and critical thinking about technology, which is not addressed in the document in question, is also noteworthy. The use of technologies in the framework is linked to the individual logic of use, with teachers being responsible for self-development, adaptation, and insertion of these instruments, and does not propose understanding the intentionality inherent to the tool and the intentionality of the groups that produce the technologies. It is argued here that critical understanding of technology must precede critical use.

As Davidov (1988) points out, the basis of teaching is to develop theoretical thinking, to teach how to think theoretically. In the case of technologies in education, technological education presupposes teaching how to think theoretically about technologies in society and education. Therefore, it is also the role of teacher training to move towards thinking critically about technologies.

The reference highlights the debate surrounding assistive digital technologies aimed at promoting the inclusion of people with disabilities, reflecting the democratization of technology advocated by Feenberg. In theory, assistive technologies are designed specifically to foster social inclusion. For further studies in the area of education and technologies, it is suggested that other official documents, references on teacher training in digital technologies based on

Feenberg's Critical Theory of Technology, be analyzed, such as: Common Digital Competences Framework for Teachers in Spain and Dynamic Framework of Reference for Digital Competence (QDRCD) in Portugal.

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Inclusive Education, Diversity, and Social Justice

Towards a transformative civic justice in Mexico

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Introduction

In the Mexican justice system, civic courts are often undervalued, but in reality they are key to maintaining good social coexistence. They are dedicated to dealing with administrative faults and conflicts in the community, being the first point of contact between the people and the State. But their role goes beyond simply imposing rules and sanctions. These courts clearly reveal the inequalities and vulnerabilities faced by marginalized groups, such as people on the streets, those with disabilities, immigrants and those struggling with addictions. For this reason, civic courts can be important spaces to promote active and participatory citizenship. Through training processes, people can be helped to know and exercise their rights, reject illegality and corruption, and strengthen both the democratic state and the social structure (MUCD, 2023).

This chapter is based on a qualitative research carried out in the state of Colima, Mexico, whose objective was to understand the experiences of civic judges in the performance of their daily duties. Through a structured questionnaire applied to civic judicial personnel in various municipalities, aspects such as the application of sanctions, attention to vulnerable communities, perception of discrimination, and gender inclusion were addressed. The results show various ethical and institutional tensions, training deficiencies, and the need to strengthen a more humanistic vision in the delivery of local administrative justice.

Justice workers face the challenge of balancing legality with respect for human rights, especially in contexts where the legal system seems to perpetuate inequalities. In societies where the legitimacy of order and the law is appealed, vulnerable sectors express their disenchantment when they perceive that what is fair for them is considered unfair by the system. Furthermore, their ways of protest are often delegitimized, distorting the notion of justice based on reciprocity (Yarza, 2011).

For this reason, civic justice should not be understood only by the norms, but as a space where the relationship between the State and citizens is built day by day, especially with those who do not have other ways of accessing justice or live in situations of social exclusion, which is closely linked to the principles of substantive equality, gender perspective, and non-discrimination that guide the recent constitutional reforms in Mexico (Cruz, 2024).

The research also shows how the institutional dynamics marked by patriarchy are still present in judicial work, particularly in the professional development of women judges. Although some progress has been made in mainstreaming the gender approach, there are still restrictions in both language and practice, reflecting an outstanding debt to real equality.

Faced with this situation, rethinking the civic court implies going beyond its traditional vision as an exclusively sanctioning organ. It is necessary to recognize it as a space with transformative potential, capable of encouraging social inclusion, preventing conflicts, and protecting rights.

This chapter adds to the efforts to document and make these experiences visible from a critical perspective, which puts human dignity at the center of judicial work.

This paper analyzes the experiences of civic judges in Colima, Mexico, to understand the ethical, social, and institutional challenges they face every day. It focuses on dealing with people who are historically vulnerable, such as those who live on the streets, have disabilities, are immigrants, or face addiction. Civic courts are seen as key spaces for encounters between the State and these communities.

Difficulties are explored in applying sanctions or trying to implement protocols adapted to needs in the various contexts where local regulatory frameworks do not address this diversity of social conditions. The research examines how human rights and gender approaches are applied in practice. Proposals for improvement by court staff are also included. The goal is to promote more humane, just and inclusive civic justice.

This study was conducted with a qualitative approach, seeking to deeply understand the experiences, opinions, and challenges faced by civic judges in Colima, Mexico, in their daily work. We start from the idea that civic courts are key to maintaining social coexistence and, moreover, serve as a direct point of contact between the State and groups that have historically been disadvantaged, such as people experiencing homelessness, people with disabilities, migrants, or those struggling with addictions.

To collect the information, a questionnaire with 18 open-ended questions was designed and administered to civic judicial staff in the 10 municipalities of the state. These questions were based on key topics previously identified: how they decide and apply sanctions, how they serve vulnerable groups, their perspective on human rights and gender, and their goals for improving justice. The aim was for them to share personal stories that would help uncover both the shortcomings of the system and the good practices that already exist.

The questionnaire was administered for self-completion, according to each participant's availability. The responses were analyzed and classified into five categories: decision-making criteria and sanctions; care for vulnerable individuals and special treatment; a human rights-based approach; gender perspective and institutional framework; and proposals for improvement oriented toward a more transformative vision (Table 1)." Each category was assigned thematic codes in order to identify patterns, tensions, and commonalities across the narratives.

It is important to note that the responses were analyzed with the aim of identifying the structural, normative, and cultural factors that influence civic judicial work. Special attention was given to the contradictions between what the law stipulates—such as the Civic Order and Justice Regulations of the Municipality of Colima (2021) and the Law for the Regulation of Civil Coexistence (2018)—and what actually occurs in daily practice. We also examined how (and whether) human rights and gender perspective approaches are actually being applied in the attention given to those who use this system.

In this way, the investigation made it possible to clearly observe the tensions between what is written in the regulations and what occurs in practice, as well as between the institutional and the human dimensions. This highlights the urgent need to reconceptualize the civic court not

merely as a place for imposing sanctions, but as a space with significant potential to foster inclusion, mediate conflicts, and uphold human dignity.

Table 1. *Categories of the questionnaire. Source: Own elaboration, 2025.*

Category of the questionnaire	Description
Decision-Making Criteria and Application of Sanctions.	Investigates the criteria used to apply sanctions and the existence of protocols for decision-making.
Care for Vulnerable Individuals and Differentiated Treatment.	Analyzes the frequency, treatment, and challenges in attending to individuals who have been historically marginalized in the civic court.
Human rights approach.	Evaluates the presence or absence of a human rights-based approach in everyday judicial practice.
Gender Perspective and Institutional Framework.	Examines the extent of gender perspective integration and the institutional barriers encountered, particularly by female judges.
Proposals for Improvement and a Transformative Vision.	Collects proposals and reflections on how to strengthen the civic justice system from a humanistic and inclusive perspective.

The analysis of this research is structured around five thematic axes, which allow for a comprehensive understanding of the functioning of municipal civic justice. The first examines how civic judges construct their decision-making criteria, combining the regulatory framework with ethical judgment and social sensitivity. Their work is not limited to imposing sanctions but also contributes to the formation of a citizenry committed to democratic and coexistence values (Law for the Regulation of Civil Coexistence in the State of Colima and its Municipalities, Explanatory Statement, 2018).

The second axis addresses the care of individuals in vulnerable situations, highlighting the importance of ensuring differentiated treatment that respects substantive equality. The existence of protocols, such as the one for handling cases involving persons with disabilities, aims to ensure non-discrimination and respect for human rights (Monterrey City Council, n.d.).

Third, the incorporation of a human rights approach in daily practice is analyzed. According to Article 1 of the Constitution, all authorities must act under the principles of universality, interdependence, indivisibility, and progressivity, promoting and guaranteeing these rights

(Congress of the Union, 2011). The fourth axis focuses on the gender perspective, highlighting the structural barriers faced by women within the judicial system, as well as the persistence of practices and language that perpetuate inequalities, despite the regulatory framework aimed at parity and the eradication of gender-based violence (CNDH, 2023).

Finally, the fifth axis collects the transformation proposals expressed by judicial staff, reflecting a vision committed to a more humane, approachable, and inclusive civic justice, thereby strengthening the link between citizenship and the rule of law.

Judicial criteria and protocols in the application of administrative sanctions

The analysis of responses regarding how civic judges determine sanctions reveals a balance between the application of regulations and the consideration of individual context. Although the Regulation of Order and Civic Justice provides general guidance, judges take into account factors such as recidivism, economic situation, emotional state, substance use, and acceptance of responsibility. This practice reflects a pro-person approach, which, as noted by the National Human Rights Commission (2018), involves choosing the rule or interpretation that most benefits the individual, promoting a more humane and contextualized form of justice. Regarding the existence of protocols for assisting vulnerable individuals, the responses show a lack of uniformity: 50% report that they do exist, 33.3% indicate that they do not, and 16.7% are unaware of their existence (Figure 1). This disparity reveals gaps in institutional training and in the communication of official guidelines. While formal procedures are reported in cases involving children and adolescents, including specific protocols and referrals to health or social services, it is also evident that many decisions continue to rely on individual judgment, without clear regulatory backing.

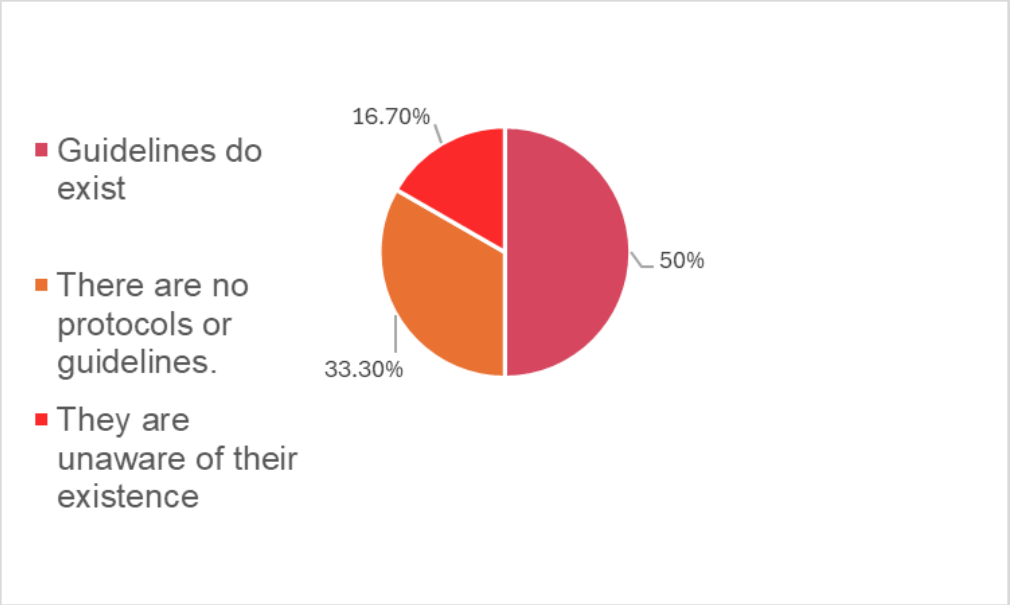

Figure 1. Protocols for assisting individuals in vulnerable situations Source: Own elaboration, 2025.

These findings indicate progress toward a more responsive and adaptable civic justice system, but they also highlight a significant gap in the standardization, training, and implementation of protocols, which affects equity and the protection of rights in this area (State of Mexico Human Rights Commission, 2024).

Differentiated care in civic courts

The analysis of the care provided to individuals in vulnerable situations in civic courts reveals a variety of experiences and approaches, reflecting the institutional challenges in handling these cases. Although the presence of individuals with addictions is common, people experiencing homelessness, migrants, or individuals with disabilities also seek assistance. Judges acknowledge the tension between providing equal treatment and offering differentiated care based on human rights, such as referrals to medical or social services. However, discriminatory practices, whether conscious or not, are also identified, highlighting unequal treatment.

As noted by Fix-Fierro and López-Ayllón (2008), effective access to justice is essential for reducing structural inequalities, which entails ensuring sensitive and accessible mechanisms, not just formal legal channels. Although efforts exist to protect vulnerable individuals, the testimonies reflect that decisions may be influenced by biases or external pressures.

Judges face obstacles such as a lack of information about the offender, inadequate infrastructure, absence of medical support, institutional discrimination, and revictimization. Despite their commitment, the system perpetuates inequalities, highlighting the need to strengthen laws, improve inter-institutional coordination, and ensure continuous training in human rights and inclusion.

In this context, Mexico faces challenges in consolidating an effective rule of law, where insecurity, impunity, and restrictions on access to justice daily undermine the rights and dignity of marginalized groups (State of Mexico Human Rights Commission, 2024).

Implementing a human rights approach in municipal civic justice

The qualitative analysis of the incorporation of a human rights approach in civic justice shows progress, but also persistent limitations. The majority of interviewees (9 out of 12) perceive a clear approach in their municipalities, highlighting practices such as oral hearings, the right to be heard, mediation, and inter-institutional collaboration with entities such as the State Police, the Institute for Women, or the Women's Justice Center. Efforts to ensure dignified and impartial treatment are also mentioned.

However, this positive perception is tempered by structural obstacles. Among the main criticisms are the lack of specific protocols, clear guidelines, and material resources, which limits the effectiveness of the approach in practice. The recurring phrase "we work with what we have" demonstrates that institutional commitment is not always supported by adequate infrastructure or resources.

In light of this situation, it is necessary to strengthen the implementation of the human rights approach through clear protocols, continuous training, improvements in infrastructure, and

enhanced inter-institutional coordination. In this regard, the Supreme Court of Justice of the Nation has developed *Protocols of Action for those who impart justice*, serving as fundamental tools to guide judicial work based on protection standards for historically marginalized groups, ensuring equitable access to justice (SCJN, 2024).

The gender perspective in the civic sphere

The incorporation of a gender perspective in civic courts is uneven and largely depends on the individual willingness of judges. Although positive practices exist, such as women being attended to by female staff or support from specialized institutions, these lack formal protocols and therefore do not constitute sustained institutional policies. This situation reflects the persistence of gender roles and stereotypes that affect women's access to justice, in contrast with international equality standards (Castellanos, 2021).

In municipalities such as Villa de Álvarez, some gender-focused initiatives have been promoted; however, female judges face obstacles such as unequal treatment or resistance from their colleagues, revealing that despite advances in formal equality, cultural patterns continue to limit equity in practice. While some interviewees assert that treatment is equal, others acknowledge differentiated criteria that, although well-intentioned, may reinforce stereotypes or undermine women's credibility.

To achieve truly equitable civic justice, it is necessary to strengthen judicial staff training in gender perspective, update municipal regulations, and ensure sufficient resources. These measures must be transformed into sustained public policies. Additionally, it is proposed to establish institutional goals to achieve real equity, including equal participation and a reform of judicial staff selection processes with a gender perspective (Gauché-Marchetti, 2022).

Towards a Humanistic Transformation of Civic Justice

The commitment of civic judges to a more equitable and accessible justice is evident, but it requires institutional support. A notable example is Mexico City, where the Professional Competency Certification Program was implemented. This program recognizes the key role of judges as the first point of contact between citizens and justice, and promotes methodologies appropriate for public service (Digital Public Innovation Agency of Mexico City, 2024).

Among the recommendations, outreach to communities with limited access to justice stands out, as it promotes conflict prevention and aligns with principles of restorative justice. Furthermore, it is considered urgent to institutionalize ongoing training in human rights, gender perspective, and alternative conflict resolution. It is also suggested to create a state network of civic judges to strengthen the exchange of experiences.

Another important proposal is to strengthen the civic court's identity through material resources, public visibility, and transparency mechanisms. The need to update outdated municipal regulations and to increase the available budget and personnel is also emphasized.

Judges value their role as an opportunity for social impact, particularly in the resolution of community conflicts. To achieve a genuine transformation, it is necessary to recognize their

strategic role within the local justice system and align it with the principles of good governance and a culture of peace.

Conclusions

The study concludes that civic courts, although little visible, play a key role in conflict resolution and as the first point of contact between the State and individuals in vulnerable situations. Judges demonstrate a strong commitment to applying humanized criteria, but face structural limitations such as the lack of protocols, resources, and infrastructure. Although human rights and gender perspectives have been incorporated, their application is uneven and depends on individual willingness. The need to institutionalize these approaches through public policies, continuous training, and regulatory reforms is emphasized. The proposals from judicial staff aim at a justice system that is more approachable, empathetic, and preventive. Civic justice in Mexico can become an innovative and inclusive model if it is consolidated as a structural policy oriented toward dignity and equity.

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Educational Supports for Attending to Diversity: Teachers' Experiences in Public Schools in Chimbote

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This study was conducted under the framework of funding provided by the national funds allocated to public universities in Peru (PIC FF.E.H. 009-2024-UNS-VRIN), Universidad Nacional del Santa – Peru.

Introduction

In the 21st century, education has been challenged by new social, cultural, and pedagogical demands that call for an inclusive and transformative approach to teaching. Within this framework, addressing diversity is no longer optional but has become a core element of educational quality. In Peru, this need has been recognized by current legislation, such as the General Education Law (Law No. 28044), which identifies inclusion as one of the guiding principles of the national education system. Nevertheless, the persistent gap between policy and practice continues to hinder the full realization of the right to equitable education.

This chapter seeks to contribute to a critical understanding of these gaps by analyzing teachers' experiences regarding institutional educational support for diversity in public schools in Chimbote during 2024. The study is empirical, descriptive, and quantitative in nature, gathering field-based perceptions and offering data relevant to the potential reformulation of educational policies and practices.

The research is grounded in the premise that teachers are key agents in building an inclusive school environment. However, their performance is closely tied to the level of institutional support they receive. Such support—understood as ongoing professional development, access to resources, pedagogical guidance, and an inclusive organizational culture—is a critical factor in the effective implementation of diversity-oriented teaching strategies (UNESCO, 2020; Teacher Task Force, 2020).

Addressing diversity in the classroom is one of the main challenges facing the Peruvian education system, especially in regions such as Ancash, where multiple social, cultural, institutional, and pedagogical factors converge in the daily teaching practice. This descriptive study aims to analyze the educational support provided to teachers in public schools in the city of Chimbote in 2024 to address diversity effectively. It is based on the recognition that addressing diversity means responding to the educational needs of all students, regardless of their personal, social, cultural, or academic conditions, which requires constant backing from the education system.

This study is based on current theoretical frameworks on inclusion, equity, and educational support, with the latter understood as the human, material, methodological, and institutional resources available to enhance teachers' work in diverse contexts. The findings show that while there is a generally positive attitude base, limited training and weak institutional support negatively affect the quality and sustainability of inclusive strategies.

Recent studies have emphasized the importance of institutional support for effective inclusive education. Gaibor et al. (2023) argue that the level of inclusion-related training directly influences a teacher's ability to develop differentiated practices. Aramendi-Jauregui et al. (2023) highlight the need to strengthen collaborative work and support networks as essential conditions for an inclusive school. Similarly, Quispe et al. (2023) find a significant relationship between teacher perceptions and inclusive institutional culture, suggesting that any sustainable transformation must involve an organizational component.

The study conducted in Nuevo Chimbote contributes empirical evidence to this discussion. From a sample of 218 surveyed teachers, 53.2% expressed an "ambiguous" perception regarding the institutional support received, while only 36.2% rated it as favorable and 10.6% as unfavorable. These findings reveal an ambivalent reality: although efforts are being made to implement inclusive education, they have yet to become a systematic practice supported by educational institutions (UNESCO, 2020; Cueto, 2019).

This scenario raises a central research question that guides this chapter: What is the level of institutional support perceived by teachers in public schools in Chimbote to address diversity in 2024? To answer this question, the study applies a rigorous methodological design based on a validated Likert-scale questionnaire, with high reliability (Cronbach's alpha = 0.761).

The findings provide a basis for critical reflection and propose actions aimed at strengthening the role of teachers within a diversity-centered educational management framework. Indeed, it is necessary to rethink in-service training systems, institutionalize continuous support spaces, develop inclusive materials, and reinforce the organizational culture from an equity perspective. As Jurado et al. (2021) and Van Steen & Wilson (2020) argue, inclusion is only possible when a collective commitment integrates policies, resources, and institutional will.

This chapter is structured into four main parts: first, an updated theoretical review of diversity and institutional educational support; second, the methodological approach and data collection process; third, the analysis of results; and finally, a set of conclusions and recommendations intended to guide future educational actions and policies.

This contribution aims to support the development of a more just, equitable, and inclusive Peruvian public school system, recognizing diversity not as an obstacle but as an opportunity to transform education from its foundation.

The present research contributes to understanding and improving diversity-related processes in the Peruvian educational context, focusing its analysis on the institutional support provided to public-sector teachers. This chapter seeks to generate context-sensitive and critical knowledge, revealing how institutional conditions directly affect teachers' ability to meet students' diverse needs. In a country like Peru, where structural inequalities in educational access and quality persist, understanding the dynamic between educational support and attention to diversity becomes crucial for developing more inclusive public policies. The analysis draws on empirical evidence collected in urban public schools in Chimbote in 2024, offering insights to advance toward more equitable education. The conclusions presented here underscore the urgency of strengthening teacher support systems from a comprehensive and inclusive perspective.

Addressing diversity involves recognizing and responding to students' individual characteristics, ensuring meaningful and equitable teaching for all. In this regard, educational support is understood as the resources, strategies, and conditions that enable teachers to effectively respond to classroom heterogeneity. Literature indexed in databases such as ScienceDirect has highlighted the importance of consolidating inclusive school environments through educational management oriented toward professional support, access to adapted materials, and the development of differentiated pedagogical capacities. However, in many Latin American contexts—particularly in Peru—teachers face serious institutional limitations that hinder this task.

In public schools in Ancash, attention to diversity requires a comprehensive perspective on available educational support, especially in contexts marked by clear cultural, linguistic, and socioeconomic diversity. Teachers acknowledge that their performance depends heavily on access to qualified human resources such as psychologists, interpreters, support staff, and specialized educators. However, in many rural or peri-urban schools, these resources are either nonexistent or insufficient. As Mfuthwana and Dreyer (2018) state, building inclusive schools requires collaborative teams with clearly defined roles to accompany the educational process and support teaching practices in complex situations. In this sense, teachers in Ancash report that professional isolation limits their capacity to respond effectively to student needs.

Material resources also represent a critical aspect in the development of inclusive practices. In regions like Ancash, many schools lack updated libraries, adapted materials for students with disabilities, accessible educational technology, or appropriate classroom furniture for diverse contexts. This shortage directly impacts the ability to provide meaningful and equitable education. According to UNESCO (2020), inclusive education requires the design and provision of contextualized materials that reflect students' cultural, linguistic, and functional diversity. When these resources are unavailable, teachers are forced to improvise, increasing their workload and emotional burden, ultimately affecting the quality of their teaching.

In terms of methodological resources, teachers in Ancash report an urgent need for practical tools that allow them to effectively adapt their instruction to the diverse realities of their

classrooms. Although many educators demonstrate a positive attitude toward inclusion, they often lack differentiated strategies to support students with special educational needs, varied learning styles, or cultural and linguistic differences. As Martínez et al., (2024) and Jurado et al. (2021) emphasize, the success of inclusive education largely depends on the teacher's methodological competence and their capacity to tailor instruction. Inclusive teaching is not simply about reaching all students, but about addressing each learner's needs individually, with clearly defined goals and a sensitivity to their unique learning paces.

With regard to institutional resources, support from school management, educational policy, and local governance is essential to ensure sustained attention to diversity. In many schools in Ancash, teachers perceive that inclusive policies are not concretely implemented, or that school leadership lacks the pedagogical guidance needed to drive this process. Aramendi-Jauregui et al. (2023) argue that without a coherent and committed institutional structure, individual efforts by teachers are diluted. An organizational framework is needed to promote continuous training, networking, and periodic evaluation of inclusion processes.

Finally, educational support must be conceived as part of an institutional culture that values diversity as an asset, not a problem. This requires transforming the vision of schooling from a standardized model to a humanistic and contextualized approach. As Van Steen and Wilson (2020) highlight, teacher attitudes, combined with institutional and community support, determine the success of any inclusive strategy. In Ancash, geographic and social conditions pose additional challenges but also offer opportunities to innovate based on local cultural identity and to strengthen equitable, intercultural, and inclusive education.

In public schools in Chimbote, attention to diversity has yet to become a systematic and adequately supported practice from leadership or administrative levels. In light of this situation, a guiding research question emerges:

What level of educational support is perceived by teachers in public schools in Chimbote for addressing diversity in 2024?

This question seeks to uncover not only the existence of support but also its relevance, frequency, and effectiveness in everyday pedagogical practice. Accordingly, the general objective is: To analyze the level of educational support received by teachers in public schools in Chimbote to address diversity in 2024. The working hypothesis is: Teachers in public schools in Chimbote perceive a moderate level of educational support to effectively address classroom diversity.

The study employed a quantitative approach, with a descriptive scope, using a non-experimental, cross-sectional design. The target population consisted of 500 teachers from public regular basic education institutions in urban areas of Chimbote, Peru. A representative sample of 218 teachers was selected through stratified probabilistic sampling. Data were collected using a Likert-scale questionnaire that explored four key dimensions: teacher training, pedagogical resources, institutional support, and participation in support networks.

The instrument was validated through expert judgment, ensuring its reliability. Data analysis was conducted using statistical software, which enabled the calculation of measures of central tendency and frequency distributions. The validation process of the Teacher Perception Questionnaire was carried out through expert judgment by a panel of five specialists in educational research and inclusive pedagogy, who evaluated the instrument in terms of content relevance, clarity, and consistency.

A pilot test was subsequently conducted with 30 teachers from a school outside the study sample, which allowed us to refine the wording of some items. Regarding reliability, Cronbach's alpha reached an overall value of 0.761, while the coefficients by dimension ranged between 0.73 and 0.79, with 95% confidence intervals, confirming the internal consistency of the scale. In addition to descriptive measures (frequencies and central tendency), inferential analyses were applied: chi-square tests to examine associations between categorical variables and ANOVA to contrast differences in perceptions according to teaching experience and school type. These additional procedures enhanced the robustness of the results and provided stronger empirical support for the study's conclusions.

The findings reveal that a high percentage of teachers perceive professional development opportunities on addressing diversity as insufficient. Additionally, there is a limited availability of adapted educational materials and infrequent access to high-quality, specialized pedagogical support from school leadership or local education management units (UGEL). Nevertheless, a significant proportion of teachers report the existence of informal collaboration networks among colleagues, which serve as a key support mechanism for implementing inclusive practices.

Table 1

Level of Institutional Support for Diversity Attention among Teachers in Public Schools in the Urban Area of Nuevo Chimbote, 2024

Category	Frequency	Percentage
Unfavorable	23	10.6%
Ambiguous	116	53.2%
Favorable	79	36.2%
Total	**218**	**100%**

Note: Based on the Teacher Perception Questionnaire.

Conclusions

Diversity attention cannot be consolidated without a clear policy framework that supports teachers. This research provides empirical evidence that highlights the urgent need to strengthen institutional support systems from a systemic perspective. It is therefore recommended to design continuous professional development programs in inclusive education, reinforce pedagogical support teams in schools, and promote effective monitoring and evaluation mechanisms for the support provided. In this way, progress can be made toward an inclusive and equitable education that recognizes diversity as a strength rather than a challenge.

There is a clear need to enhance local educational support policies by increasing the quality of teacher training, optimizing instructional resources, and promoting inter-institutional support networks. It is essential that schools are equipped with a robust system of pedagogical and technical support that ensures inclusive, equitable, and quality education for all students. This research offers relevant inputs for educational decision-making and for improving institutional management in urban contexts within the region.

The findings highlight the urgent need for education authorities to institutionalize continuous professional development in inclusive pedagogy, strengthen pedagogical support teams within schools, and allocate resources for adapted materials. These measures would not only improve teachers' daily practice but also provide concrete guidelines for local education management units and policymakers to design equity-oriented strategies that ensure sustainable inclusive education.

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Neurodivergence and Design Education: The Reality of a Non-Inclusive Higher Education System

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This text arises from a project developed at PUCE (Pontificia Universidad Católica del Ecuador), entitled "Adaptation and Enrichment of the Higher Education Experience for Neurodivergent Students on the Autism Spectrum."

Introduction

Although precise global data on neurodivergent students in higher education are limited, estimates suggest that 15–20% of the population presents some form of neurodivergence (Doyle, 2020). Despite this, many universities still operate under traditional teaching models that seldom accommodate cognitive diversity, causing inclusion policies to coexist with practices that overlook neurodivergent learning profiles. As Armstrong (2012) notes, many barriers arise not from students' learning capacities but from educational structures that fail to recognize neurological variability such as dyslexia, ADHD, and autism spectrum conditions. Similarly, Silberman (2016) emphasizes that higher education has been slow to acknowledge these diversities, with progress largely driven by neurodivergent individuals and their families. The concept of neurodiversity reframes these conditions as natural variations of human cognition and sources of creativity, innovation, and alternative reasoning (Armstrong, 2012; Grandin, 2013). From the perspective of neuroplasticity, learning potential is not fixed but shaped by experience and context (Doidge, 2007), challenging the notion that neurodivergent learners are limited to technical or analytical domains. In this context, the present project aims to enrich the educational experience of neurodivergent students—particularly those with Autism Spectrum Disorder levels 1 and 2—within design-related programs at the Faculty of Habitat, Infrastructure, and Creativity of the Pontificia Universidad Católica del Ecuador. It also considers cases of double and triple exceptionality, where high intellectual or creative potential coexists with learning differences (Assouline et al., 2010; Baum, Schader & Hébert, 2017). The project proposes pedagogical, technological, and spatial strategies that foster inclusive, accessible, and supportive learning environments responsive to diverse cognitive processing styles.

Theoretical framework and Case Study

The concept of neurodiversity, introduced by Singer (1998) and further developed by Armstrong (2012) and Silberman (2016), reframes conditions such as autism, ADHD, and dyslexia as natural variations of human cognition rather than deficits. This paradigm challenges dominant deficit-based educational models, which in higher education often privilege linear reasoning and standardized performance, marginalizing neurodivergent students and overlooking their creative

and systemic capacities (Doyle, 2020; Fletcher-Watson & Happé, 2019; Baron-Cohen, 2020). Neuroscientific research highlights strengths frequently associated with neurodivergence, including pattern recognition, divergent thinking, and visual–spatial reasoning, particularly relevant to design and artistic disciplines (Grandin, 2013; Frith, 2022). The principle of neuroplasticity further supports the need for flexible and adaptive learning environments (Doidge, 2007), aligning with Morin's (1990) theory of complex thinking and its emphasis on interconnected, non-linear knowledge. Building on these theoretical foundations, the project adopts Universal Design for Learning (UDL; CAST, 2018) alongside project-based approaches such as User-Centered Design, More-than-Human Design, and Integrated Design to foster inclusive and participatory learning experiences (Norman, 2013; Cross, 2011; Giaccardi, 2019). The study was conducted at the Pontificia Universidad Católica del Ecuador (PUCE) with 15 first- and second-year students from Architecture, Graphic Design, Product Design, and Arts programs. The sample included students with autism spectrum disorder, ADHD, ADD, dyslexia, and dysgraphia, with particular attention to ASD levels 1 and 2 (APA, 2022), as well as cases of double and triple exceptionality where high creative potential coexists with learning differences (Assouline et al., 2010; Baum et al., 2017). In line with Armstrong's (2012) definition of neurodiversity, the study advocates for pedagogical approaches that move beyond accommodation toward inclusive models that recognize neurodivergent strengths as integral to creativity, innovation, and collective knowledge production.

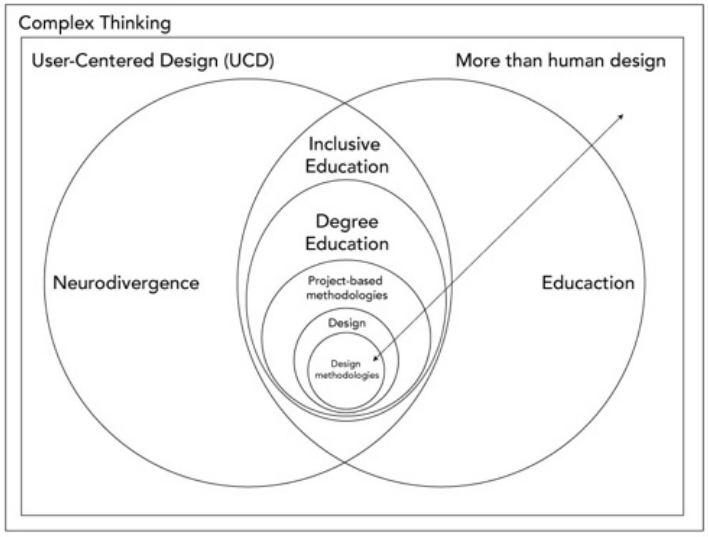

Figure 1. Complex Conceptual Map of the Project's Methodological Approach. This figure shows the interconnections between neurodiversity, inclusive education, complex thinking, project-based methodologies, and user-centered and more-than-human design within the proposed framework. Author's own elaboration based on Singer (1998), Armstrong (2012), Morin (1990).

This study forms part of the broader research project *Adaptation and Enrichment of the Higher Education Experience for Neurodivergent Students on the Autism Spectrum* (Pontificia Universidad Católica del Ecuador [PUCE], 2024), developed through an interdisciplinary collaboration between PUCE and the Escuela Politécnica Nacional. The project involved faculty

and students from Graphic Design and Engineering, as well as specialists in educational inclusion, therapy, and medicine, ensuring a comprehensive approach to neurodiversity in higher education. A mixed-methods design was employed to capture both experiential and measurable dimensions of academic engagement, integrating User-Centered Design, More-than-Human Design, and Integrated Design as its methodological framework. Data were collected over a six-month academic period through semi-structured interviews (Milton, 2020), ethnographic observations, and Likert-scale surveys assessing perceptions of the academic environment. Interviews were conducted individually at the end of each academic term, either in person or online, while ethnographic observations documented behaviors and interactions during regular academic activities. Surveys were administered online at two key stages to identify changes over time and were complemented by institutional attendance and academic performance records. Qualitative data were analyzed using inductive thematic analysis (Braun & Clarke, 2006) with NVivo 14, while quantitative data were organized into frequency matrices and descriptive correlations. Given that neurodivergent individuals constitute a vulnerable population, all procedures adhered to strict ethical standards and were adapted to participants' sensory and behavioral profiles. These adaptations included advance access to interview questions, low-stimulation settings, and accessible survey formats using pictograms and video prompts. Overall, the methodology reflects an inclusive research design that positions neurodiversity not as a limitation, but as a source of pedagogical insight and innovation.

The research identified recurring academic and contextual barriers affecting neurodivergent students' performance in design education. At a cognitive and methodological level, students showed difficulties in understanding design as an abstract and iterative process, particularly when moving beyond concrete instructions toward conceptual thinking. This was reflected in limited application of empathy-based design methodologies and a tendency to approach creativity as a fixed ability rather than a developable process, constraining ideation and problem-solving. Additionally, challenges related to time management, attendance, and sustained classroom engagement were observed, leading to delayed submissions, irregular participation, and increased academic stress. While some of these difficulties are associated with characteristics of specific neurodevelopmental diagnoses, the findings highlight the role of systemic factors. Notably, the abrupt transition from educational settings with individualized support to higher education environments with limited structured accommodations, combined with insufficient faculty training in neurodiversity and inclusive pedagogies, reinforced these barriers through rigid curricular and assessment practices. Findings reveal that higher education continues to offer limited accessibility for neurodivergent individuals, largely because neurodivergence remains one of the least visible dimensions of inclusion (Silberman, 2016; Doyle, 2020). While physical adaptations like ramps or braille signage are increasingly common, curricular and methodological adjustments are still rare (Armstrong, 2012; Richardson, 2022). Traditional lecture-based models persist, restricting the flexibility required to address diverse cognitive profiles (Morin, 1990; Thomas & Harden, 2008). Therefore, the inclusion of neurodivergent students must transcend physical or technological accommodations and evolve toward a systemic transformation of pedagogy and institutional culture—grounded in Universal Design for Learning and genuine awareness of neurodiversity (Rose & Meyer, 2002; Singer, 1998).

Faculty Selection Process for Inclusive Education

Considering the above, the first tool developed in this research project was a diagnostic survey aimed at identifying faculty members whose pedagogical profiles align with inclusive education for neurodivergent students. The survey was administered during the initial phase of the study, prior to the implementation of any intervention, and was distributed online to ensure accessibility and consistency in data collection. The instrument was designed based on pedagogical frameworks of inclusive education and Universal Design for Learning (UDL; CAST, 2018), as well as psychological perspectives grounded in the neurodiversity paradigm. Its construction was informed by previous research on teachers' beliefs, attitudes, and self-efficacy regarding diversity and inclusion (Sharma et al., 2018), and incorporated psychological constructs such as empathy, executive functioning, and cognitive flexibility, which are critical for understanding and supporting neurodivergent learning processes (Armstrong, 2012). The survey combined Likert-scale items with open-ended questions, enabling both quantitative assessment and qualitative reflection on faculty teaching practices and readiness to implement inclusive strategies. This step recognizes that not all educators possess—or are necessarily expected to possess—the specific competencies, dispositions, and reflective awareness required to teach neurodivergent learners effectively (Florian & Black-Hawkins, 2011; Norwich, 2014). The purpose of this instrument is therefore to detect strengths, biases, and potential areas for professional development in inclusive pedagogical practices within higher education. Before administering any questionnaire, it is essential to clarify that higher education—like primary and secondary education—must adopt comprehensive frameworks such as Universal Design for Learning (UDL) and Individualized Reasonable Accommodation Plans (PIAR), which promote classrooms that value all forms of intelligence and diverse cognitive processing styles (Rose & Meyer, 2002; CAST, 2018). Implementing these approaches ensures that inclusion transcends mere compliance and becomes a pedagogical commitment to equity, flexibility, and cognitive justice (Morin, 1990; Richardson, 2022).

Mobile Application

These participatory design aim to guide co-creation sessions with neurodivergent students, faculty, and specialists. They help gather ideas, requirements, and preferences directly from end-users to ensure the app's usability, accessibility, and relevance.

Within the broader project "Adaptation and Enrichment of the Higher Education Experience for Neurodivergent Students on the Autism Spectrum," this study explores the role of assistive digital technologies in promoting autonomy and inclusion in higher education. A customized mobile application was developed as a prototype to address key challenges faced by neurodivergent students—particularly in self-regulation, communication, and sensory balance. The app transforms a standard smartphone into a personalized pseudo–operating system that adapts its visual and functional interface to each user's neurocognitive profile. Visually, it minimizes sensory overload by controlling brightness, applying a monochromatic palette, and integrating a dyslexia-friendly typeface with enlarged text and simplified navigation. Functionally, it prioritizes essential communication tools, limits distracting applications, and adjusts auditory output to match individual sensory sensitivity. Emotional regulation features

include filtering ambiguous or distressing messages, content moderation, and an accessible "panic button" connected to support networks. The phone case also serves as an emergency identification card, containing essential medical and contact data. Grounded in Universal Design for Learning (CAST, 2018) and user-centered innovation frameworks (Norman, 2013; Giaccardi, 2019), the system aims to foster autonomy, emotional stability, and equitable participation through inclusive digital design. Currently, the app functions as a prototype focused on interface usability and sensory adaptation. Future development aims to incorporate artificial intelligence and Arduino-based biometric sensors capable of monitoring physiological indicators such as heart rate variability and attention span. These inputs would enable predictive responses—activating calming stimuli or alert systems—to prevent stress or anxiety crises. The long-term goal is to create a responsive, intelligent support ecosystem that dynamically adapts to each student's cognitive and emotional state.

Sensory Installation

The proposed sensory installation seeks to raise awareness about the lived experiences of neurodivergent individuals by allowing visitors to temporarily experience aspects of neurodivergent perception through controlled sensory stimulation. Using augmented and virtual reality technologies, the installation recreates phenomena such as visual and auditory overstimulation, prosopagnosia (face blindness), intrusive inner speech, and thermal dysregulation within a safe, ethically guided environment. This immersive experience aims to foster empathy by demonstrating that understanding difference requires more than observation—it requires embodied awareness. By grounding the simulation in real neurocognitive processes, the project challenges stereotypical portrayals of neurodivergence and promotes a more accurate appreciation of its complexity. Ultimately, it seeks to contribute to a cultural shift toward inclusion, positioning neurodiversity as an inherent dimension of human variability rather than a deviation from it (Grandin, 2019; Singer, 1998).

Methodological Adaptations

It is well known that explaining design methodologies is inherently complex, as they constitute a process deeply rooted in human nature and connect complex thinking, creativity, and problem-solving (Cross, 2011; Lawson, 2006). However, to achieve genuine inclusion in the classroom, it is essential first to carefully adjust the project topics (Morin, 1990). For example, projects oriented towards user profiles that are too far removed from the students' own realities are not advisable. In contrast, when common points such as age range, lifestyle, or socioeconomic background are maintained, outcomes tend to be more favorable because interaction and empathy with others are facilitated (Norman, 2013). Likewise, projects that do not directly rely on a human factor can also be suitable and rewarding in neurodiverse contexts (Armstrong, 2012). For instance, projects focused on processes and production, innovation, strategy, environmental topics, or interdisciplinary approaches enable the design of educational experiences adapted to the cognitive characteristics of each student (Singer, 1998). Such themes are more flexible for a neurodiverse classroom because they allow students to focus on solving concrete problems from multiple perspectives, without the additional pressure of interacting with contexts that may be overly unfamiliar or emotionally demanding. Regarding the methodologies, depending on the

focus of the project, the work could be approached as follows:

Conclusions

Achieving genuine inclusion in higher education requires a deep transformation of teaching practices and institutional structures—from standardized models toward pedagogical, technological, and spatial strategies that acknowledge neurocognitive diversity (Armstrong, 2012; Silberman, 2016). This shift entails not only curriculum redesign but also a rethinking of the epistemological foundations of education to embrace complexity and multiple ways of knowing (Morin, 1990; UNESCO, 2020). Findings from this pilot study highlight that inclusive technologies and adapted methodologies can strengthen students' sense of belonging and autonomy, while targeted faculty training fosters more empathetic and effective teaching practices (Florian & Black-Hawkins, 2011; Booth & Ainscow, 2011). These results align with the principles of Universal Design for Learning (CAST, 2018) and the broader call to move beyond accommodation toward the co-creation of pedagogies that value neurodivergent strengths as drivers of creativity and innovation (Singer, 1998; Grandin, 2013; Frith, 2022). The sensory installation also demonstrated the potential of immersive, affective learning experiences to promote empathy and social understanding, helping neurotypical individuals grasp the complexity of neurodivergent perception (Doyle, 2020; Baron-Cohen, 2020). Future research should expand this interdisciplinary approach to other faculties and evaluate the long-term impact of these strategies on emotional well-being, academic performance, and institutional culture (Doidge, 2007). Ultimately, inclusion must be conceived not as a symbolic gesture but as a structural and continuous commitment that views diversity as a collective source of cognitive and social enrichment (Morin, 1990; Armstrong, 2012; UNESCO, 2020).

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Evaluative approaches and practices in an intercultural framework from a perspective of social justice

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Introduction

The limited development of intercultural dialogue in the evaluative dimension from a social justice framework is based on some key aspects: 1) the Eurocentric and monocultural nature of the Latin American school education system, which has its origins in the creation of modern educational systems, constituting a dominant, hegemonic (Darder, 2022), and Westernized (Condori, 2021) school culture. This is proposed with the aim of making invisible the cultural and linguistic heterogeneity of those colonized territories and being accountable to the colonial empire (Spanish, French, Portuguese) (Mampaey and Zanoni, 2016; Quintriqueo et al., 2015). This promoted racial and cultural domination and hierarchization, as well as the way in which work was given meaning in pursuit of progress, which in schools was reflected in the establishment of a philosophical discourse on race and education (Boyer, 2013; Rodríguez and Zumbi, 2022). In the current Latin American educational scenario, we observe the search for the construction of a single republic, without divisions, sustained by colonialism in its political and symbolic ideology (Boyer, 2013); 3) the decontextualized initial teacher training of the indigenous realities of the territories where the school is located. According to Heeren (2019), in a study carried out in educational institutions with students who identify as indigenous, teachers evidence the use of discriminatory, monocultural, racist, and Eurocentric discursive strategies, designating social actors from a deficit, with negative traits and lacking knowledge. "The description of social actors in the sermons shows a discriminatory evaluative discourse that is generated in a struggle between us (teachers) with positive evaluations and them (Mapuche students) with negative evaluations" (p. 16). In this sense, schools are permeated by racism inherent to race, based on biological origin, a racism linked to gender, based on a patriarchal society, a racism that is also expressed economically, in a savage and competitive capitalism, and, of course, in an epistemological racism that grants supremacy to knowledge originating in the West (Rozo, 2021). Consequently, social inequalities and injustices are exacerbated in the social, cultural, political, economic, and educational spheres. To address the problems described in the Latin American context, it is necessary to incorporate a social justice approach into the educational field, recognizing interculturality as a key aspect in the comprehensive training of teachers with the aim of promoting professional capacities through the co-construction, participation, and recognition of the agents involved in the educational development of students from socioculturally diverse contexts. This requires an educational approach focused on the individual pace of learning, under appropriate flexibility of the country's curricular foundations. Interculturality must be considered from a critical perspective (Walsh, 2010) that promotes the student's educational space, from its linguistic, territorial, cognitive, social, and cultural

dimensions, abandoning functional views and the folklorization of the student's sociocultural context.

Educational Assessment, Interculturalism, and Social Justice

In the field of assessment, it has been proven that assessment activities require time and dedication. In this context, some studies indicate that up to 40% of classroom time is directly allocated to assessment. The global scientific literature also indicates that teachers are not thoroughly prepared to undertake assessment activities (Wang et al., 2009). Currently, educational research proposes the need to implement new ways of approaching assessment, focusing attention on the learning and practices involved (Black & Wiliam, 2009; Brown et al., 2009). In this regard, the implementation of contextualized assessment for improvement requires its deliberate use to identify students' learning needs that have not yet developed, leading to potential improvements in assessment practices (Brown & Hattie, 2012). The findings of these authors are relevant because they could enhance and strengthen student and teacher learning, especially in the context of intercultural classrooms, by establishing assessment practices that consider the social and cultural context of the educational community, assigning relevance and meaning to the teaching-learning process. Furthermore, the reasons underlying those who apply pedagogical practices are directly related to the ideology of the actor in these processes, the teacher, since the position they adopt will not be devoid of a conception that can be combined with a position of fixed, clean, and impartial assessment (Casanova, 1995). In this sense, the curriculum itself represents an ideological stance that underlies the formal curriculum generated by the State. In effect, it represents an ideological stance from the way it is used, and it represents an ideological stance in the incorporation of guidelines that come from the sociocultural construction of the teacher. Thus, the type of evaluative rationale used by teachers can impact, and in some cases, affect, the student's academic trajectory, since behind their practice lies a hidden curriculum that carries the ideological position that is shaped by theoretical, conceptual, and practical aspects (Ríos Muñoz, 2007).

Regarding the functions that evaluation can fulfill in society and for students, Elola et al. (2010) suggest that evaluation could, on the one hand, develop a functional character for obtaining a grade and generating the completion of a program; that is, a symbolic function. Or, it could serve a political function, capable of generating feedback that enables decision-making. It can also be conceived as a knowledge function, enabling the understanding of highly complex processes and generating new knowledge about the subject being evaluated. Furthermore, evaluation could serve a role that contributes to the improvement of educational processes, combining a political and knowledge function, to establish capacities in the school system and foster the development of coherent and context-appropriate evaluation practices. This is because in a national context where standardized tests govern the way teaching and learning occur, the assessment implemented becomes crucial, since standardized tests measure mastery of content achieved in a subject (Sunkel and Trucco, 2010). These conditions are essential for the successful development of the learning process in any subject, considering that what should be assessed are skills, not content.

There are several international models that employ an intercultural educational approach for indigenous and migrant populations, although they are primarily focused on secondary and higher education, leaving an opportunity for advancement at the preschool and primary levels.

In Mexico, the "Design of Bilingual Intercultural Materials" project seeks to strengthen the Intercultural Inductive Education Network (REDIIN). This project offers educational resources for teachers in intercultural contexts at the preschool, preschool, and primary levels, through diplomas, workshops, and laboratories based on interlearning between indigenous and non-indigenous teachers, using Jorge Gasché's Intercultural Inductive Method.

In Chile, research by the Center for Research in Indigenous and Intercultural Contexts (CIECII) has highlighted the problems and consequences of a Eurocentric monocultural education in Mapuche communities, highlighting the importance of including Mapuche cultural knowledge in the educational curriculum. The Chilean Ministry of Education's (MINEDUC) Intercultural Bilingual Education Program (PEIB) seeks to recognize and value Indigenous cultures through the use of their languages alongside Spanish in areas with a high Indigenous population density. Since 2013, Indigenous Language classes have been required in schools with more than 20% of students of Indigenous descent.

In North America, the University of Ontario and the Ontario government have promoted education for Indigenous students through partnerships with Indigenous communities, training and mentoring, and cultural awareness services in educational institutions. In Hawaii, the Department of Education implemented a program to promote Hawaiian culture, language, and history under the Nā Hopena A□o policy. In New Zealand, the "Te Kotahitanga" model is based on improving teaching practices and the performance of Māori students, emphasizing the importance of good relationships between students and teachers.

The purpose of this study is to critically analyze educational assessment approaches and practices in intercultural contexts from a social justice perspective that integrates equity, recognition, and participation. Therefore, this paper focuses on the theoretical and empirical literature that delves into assessment approaches and practices within intercultural educational contexts, identifying the concepts of equity, recognition, and participation from a social justice framework. The methodology employed is a qualitative, critical-interpretative study, conducted through a documentary review and comparative theoretical analysis of different sources: articles (Scopus, Wos, and Scielo), laws, books, and archives from different libraries. The study analyzes the scientific literature on educational assessment, interculturality, and social justice, systematizing international experiences such as those of Mexico, Chile, Hawaii, New Zealand, North America, Peru, and Colombia on assessment in intercultural contexts. This systematization will be recorded in an analytical matrix based on the axes of the social justice framework. The study is descriptive in nature, and the proposed methodological strategy for analyzing the representations of evaluative approaches and practices in a global intercultural context found in the literature review is through discourse analysis (Van Dijk, 2014). This approach begins with the recording of context units, which constitute an interpretive framework. This does not include the entire textual corpus, that is, the entire document. The corpus selection criteria are: a) Applied research in diverse educational contexts linked to the category of intercultural evaluation

approaches and practices. b) Representations of evaluative approaches and practices in intercultural contexts linked to different pedagogical practices: content (definitions, concepts, etc.) and activities (production, writing, etc.). The discourse analysis of the applied research articles focused on the pragmatic level, to achieve explicit and implicit representations of evaluative approaches and practices in an intercultural context.

The pragmatic level is directly related to speech acts linked to the subject. These acts are concretely evidenced as intentional actions that have implications for people's knowledge, behaviors, and opinions. This level of analysis allows us to understand the power relations and effects between the senders and receivers of a discourse. At the pragmatic level, the focus was on speech acts that, according to Searle (1969), are related to the concrete realization of language; examples of these are statements, commands, the generation of questions, commitments, among others.

There is empirical evidence worldwide regarding the way in which assessment has been addressed in intercultural contexts. In this regard, in the North American context, long-standing and ongoing detrimental effects of standardized assessment policies and practices on the educational outcomes of countless Indigenous students have been revealed (Chavers & Locke, 1989; Nelson-Barber & Estrin, 1995). In this sense, the assessment method implemented does not consider the potentially important knowledge and understanding of Indigenous students. This is further exacerbated by assessment policies that do not respond to the knowledge and understanding of Indigenous students. In this regard, some researchers have questioned the validity of assessment in an intercultural context (Nelson-Barber et al., 2005), and others have questioned the cultural congruence of assessments with the values of Indigenous students' communities of origin (Demmert, 2005; Nelson-Barber & Estrin, 1995).

Empirical evidence from a North American context with Navajo students shows that teachers who developed contextualized assessment practices obtained better results with their Indigenous students; specifically, they obtained different evaluations of their students (Nelson-Barber & Trumbull, 2007). This study reveals that teachers who implemented assessment practices from a bicultural perspective achieved better results than those who did not with their Indigenous students. Continuing with empirical evidence, in the Māori context, it was revealed that evaluative approaches implemented by agents external to the Māori themselves center evaluative practices on difference, competition, and access issues. Meanwhile, Indigenous evaluators belonging to Indigenous communities who developed evaluation approaches in Indigenous research models such as Te Kotahitanga center evaluation praxis on broader struggles such as sovereignty and self-affirmation of Indigenous students' identity (Cavino, 2013). In this sense, the evaluator's role centers on the practice of reciprocity, care, and love (Bishop, 1999; Jones et al., 2006).

In the Latin American context, there is evidence that indigenous students who use their language are valued differently. An example of this is what Zavala (2018) reveals with Quechua students in Peru, as their language has been associated with social and political marginalization, economic poverty, and evaluation practices linked to poor academic performance. In this context, some researchers have pointed out the risk that the Intercultural Bilingual Education program, used

exclusively in elementary education, runs in relation to the appreciation of the use of the Quechua language, becoming a tool of social reproduction (García, 2005; Trapnell and Zavala, 2013). This highlights the importance of language teaching and learning, as it is not an exclusively technical process; it also involves relations of power, identification, and prohibition (Duff, 2011). In this sense, the practice of using the Quechua language has become a practice of discrimination (Zavala, 2018). In the Mexican context, as pointed out by Schmelkes (2018), in 2006, a situation was first evidenced in which the use of a standardized assessment in indigenous students was officially questioned through a lawsuit process, alleging cultural bias in the instrument called ENLACE. This lawsuit was brought before the Council for the Prevention of Discrimination (CONAPRED).

Within the social justice tradition, the distributive, participatory parity, and justice-as-recognition approaches stand out. Within the distributive approach, based on liberalism, John Rawls (2019, 2018) is one of the most representative, with his concept of social justice as equity. This approach promotes the equitable distribution of resources and goods, grounded in a contractualist epistemology, which has generated a currently contested economic-political structure. In Latin America, the education system is based primarily on principles of subsidiarity and freedom of education, privatization, and social, cultural, and economic segregation. This approach is related to the social justice approach of distributing goods and services based on meritocratic equality of opportunity (Rawls, 2018), which has led to the creation of standardization systems and a liberal structure of the evaluation system that regulates the education market. This framework invites us to consider equitable redistribution to compensate for inequalities. Nancy Fraser's participatory parity approach (Fraser and Honneth, 2006; Fraser, 2008a, 2008b; Butler and Fraser, 2016) addresses injustices in three dimensions: denial of goods and resources (redistributive justice), hegemonic value patterns that affect social status (recognition justice), and political representation (representational justice). Justice is achieved when people can participate on equal terms (Fraser, 2006).

Axel Honneth's (2011) Social Justice as Recognition approach is based on three normative principles: love, legal or equal treatment, and social merit. These principles correspond to the emotional, cognitive, and social spheres, respectively, and are based on reciprocal recognition between individuals. In educational assessment, these approaches help understand injustices and discrimination, especially in diverse educational contexts. The transformative assessment paradigm (Mertens, 2018) seeks to reverse the injustices caused by the political-economic structure for marginalized groups. In education, it translates into an assessment based on social justice and human rights, which questions the power structure of the educational system and proposes transformative actions in teaching and assessment practices (criteria, procedures, methods), especially for indigenous students, students with disabilities, and immigrants, among others. This paradigm includes axiological, ontological, methodological, and epistemological components and has been highly valued by international agencies, ministries of education, and public policy centers.

The theoretical approach to student assessment for social justice (Hidalgo and Murillo, 2016) complements a multidimensional social justice approach composed of three key elements: redistribution, recognition, and participation. This approach promotes equitable, democratic,

and critical education and challenges traditional assessment to propose an approach that responds to diverse needs and contexts. McArthur (2019, 2020) also focuses on social justice in educational assessment, highlighting the importance of participation in evaluative decision-making. In short, the goal is to move toward an educational assessment that transcends traditional paradigms and positions itself within a transformative paradigm (Mertens, 2018).

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DUA-Math: an adaptive AI tutor based on universal design for learning for students with visual impairments

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Introduction

Artificial intelligence (AI) has been a topic of public discussion for decades, often associated with ideas taken from science fiction films, where advanced machines replace humans and completely transform the way we live. Although these portrayals tend to be exaggerated, the reality is that AI is already among us and has become a regular part of our daily lives. Today, it is no longer a technology of the future, but a key tool for many companies, healthcare systems, and governments around the world. This shift has sparked renewed academic interest, no longer focused solely on how AI works or how efficient it is, but on the implications and effects that its use is generating across various domains (Dwivedi *et al.*, 2021).

Various authors have proposed different definitions of AI, all sharing a common idea: it refers to non-human intelligence designed to perform specific tasks. According to Russell & Norvig (2016), AI consists of systems capable of imitating cognitive functions traditionally associated with human beings, such as learning, language, and problem-solving. A broader definition is offered by Kaplan & Haenlein (2019), who emphasize AI's ability to interpret data from the environment, learn from it, and adapt flexibly to achieve specific goals. Thanks to the use of massive data volumes, there are now highly efficient algorithms capable of performing specialized tasks such as autonomous driving, gaming, and activity scheduling. This reflects a more practical orientation of AI, in contrast to the still-unrealized attempts to develop AI with human-like thinking or emotional capacity (Hays & Efros, 2007; Russell & Norvig, 2016). In general, all definitions converge on the idea that machines are increasingly capable of performing functions traditionally carried out by humans, both in the workplace and in society at large.

AI's ability to overcome certain human limitations (whether computational, intellectual, or even creative) has opened new avenues for its application in fields such as education, marketing, healthcare, finance, and industry. This has had a significant impact on productivity and performance. More and more organizations are adopting AI-driven systems, which are deeply transforming business operations and manufacturing processes, while expanding their reach into areas previously considered exclusively human domains (Daugherty & Wilson, 2018).

Generative Artificial Intelligence in Education

Generative artificial intelligence (GenAI) has emerged as a disruptive technology with significant transformative potential in the field of education, as it enables new forms of personalized learning, content creation (such as images, sounds, and videos) data analysis, and code generation (Chiu, 2023; O'Dea *et al.*, 2024). Unlike other forms of AI that mimic human cognitive functions like learning and problem-solving based on programmed rules, GenAI is characterized by its ability to generate content automatically from instructions written in natural language. It operates using large language models (LLMs), which are trained on massive datasets drawn from the internet, social media, and various databases. As a result, it can produce texts and responses in a conversational style that closely resembles human language (Yan *et al.*, 2024). Recent research has highlighted multiple opportunities (as well as challenges) associated with integrating generative AI, particularly tools like ChatGPT, into educational contexts.

Levin *et al.* (2024), for instance, compiled empirical evidence from 19 studies demonstrating how this technology has been used in assessments, suggesting that similar tools could support learning across various domains of knowledge. Similarly, Lo (2023) analyzed 50 publications and highlighted the potential of ChatGPT as a pedagogical assistant and virtual tutor, adaptable to diverse educational needs. Vargas-Murillo *et al.* (2023) emphasized its usefulness in facilitating students' learning processes, while cautioning about the risk of excessive reliance on its responses. Zhang & Tur (2024) pointed out that this tool can also be valuable for educators in curriculum design and in the personalization of learning, although they stressed the importance of maintaining academic integrity and the quality of generated content. Finally, Lo *et al.* (2024), after reviewing 72 studies, noted that ChatGPT can enhance students' emotional, behavioral, and cognitive engagement, fostering positive feelings such as satisfaction and enjoyment during the learning experience.

Universal Design for Learning (UDL)

Authors such as Sulaiman & Tahar (2024) state that Universal Design for Learning (UDL) is an approach aimed at improving and optimizing teaching and learning processes for all individuals, based on scientific knowledge about how humans learn (UNESCO, 2020). This framework promotes the development of educational goals, materials, methods, and assessments that are accessible from the outset, allowing any student to participate, develop skills, and enjoy the learning process (Balta *et al.*, 2021). The inclusion of students with Special Educational Needs (SEN) in mainstream classrooms has shown academic benefits, such as improved mastery of school skills and progress in social development. Moreover, their presence does not negatively impact the performance of other students, provided that time and instructional planning are properly managed. Taken together, inclusive education and UDL have the potential to enrich the educational experience for all learners. While inclusive education focuses on equitable access to learning opportunities, UDL serves as a tool for designing educational processes that respond to the diversity of learning styles and ways of understanding.

Teachers adapt their instruction to address the diversity of learning styles and abilities in the classroom, using alternative materials, varied strategies, and individualized support (Gronseth et

al., 2021). Universal Design for Learning (UDL) facilitates this process by promoting multiple means of engagement, representation, and expression, allowing students—especially those with special educational needs—to learn in ways that match their strengths, interests, and goals. Flexible assessment options, such as projects or tech-supported activities, give learners the chance to demonstrate knowledge according to their own pace and style. Applying UDL fosters inclusive environments that enhance self-efficacy, particularly among SEN students, whose sense of capability and motivation increases when they experience meaningful academic progress (Lowrey et al., 2019).

Challenges in Learning Mathematical Functions for Students with Visual Impairments

Several studies have shown that learning mathematical concepts such as linear functions present significant barriers for students with visual impairments, due to the strong reliance on visual elements such as Cartesian graphs, symbolic equations, and spatial representations. For example, Maćkowski *et al.* (2023) developed an adaptive platform based on conceptual graphs and tactile feedback, which improved the academic performance of blind students in mathematics by 14%, by facilitating the understanding of abstract structures through accessible formats such as audio and braille. Similarly, Zantout *et al.* (2020) proposed an interactive environment for teaching linear algebra to visually impaired learners, demonstrating improvements in autonomy, confidence, and performance through accessible interfaces. From a more pedagogical perspective, Steinbach (2022) emphasized the importance of multisensory strategies in the teaching of mathematical functions, arguing that accessibility must go beyond technical adaptations and instead require a fundamental redesign of educational practices. Finally, the report by Lo *et al.* (2024) on ChatGPT in school settings suggests that intelligent systems can play a key role in personalizing mathematics learning when designed with inclusive principles from the outset. These findings highlight the urgent need for educational tools like DUA-Math that integrate the principles of UDL with explainable AI capabilities, in order to offer accessible, adaptive, and meaningful learning experiences for blind or low-vision students across educational levels.

Context description

The proposal for the adaptive tutor DUA-Math emerges in response to the challenges faced by students with visual impairments in learning mathematics at the secondary education level. In many school contexts across Latin America, this group of students accesses content that is not always designed with their sensory, cognitive, and technological needs in mind. Specifically, addressing concepts such as linear or affine functions presents an added difficulty, as much of the instructional material relies on visual representations such as Cartesian graphs, tables, and written equations. In this context, teachers also report limitations in adapting content to accessible formats or using assistive technologies with a pedagogical focus. Despite progress in inclusive education, structural and methodological barriers persist, restricting the full participation of these students in the classroom. It is in this scenario that the convergence of UDL and AI offers a real opportunity for transformation. The project is therefore situated within an educational context that requires not only guaranteeing access to curricular content but also

providing a personalized, understandable, and engaging learning experience that fosters autonomy and the development of mathematical thinking. DUA-Math is envisioned as a tool that addresses this need, aligning technological innovation with inclusive pedagogical principles.

From a software development perspective, DUA-Math is currently in the design and technical planning phase, with a focus on accessibility and pedagogical adaptability. The prototype is being conceived under a modular architecture that allows for the integration of an accessible web interface with a backend system based on artificial intelligence. The use of standard web technologies (HTML5, CSS, JavaScript) compatible with screen readers is planned, along with accessible formats for the representation of mathematical expressions, such as MathML or LaTeX rendered with enhanced accessibility. In the natural language processing component, the implementation of a transformer-based model trained with mathematical corpora in Spanish is envisioned, enabling interaction through both voice input and output. Additionally, features such as keyboard navigation, responsive design, compatibility with assistive technologies like NVDA and JAWS, and strict compliance with WCAG 2.1 guidelines are being considered. The objective of this phase is to establish a solid technical foundation that will enable, in subsequent stages, pedagogical validation and integration into real educational settings with students with visual impairments.

This study was conducted using a projective and qualitative approach, aimed at the conceptual design of a digital educational tool grounded in the principles of accessibility, inclusion, and adaptability. The main objective was to develop a prototype of a virtual tutor, named DUA-Math, designed to support any student seeking to learn the concept of linear or affine functions, with particular attention to individuals with visual impairments. The methodological proposal is based on the convergence of the foundational principles of UDL and the emerging capabilities of generative AI, with the goal of creating a personalized, accessible, and continuous learning experience.

The design of the virtual tutor was structured around three complementary dimensions (pedagogical, technological, and accessibility-related) in alignment with the principles of UDL and the recommendations set forth by the Web Content Accessibility Guidelines (WCAG). Pedagogical dimension: content sequences were developed with a focus on supporting the understanding of linear functions, incorporating multiple forms of representation (auditory, textual, and tactile) and expression (voice interaction, step-by-step guidance, and adaptive feedback). These sequences are intended to align with each student's pace and learning preferences, enabling an autonomous and meaningful learning process free from sensory or cognitive barriers. Technological dimension: the core feature of the prototype is its voice interaction capability, which enables students to ask questions in their native language and receive accessible, contextualized responses even in the presence of visual impairments. This functionality is made possible through the integration of speech-to-text and text-to-speech technologies, combined with natural language processing models capable of generating clear, personalized explanations. This architecture not only removes the need for visual interfaces but also fosters a continuous and empathetic learning experience. In line with Lo et al. (2024), this type of interaction has been recognized for its potential to significantly enhance students' cognitive and emotional engagement. Furthermore, the platform is fully operable through voice

commands, screen readers, and keyboard navigation, eliminating the need for a mouse and promoting total accessibility. Accessibility dimension: The development of the prototype strictly adhered to the four core principles of the WCAG: perceivability, operability, understandability, and robustness. Specific measures were implemented, including alternative text for images, oral descriptions of graphics, high visual contrast, text enlargement options, a clear semantic structure with hierarchical headings, interaction time control, predictable navigation, and compatibility with both current and emerging assistive technologies. Additionally, formats such as MathML were employed to ensure that mathematical content can be accurately interpreted by screen readers and voice assistants.

The conceptual design of the DUA-Math virtual tutor enabled the development of a preliminary proposal aligned with the principles of UDL and international digital accessibility standards, particularly those defined by the WCAG. This design results in a user experience structured in progressive stages, aimed at ensuring that each student (especially those with visual impairments) can interact autonomously, clearly, and meaningfully with mathematical content. Figure 1 illustrates the student's first point of contact with the platform, where they are prompted to select the navigation language. This initial interaction goes beyond a technical function; it is a key pedagogical decision intended to ensure a personalized and accessible environment from the very beginning. In accordance with the WCAG principles of perceivability and understandability, this screen facilitates immediate comprehension of the interface, particularly for users who rely on assistive technologies such as screen readers or braille displays. Enabling interaction in the student's native language helps reduce communication barriers and fosters a sense of inclusion from the outset.

Figure 1. Initial interface of the DUA-Math virtual tutor, where students select their preferred navigation language to ensure accessibility from the first interaction.

Once this selection is made, the student accesses the main menu, shown in Figure 2. This second stage marks the beginning of the learning journey and reflects the overall structure of the platform. The menu is organized hierarchically with both visual and textual elements that allow navigation through various sections, including theory, explained examples, interactive exercises, problem-solving situations, assessments, and accessibility settings. The clear layout of buttons and labels (designed to be compatible with keyboard navigation and screen readers) meets the

WCAG criteria for operability and robustness, enabling each user to explore the environment according to their level of technological proficiency and individual support needs.

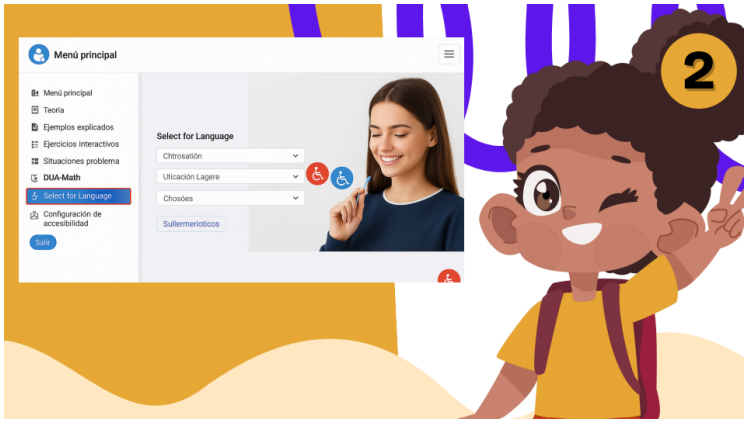

Figure 2. Main menu of the DUA-Math virtual tutor, showing accessible navigation options for theory, examples, exercises, and settings.

Figure 3 presents the third stage of the design: the introduction to theoretical content on linear functions, specifically adapted for students with visual impairments. This section incorporates multiple forms of representation, including text, audio, and alternative descriptions, in accordance with UDL principles. The structure of the content allows students to progress step by step, guided by a conversational system that adapts to their pace, interests, and learning style.

Figure 3. Voice command interface for accessing theoretical content on linear functions, adapted for students with visual impairments.

DUA-Math is a virtual tutor powered by AI, specifically designed to support students with low vision or blindness in learning mathematical concepts, particularly linear or affine functions. Through a voice-based chat system available at any time, students can ask questions and receive personalized responses tailored to their pace and learning preferences. By integrating linguistic accessibility, auditory support, and an adaptive learning experience, DUA-Math embodies the principles of UDL, offering multiple means of representation, action, and expression. Its inclusive

approach not only removes barriers but also provides an empathetic and continuous experience that enables learners to progress with autonomy and deep understanding of the content.

Conclusions

The development of DUA-Math constitutes a significant contribution to the field of inclusive educational technologies, specifically addressing the needs of students with visual impairments in mathematics learning. As presented throughout this article, the prototype is not merely a technical solution, but a pedagogical resource aligned with the principles of Universal Design for Learning (UDL), offering multiple means of representation, engagement, and expression—an approach emphasized by Gronseth *et al.* (2021) as essential for meaningful and equitable learning.

DUA-Math integrates a voice-based chat system powered by a natural language model trained with mathematical content, allowing for continuous and personalized support. This functionality responds directly to the challenges outlined in previous research regarding the lack of accessible tools that adapt dynamically to the pace and style of students with disabilities. In this sense, the prototype advances beyond existing solutions by fostering autonomy and contextualized understanding—core aspects in inclusive AI applications, as underscored by Lo et al. (2024). Moreover, the interface design of DUA-Math adheres rigorously to the WCAG, ensuring compliance with standards for perceivability, operability, understandability, and robustness. This commitment to accessibility reinforces the project's alignment with the recommendations of the W3C (2023) and highlights the importance of combining technical development with ethical and usability principles.

While the current version of DUA-Math is still in the prototyping phase, the results obtained so far suggest a strong potential to transform the learning experience of blind and low-vision students in inclusive environments. The next phases will require validation in real classroom settings and the incorporation of feedback from diverse educational and accessibility stakeholders. In light of the literature reviewed and the prototype's design features, DUA-Math emerges as a promising and innovative model that bridges inclusive pedagogy and artificial intelligence. Its future implementation could contribute to reducing persistent structural and methodological barriers in mathematics education and offer a concrete path toward more adaptive, equitable, and accessible learning environments.

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University Administration, Educational Models, and Community Engagement

Pedagogical innovation and the integration of university missions: the case of Barrio U

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Introduction

Universities face the challenge of critically integrating their core missions of teaching, research, and extension[3]. However, structures that segment these missions persist, limiting the building of meaningful interactions with their surroundings. While discourses on pedagogical innovation and social commitment are nurtured, they do not always transform epistemic hierarchies or foster sustained integration.

This chapter analyses the Barrio U Laboratory, a community of practice with 15 years of experience at the Universidad de Antioquia (University of Antioquia, Colombia), which blends academic training, knowledge creation and local action through participatory methodologies and the exchange of knowledges. The research is guided by a pivotal question: how does the lab's methodological framework enable the introduction of pedagogical innovations that enhance the integration of the university's core missions?

Barrio U's principles and practices are studied as an innovative experience through a qualitative, case study approach. Engaging with critical pedagogies, epistemologies of the Global South, and the theory of communities of practice, the study argues that this case provides empirical evidence of under-documented types of ties between universities and society, driven by solidarity work and displaying high pedagogical and institutional potential.

As such, the chapter contributes to the field of studies on higher education in Latin America, marked by structural inequalities, by documenting an experience that provides valuable insights for planning plausible institutional reforms to meet contemporary educational challenges.

[3] Sometimes referred to as third mission, community engagement, or outreach in contexts outside of Latin America.

Critical perspectives for innovation in Latin American universities

The university as a political and epistemic project: conflicting missions

Historically, public universities in Latin America have been called upon to play a political and emancipatory role, steering towards the democratisation of knowledge and social justice (Bernasconi, 2008; Hernández Bringas et al., 2015; Santos, 2021). Dating back to the Córdoba Reform of 1918, this transformative vocation merged extension as a third mission, characterised by its polysemic and heterogeneous nature, with strong roots and development in Latin America compared to other geographical contexts (Naranjo-Africano et al., 2023). However, its full realisation, in which extension embodies a bridge between teaching and research, remains more of a distant goal than a reality.

Various authors have warned of the persistent segmentation between the core missions of universities in Latin America, a phenomenon that tends to privilege one to the detriment of others (Canales Sánchez, 2019). Along the same lines, Mainegra et al. (2025) point out that, while integration appears to be a guiding principle, in practice teaching is overemphasised while extension is shifted to the background. Indeed, it faces structural barriers regarding time management, resources, and the impact on the academic career. In the European context, Lucas (2007) also reports a separation between educational processes and the creation of knowledge in elite universities.

That said, much of the literature analysing extension as a third mission has focused on the relations between university and industry, and their role in technological innovation and economic development (Naranjo-Africano et al., 2023), which leaves other, less visible approaches to engagement, often driven by solidarity work, in the background. This narrow view ignores the heterogeneity of actors involved in the relationship between universities and society and hinders policymaking relevant to the Latin American context. This study therefore seeks to provide empirical evidence on experiences that are key to understanding institutional adjustments, both in the short and medium term, that integrate their innovative potential to reshape structures that are often inflexible when met by the challenges of education and its advocacy environments.

As such, the structuring of core missions cannot be addressed solely as a technical or organisational matter. It is an ethical, epistemic and political question regarding the public essence of universities because, as Santos (2021) warns, they are trapped between a privatising logic that turns knowledge into a commodity and a social demand that expands their public space and demands greater pluralism and social commitment.

From this perspective, we must explore the pedagogical devices that can foster meaningful modes of integration, for which the concept of communities of practice provides an important analytical key.

Communities of practice and ecology of knowledges: critical contributions to pedagogical innovation

From constructivist and sociocultural approaches to learning, the fundamental role of communities as environments that mediate the appropriation of knowledge by individuals has been recognised (Bandura, 1977). Within this framework, Wenger (1998) defines communities of practice (CoP) as groups of people who share a passion or interest in a topic and deepen their knowledge through continuous interaction. These networks are structured around a shared domain, an enduring social commitment and a common body of practices, tools and narratives, within which their members also shape their sense of belonging and identity.

In the field of higher education, communities of practice have been explored as institutional and pedagogical devices (Magnusson et al., 1998; Sánchez-Cardona et al., 2012). Their potential lies in their ability to generate flexible environments that transcend traditional academic frameworks in favour of contextualised learning processes.

In the case of Latin America, communities of practice such as those analysed in this study need to be part of alternative epistemic frameworks to technocratic approaches to educational innovation. Formulated by Santos (2021), the epistemologies of the Global South provide a relevant theoretical basis for interpreting these experiences in their pedagogical and political dimensions. Central to the author's proposal, the concept of ecology of knowledges outlines the coexistence and complementarity of different systems of knowledge, both scientific and non-scientific. In line with this, Alcoff (2022) warns that dominant epistemologies tend to be guided by an extractivist logic, which converts knowledge into a decontextualised resource and seizes knowledges unilaterally. In contrast, he proposes an interepistemology based on horizontal and collaborative ethical relationships.

The concretisation of the ecology of knowledges calls for critical pedagogies that frame education as a political act intended to generate critical awareness and social transformation through dialogue between educators and learners, through collective reflection and action (Freire, 2005).

This is the context for Communication/Education, a concept coined by Huergo (2013) to highlight a transdisciplinary field rooted in culture as a conflictive territory of meaning. The author identifies two Latin American traditions: liberating educational communication, influenced by Freire, and educommunication, which integrates popular media and languages in a pedagogical context. For the author, education requires an affective, ethical and political practice that starts from the recognition of the other in their geocultural setting.

From this critical perspective, pedagogical innovation is not defined by technological novelty, but by its ability to reorganise relationships between subjects, knowledges and territories. Valdés and Gutiérrez-Esteban (2023) view it as the introduction of new elements or practices into the education system that improve learning and address tangible issues, with the active participation of the educational community. Fernandes et al. (2024) highlight that strategies such as project-based learning, co-creation, and communities of practice contribute to the development of

critical and collaborative skills in dynamic environments. Along the same lines, Walder (2017) emphasises that innovation is not limited to novelty, but encompasses a significant transformation of approaches, relationships and structures that can be sustainably integrated into institutional life.

From these approaches, the Barrio U Laboratory stands as an exemplary experience of community of practice that, from a critical standpoint, allows us to understand how pedagogical innovations can be structured to articulate teaching, research and extension through cognitive justice and social commitment.

This study is framed within the sociocritical paradigm and adopts a qualitative methodology of a descriptive nature. The general goal was to analyse how the methodological structure of a university community of practice (the Barrio U Laboratory at the Universidad de Antioquia) implements pedagogical innovations aimed at integrating the three core missions of a university. The specific objectives were: (1) to outline Barrio U's methodological structure, based on its guiding principles and collaborative processes as a community of practice; and (2) to identify emerging pedagogical innovations and their contribution to articulating the integration of the university's mission. An intrinsic case study (Stake, 1995) was chosen, based on its uniqueness, longitudinal and multi-actor behaviour, and limited previous academic documentation. The time frame (2019–2025) was defined based on the lab's maturity phase in terms of methodological consolidation and diversification of strategies for university-society collaboration.

The analysis of the information was structured around four key categories drawn from the literature and the research objectives: (1) methodological principles; (2) collaborative practices; (3) pedagogical innovations; and (4) articulation of core university functions (teaching, research, and extension). These categories guided both the collection and interpretation of data through three main techniques:

- A questionnaire with Likert-type items and open-ended questions, conducted with 34 volunteers (49% of the total historical population) who had participated for at least one semester, which sought to gather perceptions about the various dimensions of the community of practice. The instrument was structured in three sections: the first, a profile of the participant, allowed for characterising the role of involvement, the period, and the type of activities carried out. The second section included 17 closed items assessed on a scale of one to five points, designed to measure perceptions on four themes: a) methodological and pedagogical experience, with questions aimed at exploring situated learning, the connection between theory and practice, and the development of communication and critical thinking skills; b) principles, values, and sense of community, focusing on the recognition of the relational climate, sense of belonging, and forms of relationship; c) pedagogical innovation, which inquired about methodological adaptations and ruptures with tradition; and d) articulation of institutional missions, aimed at identifying connections between academic training, community work, and production of knowledge. Finally, the third section included four open-ended questions that encouraged personal narratives about learning and transformations, perceived innovations, bonds formed, and areas for improvement.

- A documentary analysis of 80 internal Barrio U files (minutes, reports, methodological records, and audiovisual memoirs) for the 2019-2025 period. The purpose was to recognise the trajectory, reflections, and methodological consolidation of the lab and to contrast the empirical findings with its stated principles. To this end, a matrix was designed to systematically examine the documents, identifying type, date, authorship, content, methodological principles, collaborative practices, evidence of pedagogical innovation, mission articulation, limitations, and relevant citations. The use of the digital tool NotebookLM facilitated the management and reduction of data.

- Participant observation between January and June 2025. Eight internal work sessions and four activities with communities were conducted. This technique was key to gaining an understanding of the current state of the lab, through an observation guide based on the same categories used in the document review.

For the analysis, a coding framework with deductive categories was implemented. To identify characteristics and nuances that would facilitate the review of patterns, thematic memoranda were drawn from the data sets. To strengthen the interpretative validity of the analysis, a threefold triangulation was applied: of theories, using theoretical frameworks such as critical pedagogies, epistemologies of the South and communities of practice; of sources, by contrasting the findings from the three instruments used; and of researchers, to mitigate biases. This method enabled the categorisation of conclusions according to the research objectives, as illustrated in the following graph.

Ethically, the study sought informed consent and ensured respect for the principles of confidentiality, authorship, voluntary participation, integrity in the use of data, and management of findings. The study acknowledges the limitation of not including the perspective of university administrators or the community, whose voices would broaden understanding of the matter at other levels. Future research could include multiple case studies involving several Latin American universities.

The case of the Barrio U Laboratory

The Barrio U Research and Extension Laboratory is an academic community of practice with fifteen years of experience in the Faculty of Communications and Philology at the Universidad de Antioquia. It is a space open to students, graduates and professors from this and other disciplines and institutions, which gathers around the drive for communication and education for social change. Its sustainability has depended less on institutional structures than on collaborative processes, alliances and self-management.

Regarding the first specific objective on the lab's methodological design, the findings highlight ethical and pedagogical foundations rooted in the dialogue between scientific and non-scientific knowledges, experience systematization, adaptability to various contexts, situated learning, intrinsic motivation, and interactive, participatory methods. In addition, a critical perspective guides its practices towards social transformation, "taking the university to the public space and the public space to the university" (Facultad de Comunicaciones y Filología – Barrio U, 2020), as

well as the integration of contemporary reflections on differential approaches such as gender, interculturality and inclusion. This vision has led to a horizontal organisational culture, in which 88% of the volunteers report feeling in a safe and respectful space, while 82% state that the activities transcend the boundary of the group towards communities and other social actors. High identification with the collective purpose (4.7/5), coherence between discourse and practice (4.8/5) and horizontal relationships (4.9/5) are also reported.

Barrio U allows the shaping of identity and belonging among its members, who recognise themselves in common purposes. As one volunteer voiced it: "we are united by a passion for making education possible that breaks down institutional barriers and closes inequality gaps". This suggests that the lab represents a learning environment in which practice is also an experience of political subjectivation. This shared identity favours learning that transcends disciplinary content. Participation strengthens skills in the analysis of the context, project management and outlining, communication and systematisation, as well as cultivating a critical scientific culture, networking and an ethical sense of the public. Several participants indicated that their experience in the lab has been decisive in defining their vocation or career.

The most prominent collaborative practices include the organisation by commissions, joint planning, participatory evaluation, co-creation of methodologies and constant deliberation on ethical principles. A significant part of the working time is dedicated to reflecting on ethical dilemmas that affect the relationship between universities and the community, which are made explicit in strategic documents and were corroborated during field observation. These practices are designed in collaboration with different actors through partnerships with schools, cultural groups, and other faculties and organisations, which has allowed for a permeable and multi-stakeholder institutional system that coordinates communication and strategies tailored to different audiences and realities, highlighting the potential of the Latin American approach (Freire, 2005; Huergo, 2013) of critical pedagogies to effectively develop social mediations, if collective reflection is intended based on practice. In addition, the data show that voluntary participation is enabled through different paths (courses, calls, internships, thesis projects) and has led to long-term processes: some volunteers have been involved for over a decade, which has contributed to nurturing social capital for the management of alliances, resources and new projects. These results suggest an organisational logic in which group cohesion and practices are based on a shared sense of purpose and belonging, structural traits that define the functioning and sustainability of communities of practice according to Wenger (1998).

As for the second objective, aimed at identifying expressions of pedagogical innovation, the results show that Barrio U implements approaches that distance themselves from traditional models. According to the field reports and logs, the lab designs and adapts playful, artistic, experiential and challenge-based methodologies. Furthermore, 73% of the volunteers stated that the experiences merged what they thought, did and felt, integrating the affective aspect of learning. Narrative creativity, pedagogically meaningful use of media and technologies, and questioning of dominant frameworks were also highlighted. 85% stated that the activities helped them to question what they took for granted and to recognise other realities, while 70% reported having strengthened their skills in listening, expressing themselves and communicating. In

addition, non-conventional assessment strategies that promote peer evaluation and self-reflection are implemented.

This indicates that Barrio U acts by reorganising the relationships between knowledges, subjects and territories, managing to transcend, albeit with limitations, disciplinary and institutional boundaries. It can therefore be affirmed that its innovation lies not only in the techniques applied, but also in the creation of a pedagogy built on bonds, bringing together knowledges, emotion, and collective impact. These innovations have contributed to an effective articulation of core missions. Teaching expands into community contexts, weaving what is gained in the classroom with social life (85% rated it 5/5). Research originates in collective action and in the systematisation of experiences, generating questions, knowledges and analysis from the territory. Outreach is conceived as a constant dialogical process, rather than a one-off initiative, and is developed as a complete cycle: diagnosis, planning, execution, evaluation, systematisation and production of knowledges, immersed in experimentation and iteration. This differentiates Barrio U from other solidarity outreach initiatives limited only to implementation. In addition to these findings, the lab contributes institutional value in aspects that tend to be overlooked: it generates social legitimacy, maintains a presence in territories and organises academic events to promote scientific culture.

In short, the methodological configuration of Barrio U makes it a unique and valuable experience for inspiring transformative pedagogical models, consistent with Santos' (2021) proposal to advance toward an ecology of knowledges that brings public universities closer to a more democratic, participatory, and socially committed form through the integration of their core missions.

Conclusions

By analysing how the methodological configuration of the Barrio U Laboratory of the University of Antioquia implements pedagogical innovations aimed at integrating the three core university missions (teaching, research and extension), it is concluded that this community of practice is structured in a disruptive model that effectively introduces pedagogical innovations in the context of university institutionality, by shifting teaching towards collective processes of knowledge construction outside the limits of academia: interactive and experiential methodologies, co-evaluation and self-reflection integrate the affective dimension with the technical, strengthen communicative skills and produce research inputs from the territory. This confluence of elements supports the idea that these practices are not only didactic resources, but also narratives and ethical positions that question the epistemological referents of knowledge production through reflective cycles.

As illustrated by the experience of the Barrio U Laboratory, an academic community of practice can be framed to effectively articulate its core missions through an ethical, collaborative and contextual methodology. Its trajectory shows that the integration of teaching, research, and extension cannot depend exclusively on structural reforms, but above all on pedagogical devices capable of catalysing social commitment, methodological creativity, and the critical production of knowledge.

One of Barrio U's most significant contributions is its capacity to generate an integral training model based on the horizontal co-construction of methodologies, experimentation, co-responsibility with community actors and the pivotal role of emotions as the driving force behind the work. The experience not only strengthens research, communication and organisational skills, but also influences the professional orientation of its members, strengthening ethical, aesthetic and civic vocations. Despite these achievements, the lab faces structural limitations. The lack of its own budget, partial institutional recognition and dependence on internal and external calls for proposals hinder its sustainability and growth. Universities must recognise this type of initiative in their policies, allocate stable resources and generate institutional strategies that promote long-term processes, without blurring their autonomy and flexibility.

Finally, Barrio U raises challenges and opportunities in the research field. While it is an incubator for research, a more in-depth approach to measuring and understanding community impact and disseminating its learnings would not only strengthen its legacy, but also influence debates on pedagogical innovation, epistemic justice and critical extension. Initiatives such as a professorship or a transdisciplinary programme of learning exchange between different faculties and levels could enhance their impact.

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University educational models: the foresighted determination for educational quality

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This text arises from the first part of the doctoral thesis and research of Luzmila Flores at University of Piura.

Introduction

Defining a university's educational model is a participatory process aligned with institutional identity, strategic goals, and social demands reflected in graduate profiles. According to Dier (2012), these models embody innovation and must periodically adapt to societal changes. This study aims to (a) establish a state of the art based on scientific sources and (b) identify factors that affect the development of the University Educational Model (UEM), as well as the main strategy for ensuring its quality and success.

As background, we note previous research (Fresán & Magdalena, 2008; Rojo, 2012) that highlights the importance of participatory and community-based approaches in the construction of educational models, emphasizing institutional identity, teacher profiles, and educational quality. Other authors, such Murueta et al. (2016), and Valencia (2025), relate these models to achieving curricular objectives, innovation, and quality assurance. In this context, Flores (2022–2024) identified several quality assurance needs in UEM design and implementation, proposing the foresighted determination strategy — a set of preventive measures to guarantee quality during model formulation and application.

This study addresses the question: What is the key strategy for ensuring success and quality in the development and implementation of educational models? The hypothesis proposes that foresighted determination ensures relevance, sustainability, effectiveness, and efficiency in the UEM. Following Martínez (2006), the study adopts a qualitative case study approach, emphasizing the perceptions and participation of institutional actors. Conducted at the University of Piura's Center for Educational Quality, the research involved dialogical participation, interviews, and data analysis to identify needs and strategies for quality improvement.

UEM-UDEP Case Study

For the experimental phase, a case study was used as both a research method and an analysis strategy, focusing on the development of the University Educational Model (UEM) at the University of Piura, following the approaches of Haya (2011), Martínez and Musitu (1995), and De Ceretto et al. (2009).

The University of Piura updated its educational model between 2021 and 2023 through four phases: Planning, Diagnosis, Development, and Approval and Publication. For planning, we defined tasks, timelines, and responsibilities, and included an induction workshop for the planning team, resulting in an approved work plan and trained personnel. For diagnosis, we reviewed institutional and external documents (e.g., University Law 30220, SINEACE model) to gather key information for the model's components. For development, we prepared a draft based on prior analysis, reviewed by selected working groups (administrators, faculty, students, alumni), and refined through questionnaires, producing the final ME-UDEP document. For approval and Publication, a final document was reviewed, approved by the Board of Governors, and published on the university's Transparency Portal.

This process culminated in the official University Educational Model document, reflecting a participatory and structured approach to educational quality and institutional identity.

Context description

In 2019, the Academic Vice-Rectorate of the University of Piura (UDEP) initiated the development of its Educational Model (ME-UDEP) as part of the academic planning process, with the purpose of defining, in an institutional document, the conception of the teaching–learning process and student training. The update of the model was primarily driven by a regulatory requirement from the State. In 2021, Peru approved the Institutional License Renewal Model, which requires universities to have an educational model that assesses their training proposal, in accordance with Article 8 of University Law No. 30220.

To meet these requirements, UDEP established an interdisciplinary team responsible for planning, developing, and updating the ME-UDEP. The Office of Educational Quality led the operational process, supported by an external advisor who defined the profiles and composition of the planning team, which included an internal advisor, two members of the Office of Quality, and a doctoral student (Luzmila Flores) in charge of researching the processes.

A qualitative methodology based on inquiry is followed, using the cartographic study method for theoretical analyses and a case study method for experimental analyses, based on direct and indirect participant observation.

The cartographic method consists of mapping the most important elements of an investigation, considering the research of other authors and their analyses. In this way, the search for sources creates a roadmap that allows us to visualize the achievement of research objectives. Authors such as Álvarez (2011) associate it with the intentional factor for which researchers determine their sources. For Rey and Granese (2019), the cartographic method allows an illustration of the research process and findings that are gradually being discovered.

As Haya (2011) points out, this case study uses qualitative research that allows the use of techniques and strategies that enable participants to understand the meanings of specific contexts and situations, allowing them to express their opinions and perceptions about what is happening (Haya, 2011). In this same sense it is expressed by the authors Martínez and Musitu (1995), and De Ceretto et al. (2009). They point out that case studies allow for an understanding

of the object of study in the complex events inherent to institutional life, their meanings, and intentions.

On this study, the cartographic method was based on an analytical framework addressing topics to be explored in the theoretical framework and recent research related to the construction of educational models in higher education, to establish a state of the art, as Pineda et al. (2017) point out.

Given that the central purpose of qualitative research is to achieve an in-depth understanding of the study problem rather than fitting the data into a deductive logic (Martínez, 2006), the case study method was employed to foster spaces for participation and dialogue among the actors involved. This approach enabled the collection of perceptions, profiles, and challenges through a 19-item checklist and analysis sheets consisting of 10 problem-oriented questions, applied throughout the various phases of the educational model's development. The instruments were designed in accordance with the methodological guidelines proposed by Haya (2011) and Martínez and Musitu (1995), ensuring coherence between the theoretical and empirical dimensions, and were additionally grounded in previous studies on institutional innovation (Álvarez, 2011; Rey & Granese, 2019).

The application of these instruments allowed for the collection of qualitative data regarding institutional, pedagogical, and management factors that influence decision-making processes related to the design and implementation of the educational model, as well as for the characterization of the prospective determination strategy. This article presents the first two phases—planning and diagnosis—and the teams involved in their development, which proved decisive in terms of quality and strategic orientation. The subsequent phases will be addressed in a separate publication, as they require a more detailed analysis of the results and institutional impacts.

In experimentation during the development process of the UEM, participation took place in phases with different teams at non-concentric levels. The first phase was developed as a level for planning and drafting a base document (initial document prepared by the planning team as a result of the review of institutional documents). It was carried out with a team of managers called the "expert group". The second phase was carried out with a working group as a forward-looking determination level, that is, the initial decision-making level to ensure quality in the various aspects of the educational model and obtain a ratified document that would subsequently be shared with other participatory forums (teachers, students, partners, stakeholders).

The Working Group was composed of faculty members and staff from the Office of Quality, selected for their prior participation in institutional projects and their knowledge of academic and university management processes. This diversity fostered a comprehensive vision of the model by integrating pedagogical, administrative, and educational quality management perspectives. Members were appointed based on their experience in educational innovation, their trajectory within the institution, and their willingness to engage in interdisciplinary collaborative work. Faculty members contributed their expertise in curriculum design and

teaching strategies, while the staff from the Office of Quality provided knowledge of academic management processes and quality assurance. The group was organized into teams and met periodically to analyse diagnostic information, contrast theoretical frameworks, and build consensus on the principles and guidelines of the educational model. Collaborative methodologies and a dialogical approach were employed to promote collective reflection.

These teams underwent an induction session, followed by planning and establishing the objectives and goals to be achieved. Data collection tools (analysis guide, worksheet, questionnaires), participating groups (teachers, administrators, students, graduates), as well as participation strategies and definition of the profiles and tasks for each group were also defined. Each team was composed of four members, selected based on their experience and professional relevance. The members were required to have a minimum of 10 years of experience at the institution; in addition, they demonstrated a high level of performance in competencies such as collaborative work, effective communication, and the ability to perform well under pressure.

The case study was organized into 5 categories, as shown in the following figure:

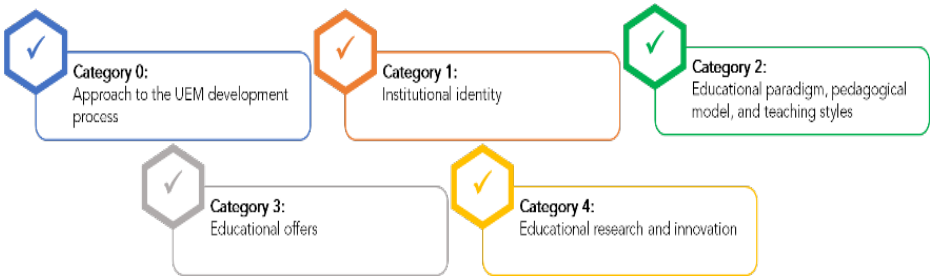

Figure 1. Categories of the Case study.

In this paper we analyse procedures from category 0 related to different aspects, especially participants. We established eight items. The purpose of selecting these elements was to establish the ad hoc profile of the participants in the constructive process of the UEM, which are indicated below.

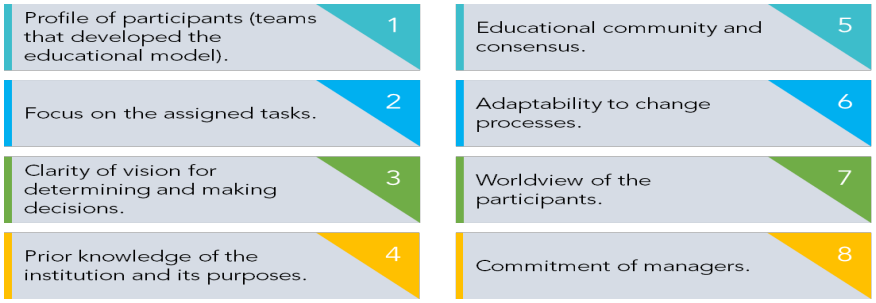

Figure 2. Items from the checklist.

Those items were posed as problem-based questions that were answered through direct and indirect observation in hearings, focus groups, and written consultations.

The application of instruments allowed for identification of certain factors that should be considered as learned practices to ensure the success of the quality of both the initial document and the document developed (UDEP-EM). These factors and relationships with measures of strategy for success (Foresighted determination) are explained below:

Factor 1: Lack or underdevelopment of skills within the planning team, which influences the poor understanding of the theoretical foundations related to the nature and development of an educational model. As a measure of foresighted determination, an efficient induction process for the planning team was developed as a proactive strategy. The profile of the planning team members was properly defined for selection, and an external expert was provided throughout the process to offer adequate guidance and direction to the planning team.

Factor 2: Dispersion in implementation of activities and tasks for development of the UEM. This may be the result of poor management of the planning process, which aims to establish a work plan that guides the proper development of tasks and the achievement of the objective (educational model document As a measure of foresighted determination, a proactive strategy's characteristic was related to a planning action that involved all members of the planning team. The team was instructed to anticipate risks, impacts, and contingencies, which would allow them to assess potential problems and analyse their possible consequences. Part of this proactive approach is that the planning team's profiles must be aligned with the project managers' competencies.

Factor 3: Lack of understanding and mastery of the participation processes generates biased views, such as having only the planning team participate, which does not take experience and knowledge of other stakeholders into account. As a measure of foresighted determination, given this factor, the participation of all groups and stakeholders was required as a forward-looking strategy. The result was that this strategy helps consider the needs and priorities of the entire university community, increases the likelihood of success, and ensures the contribution of innovative solutions tailored to the context.

Factor 4: Lack of understanding of institutional identity, functioning, and management among expert group participants leads to misinterpretations of the documents and/or standards being analyzed, which therefore prevent the development of foundations that constitute an educational model. As a measure of foresighted determination, in this case, the measure consisted of determining the profile of the expert group members and their prior knowledge of the institutional identity. This measure ensures a proper review of the EMU core document and a more complete understanding of the ideas it contains.

Factor 5: Lack of understanding of the academic world's consensus regarding concepts and foundations of an educational model can lead to the inclusion of elements and processes that do not meet global educational criteria. As a measure of foresighted determination, considering this factor, the introduction of group training, as well as the support of an external expert, contributes to a more precise academic construction of the MUE and the relevant determination of its content.

Factor 6: Educational models described in detail can be vulnerable to changes in external regulations (accreditation and certification systems, quality standards, educational laws). As a measure of foresighted determination, pivoting construction of the UEM on elements of a certain permanence (medium or long term), such as the vision, mission, principles, values, basic educational laws, strategic plans, founding acts, etc., it is possible to give the UEM a certain stability and ensure its duration for at least the medium term.

Factor 7: Aspirations (intentions) and worldview of managers, which are neither collegial nor consensual, are biased by personal and/or other interests (political, economic, or those unrelated to training) not aligned with unified criteria on quality, around aspects of institutional identity). As a measure of foresighted determination, a proactive measure, participants' constructions are encouraged to be based on the foundations of institutional identity and team spirit, addressing common institutional objectives and goals. Participants feel compelled to include consensus-building activities in all phases of EMU construction, before and during the planning phase.

Factor 8: Furthermore, the lack of participation by the institution's highest authorities' limits, delays, and distorts the processes of developing educational models and can even affect their completion and approval. As a measure of foresighted determination, one of the proactive measures is to assign primary and ultimate responsibility for the construction of the EMU to the institution's directors, ensuring their constant and effective presence throughout the process. The result of this strategy is for the authorities to participate efficiently and effectively, eager to be informed about the progress and results of the process.

Within this framework, we can say that a set of measures were introduced to ensure that decision-making in development of the "Ratified Educational Model" document is based on foresight, as a strategy for success of the collective construction process of UEM and its implementation.

The study analyzed which strategy enables the successful development of educational model construction and implementation processes that meet quality criteria. The results show that factors such as participants' profiles and commitment, institutional identity, and the approach to quality are decisive. The foresighted determination strategy was effectively applied, identifying risks and countering them through concrete actions such as defining expert profiles and providing training aligned with their functions. In this regard, Schoemaker (1995) argues that anticipating scenarios strengthens decision-making, while Van Vught (1997) emphasizes that universities must combine planning with contextual flexibility to maintain quality and relevance. In the Latin American context, Inga (2020) asserts that anticipatory strategic management ensures the sustainability and quality of academic processes.

This strategy enabled a participatory process that fostered consensus around the University Educational Model (UEM). Defining team profiles and providing targeted training for planning and working groups were key to ensuring technical, institutional, and pedagogical coherence, as highlighted by Biggs and Tang (2011) and Martínez (2014). Moreover, approaches such as constructive alignment and studies on academic staff development in Europe and Latin America (O'Mahony et al., 2024) demonstrate that aligning team competencies and training with

institutional goals is essential for the successful implementation and sustainability of educational models.

The results confirm that foresighted determination during the UEM development process ensures quality parameters related to relevance, sustainability, effectiveness, and efficiency (Van Vught, 1995; Fullan, 2001). Furthermore, quality is not an added element but rather the core axis that structures the model, based on the institution's vision, mission, and values. Conceptions of quality define educational paradigms, learning styles, and research orientations, ensuring coherence between institutional vision and educational practices, as noted by Acevedo Calamet et al. (2022). Consequently, the foresighted determination strategy stands out as the main success factor for ensuring quality during the planning and diagnostic phases.

Conclusions

As the state of the art refers to the importance of participatory processes in the development of university educational models, we find that it is not only important to ensure participation but also necessary to anticipate the ad hoc profile of participants and train them beforehand to assume their roles.

As the results obtained from both the case study and the cartographic study show, In the construction of university educational models, ensuring the active participation of all stakeholders is essential to achieve a fully participatory process and promote consensus around the model. This is supported by Biggs and Tang (2011), who emphasize the importance of aligning objectives, activities, and evaluation through constructive participation, as well as by Fullan (2001) and Van Vught (1997), who highlight that sustainable educational innovation and institutional quality require the involvement of all actors.

Moreover, anticipating participants' profiles and providing training aligned with their competencies is critical. Inga (2020) argues that strategic management in educational institutions requires preparing teams in advance to assume their roles effectively, while O'Mahony et al. (2024) demonstrate that targeted staff development positively impacts the quality and efficiency of academic processes.

On the other hand, the goal of identifying factors that impact the quality of determinations and decisions made in UEM is relevant from the planning phase, to address their negative effects in advance. The strategy of foresighted determination allows for controlling factors that affect the quality of decisions and actions in the UEM without compromising institutional standards. Schoemaker (1995) explains that anticipating possible scenarios reduces uncertainty and strengthens decision-making, and Van Vught (1997) emphasizes that combining planning with flexibility ensures quality amidst changing conditions. In the Latin American context, Acevedo Calamet et al. (2022) show that anticipatory strategic planning guarantees coherence between institutional vision and pedagogical practices. Therefore, foresighted strategy responds to the need to determine in advance different measures to control the effects of the following aspects and factors affecting quality: deferred spiral participation of educational agents; training plan for participants; a clear establishment of the professional profile of participants; adoption of a

pedagogical and quality model with a high degree of university consensus and; a training offering that distinguishes the actual offering from the desired one.

Finally, in the continuity of the process of this study, it is necessary to identify other factors that may affect subsequent phases of model development and determine additional foresighted strategies. Biggs and Tang (2011) and O'Mahony et al. (2024), underscore the importance of continuous evaluation and feedback to detect gaps and improve implementation, highlighting the dynamic and adaptive nature of educational model construction.

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University and Sustainability: Training Change Agents for a Sustainable Future

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Introduction

In recent decades, global society has faced a multidimensional crisis characterized by environmental degradation,2 rising social inequalities, and global economic instability. These challenges are evident in phenomena such as climate change, biodiversity loss, job insecurity, and the increase in poverty and inequality, affecting both present and future generations (World Bank, 2022). Therefore, it is imperative to promote development approaches that integrate sustainability, social justice, and collective responsibility.

In response, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development in 2015, establishing 17 Sustainable Development Goals (SDGs) as a global framework to promote human well-being and ecological balance (UN, 2015). These goals seek to coordinate governmental, institutional, and civic efforts to address the 21st-century challenges comprehensively. Among these, SDG 4: Quality Education highlights the central role of educational institutions in promoting learning processes that equip people to actively contribute to social transformation.

Higher education plays a strategic role within this framework. As a formative space, it not only transmits technical or disciplinary knowledge, but also develops critical thinking, ethical awareness, and capacities for civic participation (UNESCO, 2020). Education, in this sense, should promote competencies to understand the complexity of global problems and to act ethically in response.

However, the incorporation of sustainability in universities has shown uneven progress and is often limited to institutional statements, without a transversal integration into curricula and educational practices (Lozano, 2015). Authors such as Sterling (2010), Tilbury (2011), and Wals (2015) agree that education for sustainability requires transformative pedagogical approaches that go beyond information transmission and engage in reflective, collaborative processes grounded in students' social realities. This approach recognizes students as agents of change, capable of initiating projects that promote social justice, environmental awareness, and community participation.

Nevertheless, students' potential to create social impact depends on institutional conditions that offer participation opportunities, meaningful learning experiences, and a university culture

consistent with sustainability principles. Thus, it is important to analyze students' knowledge, ownership, and commitment to the SDGs, as well as the factors that either enable or limit their transformative leadership.

In this context, university students can become change agents, capable of questioning structures, leading community initiatives, and promoting sustainable innovations (Tilbury, 2011). However, this potential depends largely on curriculum design, pedagogical practices, participation spaces, and the coherence between the university's sustainability discourse and its actions (Lozano, 2015).

Understanding students' knowledge, commitment, and participation related to the SDGs is therefore essential to identifying opportunities, challenges, and paths for strengthening sustainability in higher education.

For Barros-Bastidas & Gebera, (2020) the modern university faces the challenge of redefining its social role and its contribution to building a sustainable future. It is not enough to incorporate sustainability into institutional discourse or in isolated courses; it must become a guiding principle across teaching, research, and community engagement. Integrating the SDGs in higher education involves transforming pedagogical structures, promoting interdisciplinarity, and strengthening the link between academic knowledge and real societal needs (Tilbury, 2011; UNESCO, 2020).

From this perspective, training students as change agents requires sustained institutional commitment, capable of turning the values of the 2030 Agenda into concrete, relevant, and transformative educational actions. In this way, the university not only trains competent professionals, but also fosters critical citizens, ethically responsible and committed to collective well-being and the planet's sustainability.

This study contributes to such purpose by analyzing the case of students from the economic-administrative area of Universidad Michoacana de San Nicolás de Hidalgo, in order to identify their transformative potential and the factors that either enhance or hinder it.

This research adopted a mixed-methods approach, integrating both quantitative and qualitative methods to gain a deeper understanding of university students' knowledge, commitment, and willingness to engage with the Sustainable Development Goals (SDGs). This approach allows for data triangulation and enriches findings through multiple sources (Creswell & Plano Clark, 2017; Fetters et al., 2013).

Research Approach and Design

This research adopts a mixed-methods approach grounded in the pragmatic research paradigm, which assumes that the integration of quantitative and qualitative methods provides a more comprehensive understanding of complex social phenomena (Creswell & Plano Clark, 2017). Pragmatism allows the use of multiple forms of evidence to address research questions,

particularly in studies related to sustainability education, where both measurable outcomes and contextual interpretations are required.

The study follows an explanatory sequential mixed-methods design, in which the quantitative phase constitutes the dominant component of the research, while the qualitative phase serves a complementary and interpretative function. In the first stage, quantitative data were collected through a structured questionnaire applied to undergraduate students in the economic-administrative area, with the aim of assessing their level of knowledge of Sustainable Development Goals (SDGs), sources of information, participation in sustainability-related activities, and willingness to engage in sustainable actions.

Subsequently, a qualitative phase was conducted through document analysis of study plans and course syllabi, in order to examine the degree of integration of sustainability within university curricula. This phase allowed for a deeper understanding of the institutional context and provided explanatory elements to interpret the quantitative findings.

This design enables the triangulation of quantitative and qualitative data, strengthening the validity of the results and allowing the identification of consistencies and gaps between students' perceptions of sustainability and the level of curricular integration of the SDGs within the university.

Based on the research objective, the following hypothesis is proposed: H1: Students with greater knowledge of Sustainable Development Goals show a higher willingness to participate in sustainability–related initiatives.

Context, Population, and Sample

The study was conducted at Universidad Michoacana de San Nicolás de Hidalgo (UMSNH), focusing on its undergraduate programs in the economic-administrative area (Business Administration, Accounting, Administrative Informatics, and Marketing). During the 2023–2024 academic year, the total estimated population was approximately 4,200 active students.

A non-probabilistic purposive sampling method was used, selecting 200 students enrolled between the fourth and eighth semesters, with an equal distribution by program and gender.

Instruments and Data Collection Techniques

Quantitative Phase

A structured questionnaire with 25 items was designed, grouped into four dimensions: (1) Knowledge of the SDGs, (2) Sources of information on sustainability, (3) Participation in activities related to the SDGs, and (4) Attitudes and willingness to act.

Responses were recorded on a five-point Likert scale (1 = "strongly disagree" to 5 = "strongly agree"). The instrument was validated by a panel of experts and yielded a Cronbach's alpha coefficient of 0.87, indicating acceptable internal consistency (Darren & Mallery, 2019).

Qualitative Phase

A document analysis was carried out on the study plans and course syllabi of the four selected programs. A thematic content analysis was applied (Bardin, 2002) to classify the degree of sustainability integration into three levels: (a) Superficial reference, (b) Partial integration, and (c) Transversal integration.

Variables of the Study

The study analyzes four main variables related to sustainability education among university students. These variables are derived from the dimensions of the instrument applied and are defined as follows:

a) Knowledge of Sustainable Development Goals (SDGs): Refers to the level of familiarity and understanding that students have regarding the SDGs and their components.

b) Sources of information on sustainability: Refers to the channels through which students acquire knowledge about sustainability, including formal academic sources and informal digital media.

c) Participation in sustainability-related activities: Refers to students' involvement in initiatives such as environmental campaigns, social projects, or volunteer activities related to sustainable development.

d) Willingness to engage in sustainable actions: Refers to students´ attitudes and disposition to participate in actions that promote sustainability within and beyond the university context.

These variables were measured using a Likert-type scale and allow for the analysis of students' sustainability literacy and their potential role as change agents.

Procedure

Data collection took place between March and May 2024. The questionnaire was administered both digitally and in person, following institutional approval and informed consent from participants.

Quantitative data were processed using IBM SPSS Statistics 26 to generate descriptive statistics (frequencies, means, standard deviations). Qualitative analysis involved thematic coding to triangulate results with quantitative findings.

Ethical Considerations

The study followed ethical principles of social research, including participant anonymity, voluntary participation, and data confidentiality, in line with the American Psychological Association (2017) and the Declaration of Helsinki.

This section presents the findings obtained from the analysis of the information collected during the quantitative and qualitative phases of the research. First, the results of the questionnaire applied to 200 students from the economic-administrative area at the Universidad Michoacana de San Nicolás de Hidalgo (UMSNH) are presented. Then, the findings from the document analysis of the curricula are detailed. The data are organized into four key areas of analysis:

1. Knowledge about the SDGs
2. Sources of information
3. Participation and willingness toward sustainability
4. Integration of sustainability in the university curriculum

Level of Knowledge about the Sustainable Development Goals (SDGs)

The results show that students' overall level of knowledge about the SDGs is moderate, with an average score of 3.2 out of 5 on the Likert scale, suggesting a limited level of sustainability literacy within the university context. Although 68% of respondents reported being familiar with the SDGs, only 37% were able to correctly identify more than five goals, revealing a gap between general awareness and substantive understanding.

This finding highlights that sustainability knowledge among students remains partial and fragmented, which may limit their capacity to act effectively as agents of change.

The most recognized goals were those related to the environmental dimension, such as: SDG 13 (Climate Action), SDG 15 (Life on Land), and SDG 12 (Responsible Consumption and Production). In contrast, the goals linked to social and economic dimensions—such as SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities)—were less frequently mentioned or understood.

The partial knowledge identified reflects an asymmetry in how sustainability is communicated within the university setting. The predominance of environmental topics over social and economic ones suggests that higher education continues to address sustainability from a fragmented and sectoral perspective, leaning more toward ecology than toward social justice or inclusive economics.

This trend may be related to the limited interdisciplinary content in the curricula and the lack of faculty training in sustainability education. Therefore, curricular strategies are needed to promote a holistic understanding of the SDGs, integrating sustainable development principles across several subjects and learning contexts, so that students can recognize the interdependence of environmental, social, and economic dimensions.

These results are consistent with previous research indicating a tendency to associate sustainability almost exclusively with environmental issues, neglecting the social and economic

aspects (Lozano, 2015; UNESCO, 2020). This confirms the need to broaden the educational perspective to address sustainability in an integrated manner.

This result reflects a limited development of sustainability competencies, particularly in relation to the comprehensive understanding of the environmental, social, and economic dimensions of sustainable development.

Sources of Information and Knowledge Channels

Regarding sources of information, the results reveal that university students obtain most of their knowledge about the SDGs through informal channels, 65% cited social media as their main source, followed by digital platforms and online media (54%). Only 29% reported learning about the SDGs through a university course or formal institutional activity.

These findings show a significant gap between students' individual interest in learning about sustainability and the university's ability to provide structured, systematic learning spaces on the topic.

In other words, the university has not yet assumed a leading role in sustainability education, leaving SDG knowledge to be acquired mainly through self-learning and exposure to informal sources.

This trend suggests that the digital environment has become a key space for the socialization of knowledge, although often through fragmented, superficial, or unverified information. As such, this presents an opportunity: universities could better leverage technological platforms and digital resources to strengthen the link between formal education and the information sources most used by students (UNESCO, 2020).

These results align with Ceulemans et al. (2015), who noted that although universities often state a commitment to the SDGs, curricular inclusion remains limited and fragmented. Similarly, Lozano (2015) points out that sustainability in higher education often appears in strategic documents or institutional discourse, but with little translation into pedagogy, applied research, or outreach practices.

Therefore, the findings highlight the need to redefine communication and educational strategies to embed the SDGs into a comprehensive sustainability literacy effort. This includes developing educational activities, interdisciplinary projects, and teaching materials that allow students to access reliable, contextualized, and critical information, strengthening their role as active agents in promoting sustainability.

This result suggests that universities are not yet fulfilling a central role as institutional agents of sustainability education, which weakens the development of structured and critical knowledge regarding the SDGs.

Student Participation and Willingness to Act

A significant gap was identified between students' willingness to engage in sustainability-related activities (78%) and their actual participation (22%).

This discrepancy suggests that, although students show a positive disposition toward sustainability, institutional conditions limit their effective involvement, reducing their potential as change agents within the university and society.

The most common reasons for not participating were:

a. Lack of institutional information (46%)

b. Few calls for action or visible opportunities (31%)

c. Time constraints due to academic workload (23%)

In spite of this, the high level of willingness reflects a positive attitude toward taking sustainable action, representing a transformative potential that institutions could harness through service-learning programs and community engagement initiatives.

This supports Tilbury (2011), who argues that university students are a key resource for social innovation—provided that universities foster participatory environments and experiential learning opportunities.

Integration of Sustainability in Curricula

The analysis of curricula confirms that sustainability is not integrated as a transversal component of professional training but rather appears in a fragmented and isolated manner.

This lack of curricular integration restricts the development of sustainability competencies and limits the capacity of students to understand the SDGs from an interdisciplinary perspective.

All four programs included a course titled "Social Responsibility in Organizations," which covers theoretical and historical aspects of social responsibility. However:

- None of the reviewed curricula included sustainability as a generic competency or transversal learning outcome.
- Environmental or ethical topics were not consistently embedded throughout the coursework.
- No institutional indicators were found to monitor or evaluate SDG implementation in the curriculum.

These findings align with international literature stating that many universities are still in a declarative phase when it comes to sustainability, lacking systematic curricular integration (Lozano, 2015; Wals, 2015).

Moreover, these results underscore the need to strengthen sustainability education in the university setting through active methodologies, interdisciplinary projects, and institutional policies that encourage student participation.

The integration of quantitative and qualitative findings allows for the triangulation of results. While students express a high willingness to engage in sustainability-related actions, the document analysis reveals a limited institutional integration of sustainability within curricula.

This contrast highlights a structural gap between students' interest in sustainable development and the opportunities provided by the university to foster such engagement.

Conclusions

The analysis carried out confirms that higher education is a key space for the formation of critical and committed citizens in the face of the challenges of sustainable development. However, the findings show that this potential is not yet fully realized in the university context under study.

Although students from the economic-administrative area at Universidad Michoacana de San Nicolás de Hidalgo (UMSNH) show a positive attitude and high willingness toward sustainability, their level of knowledge and effective participation in initiatives related to the Sustainable Development Goals (SDGs) remains limited.

These findings reveal that students' knowledge of the SDGs is partial and predominantly focused on environmental aspects, which suggests that educational discourses continue to emphasize the ecological dimension, while placing less importance on the social and economic dimensions of sustainability. This highlights the need to redefine educational strategies to integrate sustainability principles across all disciplines, fostering a comprehensive and systemic understanding of the SDGs.

On the other hand, the fact that the main sources of information on sustainability are social media and digital platforms, rather than the academic contexts and sources, reveals a significant institutional challenge. As a socializing agent of knowledge, the university must take a more proactive role in teaching, disseminating, and applying the SDGs —not only through theoretical content, but also by providing experiential learning, community outreach projects, and university social responsibility programs.

Furthermore, the gap between students' willingness and actual opportunities to participate underscores the urgency of strengthening institutional structures that facilitate transformative student action. The creation of student organizations, volunteer programs, and service-learning spaces would help make sustainability a daily practice within the university environment, reinforcing students' sense of belonging and social responsibility.

Document analysis also confirms that sustainability is not yet integrated as a transversal competency in the curricula but instead appears in a fragmented manner through isolated courses. This lack of curricular coherence limits students' ability to develop competencies for sustainable action from an interdisciplinary perspective.

To move toward a university truly committed to the SDGs, it is essential to promote curriculum reforms that incorporate goals, content, and methodologies aligned with the 2030 Agenda in an interdisciplinary and transdisciplinary way, as well as implement of institutional monitoring and evaluation mechanisms.

In summary, the results show that university students have high potential as change agents, but they need an educational environment that nurtures their leadership, fosters critical thinking, and facilitates community engagement. The university, in turn, must consolidate its role as a trainer of global citizens and promoters of sustainable development, integrating sustainability as a guiding principle in teaching, research, and community outreach.

The integration of quantitative and qualitative findings allowed for the triangulation of results, providing a more comprehensive understanding of sustainability within the university context. While students show a high willingness to engage in sustainability-related initiatives, the qualitative analysis of curricula reveals a limited institutional integration of the Sustainable Development Goals.

This contrast highlights a structural gap between students' interest in sustainable development and the opportunities provided by the university, reinforcing the need for stronger institutional strategies to promote sustainability education and student participation. These findings contribute to the understanding of higher education as a key space for fostering sustainability competencies and training students as agents of change.

This study provides empirical evidence from a Latin American public university, contributing to the understanding of sustainability education in higher education contexts.

Finally, it is recommended that future research expands the study to other disciplines and universities, incorporating comparative methodologies and longitudinal indicators to evaluate the evolution of students' commitment to the SDGs. These actions will help build a higher education system that embodies the principles of the 2030 Agenda and contributes to a sustainable, equitable, and just future. These findings reinforce the relevance of higher.

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Application of biplot models in the relationship between university sports participation and academic performance for student retention

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This text is part of a doctoral thesis research project at the University of Salamanca, entitled "Models for predicting dropout rates among Chilean university students, based on Educational Learning Analytics."

Introduction

This research aims to evaluate the contribution of sports participation to academic performance and student retention at Bernardo O'Higgins University, Chile. Considering that organized sports participation is positively associated with academic performance and institutional retention when controlled for socio-family factors and subjective conditions of well-being, biplot models are an appropriate tool for representing and exploring these relationships in a multivariate manner. This work presents the conceptual context, theoretical framework, methodological design, operationalization of variables, specification of the biplot model, expected interpretation of results, potential criticisms, and implications for institutional management (Tom St Quinton, 2018; Senevirathne, 2023).

Enrollment in higher education (HE) is increasing worldwide, with twice as many students enrolled between 2000 and 2020 (UNESCO Institute for Statistics, 2022). Chile is the country in the region with the highest increase in HE enrollment (Muñoz & Salazar, 2014), reaching annual growth rates in first-year undergraduate enrollment of 4.2% between 2010 and 2011 (Higher Education Information Service (SIES) - Chilean Ministry of Education, 2017). Although the global pandemic caused a partial decline in enrollment in 2020, the following year saw a recovery in first-year student enrollment, driven by distance learning. In 2021, a particular phenomenon occurred in Chilean undergraduate enrollment, with an increase of 4.6% over the previous year and an increase of up to 68% in distance learning (Higher Education Information Service (SIES) - Chilean Ministry of Education, 2021). By 2024, overall enrollment had increased by 2.2% compared to the previous year (Higher Education Information Service (SIES) - Chilean Ministry of Education, 2024). This increase is related to the incorporation of sectors of the population that traditionally did not have access to HE for economic reasons. Thanks to the promotion of benefits such as scholarships or loans, parents became more motivated to enroll their children in a professional or technical degree program (Dinkelman & Martínez, 2014). On the other hand, state benefits show an increase in retention within the first three years of students with some benefit (Espinoza, et al., 2023). Many of these cases are the first generation to enter higher education, which can be linked to the financing policies implemented by successive governments, which have allowed the entry of sectors that were historically excluded from higher education (Gómez Marcos, Ruiz, & Ruff, 2023). This has enabled many Chilean families to achieve a better quality of life thanks to their children's education, creating opportunities for social

mobility (Fukushi, 2010). These factors explain the expansion and diversification of enrollment over the last 25 years. Therefore, understanding the importance of mass enrollment in higher education, the following study will focus on how higher education institutions contribute to student retention through university life activities, specifically those that focus on sports. It is therefore considered relevant to examine the connection between participating in sports at university and the grades that students obtain, using statistical methods as the main form of multivariate analysis.

Case Study

Bernardo O'Higgins University is part of a Chilean higher education system characterized by socioeconomic heterogeneity among students and retention challenges. International studies have linked sports participation in university settings with cognitive improvements, social networks, and mental health, all of which are potential mediating factors in student retention (Ferdous & Basit, 2025; Malik & Mohammed, 2025). In Chile, there is partial evidence suggesting the beneficial effects of extracurricular activities, but there is a lack of multivariate and visually integrative analysis that simultaneously compares multiple academic, family, and well-being variables. The present study aims to fill this gap by applying biplot models as a tool for synthesis and exploratory analysis (Osmond, 2006).

Context description

An interdisciplinary approach is adopted that integrates social capital theory, human capital theory, and student well-being models. The central hypothesis posits direct and indirect effects: sports practice improves subjective well-being and socio-emotional skills, which affects academic performance and reduces the likelihood of dropping out (Ramayudha, 2018). Contextual variables, such as family support and parents' higher education, function as moderators that condition the magnitude of the effects of sports. Biplot models are conceptually justified by their ability to represent relationships between individuals and variables in a small space, facilitating the identification of patterns relevant to institutional policy (Osmond, 2006).

Validated scales will be proposed for subjective measurements, and administrative records will be used for academic variables, avoiding single self-reporting for core indicators (Ferdous & Basit, 2025). Biplots are expected to enable the visualization of correlations between sports participation and dimensions of performance and well-being, detecting subgroups (e.g., athletes with high family support and high performance) and revealing key variables that explain interindividual variance (Senevirathne, 2023). Integration with confirmatory regressions will allow the marginal contribution of sport to be quantified and interactions with family support and state benefits to be evaluated. The analytical contribution lies in translating complex multivariate relationships into interpretable representations that inform institutional policy decisions. The main objections include the impossibility of establishing causality with cross-sectional design, selection biases (students who practice sports may differ systematically), and limitations of generalization (Ramayudha, 2018). To mitigate these criticisms, extensive statistical control of covariates, sensitivity analysis, and complementarity with longitudinal administrative data when available are proposed. Triangulation with qualitative evidence will address plausible causal

processes. The dependence on the quality of administrative data and the need for scale validation in the Chilean context are recognized (Byun, Jeon, & Yi, 2022). If a robust positive association is confirmed, the university should consider expanding inclusive sports programs, coordinating between student wellness services and academic units, and prioritizing sports scholarships combined with academic support (Malik & Mohammed, 2025). It is critical to design evidence-based interventions that do not exclusively privilege sports elites, promoting accessibility and equity. The findings could inform retention strategies aimed at strengthening social networks and socio-emotional skills as components of academic success.

This study considered 166 student athletes from 24 undergraduate programs at Bernardo O'Higgins University. Fifty-nine were female and 107 were male, belonging to the following teams: futsal, basketball, volleyball, and taekwondo.

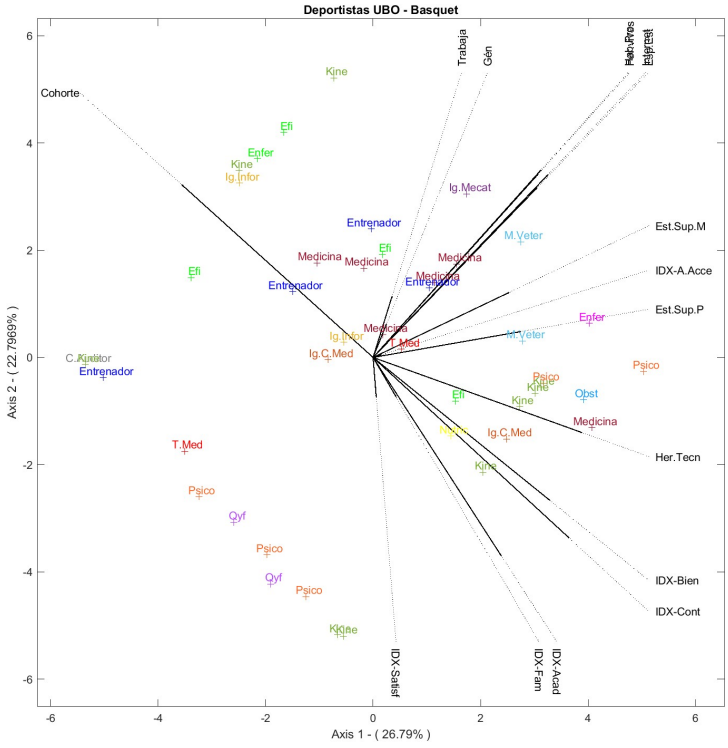
Table 1. Active variables of the HJ-Biplot model and their abbreviations.

Acronym in HJ-Biplot	Name of the original variable
IDX-Acad	Índice Académico General
IDX-Bien	Índice de Bienestar
IDX-Cont	Índice de Continuidad Académica
IDX-Satisf	Índice de Satisfacción Universitaria
IDX-Fam	Índice de Apoyo Familiar
IDX-A.Acce	Índice de Accesibilidad Académica
Her.Tecn	Herramientas Tecnológicas
Hab.Pro	Hábitos Profesionales
Esp.Est	Experiencia Estudiantil Global
Per.vives	Condiciones de Vivienda
Trabaja	Situación Laboral
Internet	Acceso a Internet
Est.Sup.M	Nivel Educacional del Padre
Est.Sup.P	Nivel Educacional de la Madre
Gén	Género
Cohorte	Año de Ingreso

The results shown below were analyzed using the HJ-Biplot model for groups of university athletes who are members of the basketball, volleyball, taekwondo, and futsal teams at Bernardo O'Higgins University (UBO). The multivariate analysis revealed relationships between academic, family, vocational, technological, and well-being variables, with the aim of identifying the factors that influence student retention and academic performance within the context of university sports. The use of the HJ-biplot model revealed groups of people and variables in very easy-to-understand factor planes, where each vector shows what the dimensions seen contribute. In all models, the explained variance was over 50%, ensuring a solid and consistent representation of the internal forms of the data. If a third axis is incorporated into this data, the percentage reaches or exceeds 60%.

Analysis of HJ-Biplot

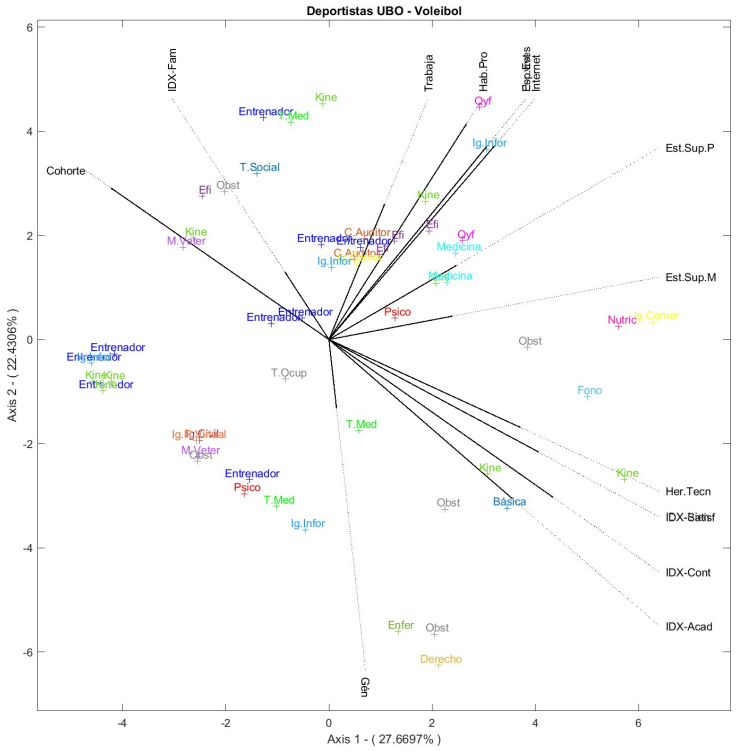
Figure 1. HJ-Biplot – UBO athletes from the basketball team.



Axis 1 (26.79%) – Academic-Family Dimension of Permanence: This axis groups variables such as: IDX-Acad, IDX-Fam, IDX-Cont, IDX-Bien, and IDX-Satisf, which represent indices of satisfaction, well-being, and academic continuity. The highest projections on the far right show consistency between academic performance and family support, consolidating the hypothesis that permanence is based on both performance and family and emotional support. Conversely, individuals on the left side of the axis reflect lower academic satisfaction or institutional disconnection, linked to career profiles with greater medical or psychological demands, where the balance between academic and athletic workload is more complex.

Axis 2 (22.79%) – Vocational and Student Experience Dimension: The second axis is associated with variables such as: Est.Sup.M, Est.Sup.P, IDX-A.Acce, Her.Tecn, and Trabaja, which reflect levels of higher education, academic access, and technological/work support. Positive loadings represent students with upward trajectories, high technological autonomy, and early professional engagement, while negative loadings group profiles that are more dependent on teaching or institutional guidance.

Figure 2. HJ-Biplot – UBO athletes from the volleyball team.

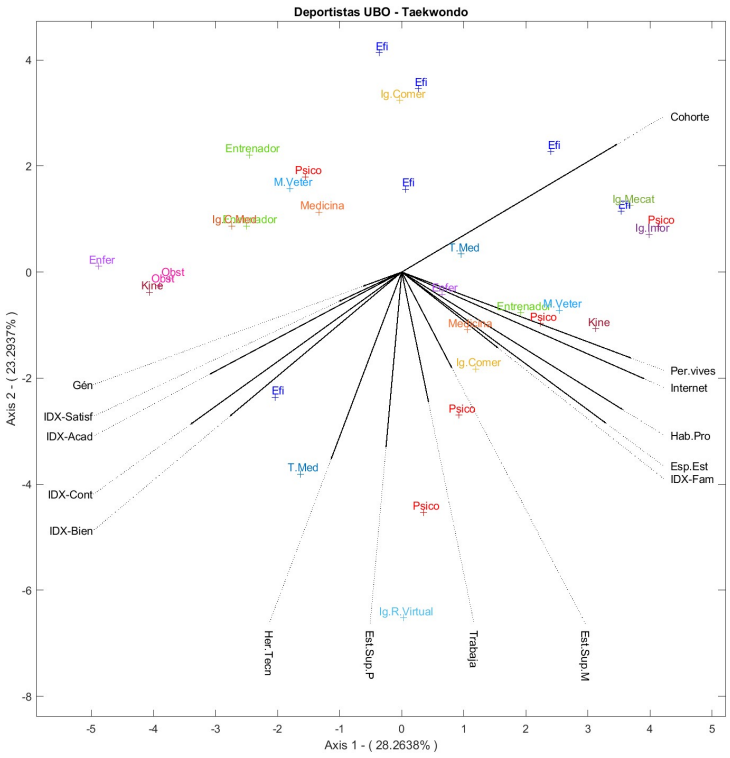


Axis 1 – Academic Success and Personal Autonomy Dimension: Explains 27.66% of the variability and is strongly determined by the variables IDX-Acad, IDX-Cont, IDX-Satisf, Her.Tecn, and Est.Sup.M/P.

These variables are associated with sustained academic performance, institutional satisfaction, and autonomous use of technological resources, reflecting a stable and self-regulated educational trajectory. Students projected on the far right of this axis show high levels of satisfaction, continuity, and technological mastery, particularly those in Kinesiology, Obstetrics, and Physical Education, who exhibit synergy between sports discipline and academic progress. In contrast, the left end is concentrated with students from Law, Occupational Therapy, and Industrial Civil Engineering, whose trajectories combine high academic demands with a lower perception of institutional support and a weaker emotional connection to the university. This is consistent with research showing that heavy academic workloads can create tensions between academic performance and athletic commitment.

Axis 2 – Family and Socio-emotional Dimension: Accounts for 22.43% and is made up of IDX-Fam, Works, Hab. Pro, and Internet Bases, which express the influence of family context and socioeconomic conditions on the student experience. Students in the upper quadrant have greater family support, work participation, and established professional habits, which enhances their retention. The lower quadrant, on the other hand, concentrates on majors with a high academic load and less direct family support (e.g., Medicine and Psychology), showing that the emotional environment modulates the ability to simultaneously sustain sports practice and academic performance.

Figure 3. HJ-Biplot – UBO athletes from the Taekwondo team.

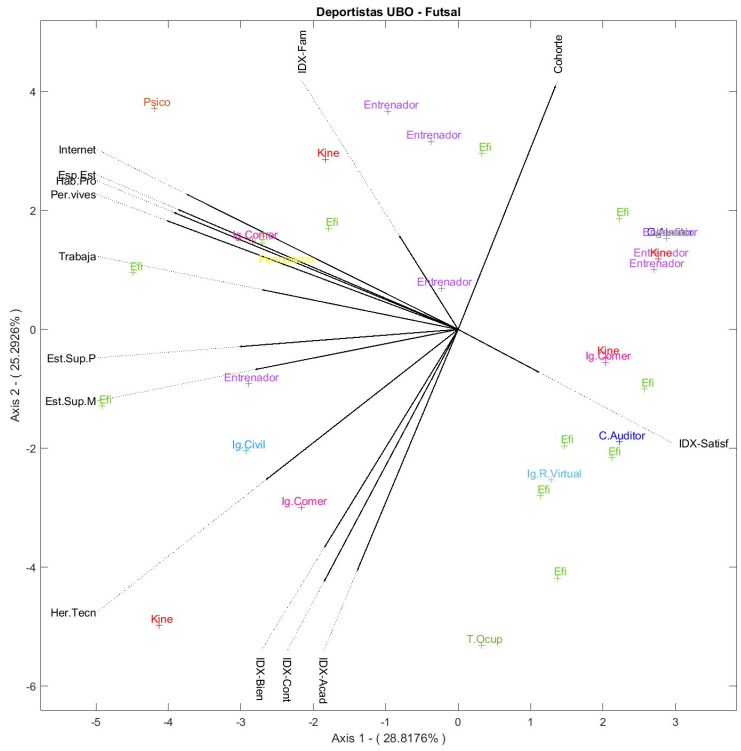


Axis 1 – Academic-Vocational Dimension: The first axis (28.26%) is dominated by variables such as IDX-Acad, IDX-Cont, IDX-Bien, Her.Tecn, and Est.Sup.M/P, which represent academic performance, educational continuity, and technological self-management. Students in the right quadrant (such as Medicine, Psychology, Mechatronics Engineering, and Kinesiology) have profiles of high academic autonomy and vocational projection, accompanied by strong family support and solid professional habits. These results reinforce the hypothesis that the practice of Taekwondo—due to its disciplined and individual nature—fosters autonomy, planning, and self-regulation, factors that positively impact academic performance.

Axis 2 – Family Dimension and Lifestyle Habits: The second axis (23.23%) integrates variables such as IDX-Fam, Esp.Est, Hab.Pro, Internet, and Per.vives, which reflect the influence of the family environment and living conditions on retention. Students at the top of the graph (e.g., Physical Education and Veterinary Medicine) have high levels of well-being, family cohesion, and

healthy habits, factors directly related to university retention. Conversely, those at the bottom (Engineering and Medical Therapy) show less association with the family axis, probably due to a heavier academic load and less time available, although they maintain high levels of individual satisfaction and institutional commitment. In the left quadrant, where Nursing, Obstetrics, and Virtual Resources Engineering converge, there is a greater association with IDX-Well and IDX-Satisf, reflecting an orientation toward well-being and emotional stability rather than academic competition. This duality indicates that the group presents a balance between performance and psychological well-being, both enhanced by regular sports practice.

Figure 4. HJ-Biplot – UBO athletes from the Futsal team.



Axis 1 – Academic Performance and Continuity Dimension: Axis 1, which explains 28.82% of the total variability, is mainly determined by the variables IDX-Acad, IDX-Cont, IDX-Bien, and Her.Tecn. The vectors oriented toward the far right (such as Physical Education, Accounting and Auditing, Business Engineering, and Occupational Therapy) indicate high levels of academic performance, institutional continuity, and satisfaction, which demonstrates the ability to balance sports practice with curricular demands. Individuals on the far left (e.g., Psychology and Kinesiology) have a stronger relationship with Her.Tecn and a weaker connection with satisfaction indices, which could reflect academic overload or time constraints arising from their professional training. This pattern confirms that futsal athletes tend to develop academic autonomy and time management skills, factors that are positively associated with retention.

Axis 2 – Family and Socioeconomic Dimension: Axis 2 (25.29%) groups variables related to the socio-family context, such as IDX-Fam, Per.vives, Esp.Est, Hab.Pro, Internet, and Trabaja. The

vectors with the highest positive weight (upper part of the plane) show a strong influence of the family and economic environment on academic retention, demonstrating that those who have stable family support and technological resources maintain a higher level of well-being and satisfaction. In contrast, the lower vectors of the axis reflect more autonomous or self-demanding trajectories, where technological and academic self-management partially replaces the role of family support, a pattern frequently seen in working students or those who are financially independent.

Conclusions

The results observed with the HJ-Biplot models confirm that participation in sports at university is a multidimensional factor that helps students stay in school and perform well academically. The links between well-being, family support, institutional satisfaction, and academic continuity show that playing sports not only improves performance but also strengthens students' emotional and social bonds, acting as a connector of stability and commitment to their studies. Likewise, the differences between studies and sports show that both personal independence (in sports such as taekwondo) and group unity (in basketball, volleyball, and futsal) are linked to the variables of well-being and academic access. In summary, participating in organized sports seems to be an indirect advance for academic performance and retention. Therefore, the HJ-Biplot model allows us to demonstrate and contribute to higher education institutions that providing complementary services such as sports is a strong indicator of stability for students and their retention in their studies.

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Beyond social work, determining the linkage activities carried out by the universities

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Introduction

There are countless experiences worldwide that outline the linkage activities that universities apply in their own surroundings. Just as there are a variety of activities, there is a multiplicity of definitions that try to explain the nature of this university mission. The classic definitions include those that have an economistic vision that validates linkage activities as long as they represent income for the universities, and those that have a social responsibility vision that aims at reducing the distance between society and the university, regardless of the type of activity that takes place in this approach.

The transfer and exchange of knowledge between universities and society as a whole is a necessity recognized by researchers, businesses, and public administrations alike. A review of the international literature confirms that knowledge transfer as a third mission is pursued by universities worldwide, albeit with different approaches and models (Osorio-García & López-Rosado, 2024. These classical positions do not cover what universities apply as linkage activities. First, it is necessary to clarify what is understood by this concept, and second, to identify the activities that are part of the university linkage.

Reflecting the nature of the third mission of the Valencia Manual D´Este *et al*. (2014), state that linkage is understood as the set of university activities related to: a) the generation of knowledge and capabilities in collaboration with non-academic organizations and agents, as well as b) the use, application and exploitation of the university's existing knowledge and other capabilities outside the academic environment (Table 1).

Table 1. *Classification of linkage activities.* **Source**. D´Este *et al*. (2014).

		Linkage Activities
Capabilities	Knowledge stock	Results marketing
		Entrepreneurship
		Advisory and consulting
	Physical infrastructure	Marketing of infrastructure-based services
Activities	Research	Research contracts
		Collaboration in research projects
	Teaching	Personnel mobility
		Internships in companies
		Courses and training activities
		Curricular alignment
	Dissemination	Social network formation
		Non-academic dissemination

The role of universities and their linkage activities

Benavides and Borrell (2023) argue that teaching and research without contact with the reality of problems and their possible solutions is bookish and futile. Academia and professional practice must maintain a two-way relationship that nourishes and fosters growth. The role of universities, as far as social action is concerned, is not to play the role of the State or of NGOs. Its function, on the contrary, is to assume in the best way its role of integral formation of people with ethical purposes and in search of the sustainable development of its community (Beltrán-Llevador *et al.*, 2014). Linkage is not simply offering services free of charge to vulnerable groups; its essence goes beyond gratuity; it is rather to offer services based on research results that may or may not generate income for the university. Thus, the third mission has two dimensions, one economic (human resources, intellectual property, spin-offs and contracts with industry) and another social (public understanding of science, participation in social and cultural life, participation in policymaking and contracts with public bodies) (Laredo, 2007).

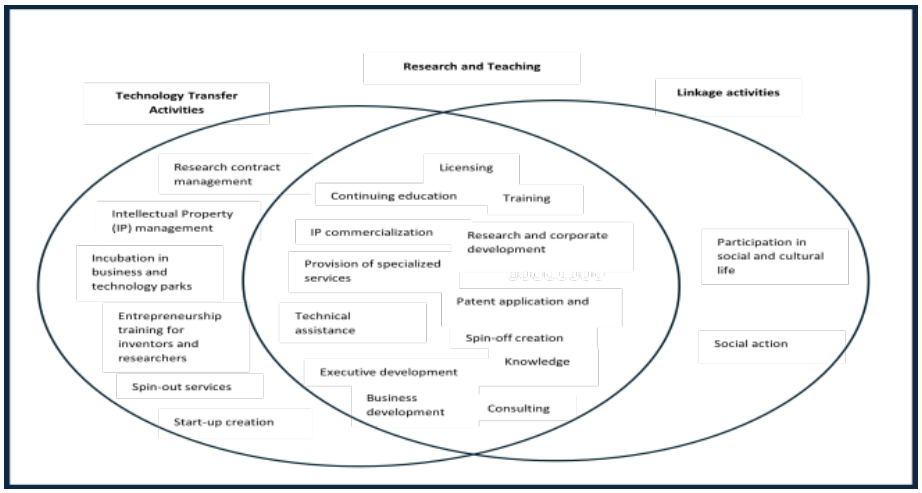
An important component observed in models developed to determine linkage in Higher Education Institutions (HEIs) is the establishment of research and technology transfer activities as generators of linkage activities. In other words, linkage is not simply limited to social work, cultural activities, community service and sports activities, as some countries consider it to be.

Technology transfer (TT) can be divided into three groups: First, aspects related to the provision of specialized services, consulting services, training and continuing education programs, technical assistance, research contract management, business planning services for inventors and researchers, and corporate research and development arrangements. (Alessandrini *et al.*, 2013; Martínez-Senra *et al.*, 2012; Necoechea-Mondragón *et al.*, 2013; Ranga *et al.*, 2016). Second, the management of intellectual property, application for and obtaining of patents based on research results, commercialization of intellectual property, and income from licensing agreements (Alessandrini *et al.*, 2013; Feng *et al.*, 2012; González-Pernía *et al.*, 2013; Necoechea-Mondragón *et al.*, 2013; Ranga *et al.*, 2016; Schoen *et al.*, 2014; Vinig & Lips, 2015).

And thirdly, spin-out tools, spin-off creation (González-Pernía *et al.*, 2013; Ranga *et al.*, 2016; Vinig & Lips, 2015), creation of start-ups and business incubation services and technology parks (González-Pernía *et al.*, 2013).

Based on the reviewed literature, Figure 1 presents the activities of technology transfer (TT) and linkage with society that universities should develop. As can be seen, social action and participation in social and cultural life are only considered to be linkage activities; the rest of the activities are directly related to TT, whose main input is R&D performed by the university.

Figure 1. Relationship between TT and linkage.



Source: Rueda et al. (2020)

Therefore, the basis for the university's linkage with society lies on the one hand in the needs of the business sector, and on the other hand in the economic possibilities of acquiring the knowledge and skills required by the business sector. This sector thus constitutes a social structure that demands technology and receives the knowledge and innovations generated by universities (Medina *et al.*, 2016).

In order to determine the correspondence of linkage and the state of the relationship with society in Ecuadorian universities, we worked with the universe of 60 Higher Education Institutions, including public, private and co-financed institutions currently operating in the country. The information was collected through the secondary source available on the website of each institution to analyze aspects related to the relationship with society in 2018 and 2023. The following documentation was reviewed for the analysis of these years: a) 42 regulations and policies associated with linkage; b) 102 accountability reports and management reports for the years 2018 and 2023; and c) 53 strategic plans in effect for 2018, and 54 plans in effect for 2023.

The data were examined through content analysis based on the review of the literature presented in the previous section, and in terms of the following theoretical constructs: a) the HEI has a strategic plan in force for the year under analysis and how many of its objectives are related

to linkage; b) quantity and type of linkage activities carried out by the institution; correspondence of the activities carried out with the concept of linking with society; and, d) ratio of activities declared in the regulations to those reported in the accountability reports. By analyzing the data according to these criteria, the results will show how linkage is articulated in strategic planning and which linkage actions are most present in the objectives; the most developed linkage activities carried out by the HEI; activities that are not, but are declared to be of a linkage nature; the activities that, being linkage activities, are declared as part of the teaching or research aspect; and the correspondence between what was planned and what was executed in relation to linkage.

There are 60 higher education institutions in Ecuador, comprising 52 universities and 8 polytechnic schools; of which 33 are public, 19 are private and 8 are co-financed, which shows that the country's higher education is supported by the State. Of the total number of HEIs, half are located in Quito and Guayaquil; in other words, higher education is concentrated in two urban centers. Of the 60 HEIs, 82% (49) have a formally established department of linkage in their organizational structure, whose function is to plan, organize, monitor and evaluate linkage activities. The data show that the third mission is institutionalized in Ecuadorian HEIs. This institutional framework is the result of the application of evaluation and accreditation models imposed by the governing organizations of higher education since 2010. Although there are universities without linkage departments, it was found that they do carry out linkage activities in accordance with the provisions established by control agencies such as CEAACES (Council for Assessment, Accreditation and Quality Assurance in Higher Education).

This institutionalization of linkage was also verified by analyzing the objectives proposed in the strategic plans of the HEIs. As of 2018, of the total number of universities, 88% had a strategic plan in place. By 2023, 90% of HEIs had a strategic plan in place; of these, 96% included explicit objectives related to linkage, which demonstrates that strategic planning processes have taken root in most Ecuadorian HEIs. These objectives are classified into six main areas. Notably, 55% of them are focused on increasing the number of beneficiaries and the overall level of linkage. Other goals include expanding the number of programs and projects (25%), creating strategic alliances (18%), and improving community well-being (16%). Less frequently, institutions aim to enhance internal systems for managing linkage (7%) and to raise awareness within the university community (4%). This reflects a clear orientation of HEIs towards strengthening

On the other hand, when analyzing the activities identified on the institutional web pages, it was determined that there are 20 types of actions that the HEIs consider as linkage activities. According to the reviewed literature, 10 activities are considered simultaneously as linkage and technology transfer (LATT), two are exclusively linkage activities with society (LA), and eight are not linkage activities, although universities consider them as such (NLA) (Table 2**¡Error! No se encuentra el origen de la referencia.**). This shows that universities devote their efforts to 40% of activities that do not add impact in terms of linkage with society.

Comparing the activities recorded by each HEI as linkage with society between 2018 and 2023 (Table 2), there is evidence of a significant change in the stated linkage practices. Although there is a growth in the declaration of activities such as continuing education, community services,

training and research-linkage, there is also evidence of a decrease in key activities such as social action, consulting and spin-off creation, which are fundamental from the social and economic approach of university linkage. In addition, the table shows that some non-corresponding activities (NV) have considerably increased their presence on institutional portals (international relations and student and faculty mobility), which suggests that HEIs still confuse internationalization or professional training with social linkage.

Table 2. *Activities reported by HEIs as linkage*. **Source.** Own elaboration.

Type	Activity	% of HEIs reporting 2018	% of HEIs reporting 2023	Differences	Correspondence
LA	Social action	88%	76%	-12%	Yes
LA	Participation in social and cultural life	42%	55%	13%	Yes
LATT	Continuing education	60%	76%	16%	Yes
LATT	Community service	43%	86%	43%	Yes
LATT	Training	42%	80%	38%	Yes
LATT	Consulting	37%	18%	-19%	Yes
LATT	Specialized Services	33%	43%	10%	Yes
LATT	Research-linkage	48%	82%	34%	Yes
LATT	Technology transfer	18%	27%	9%	Yes
LATT	Spin-off creation	37%	22%	-15%	Yes
LATT	Technical support	17%	27%	10%	Yes
LATT	Patent application and procurement	2%	2%	0%	Yes
NLA	Internships	67%	78%	11%	No
NLA	Networking	18%	61%	43%	No
NLA	Graduate follow-up	40%	67%	27%	No
NLA	Job placement	22%	53%	31%	No
NLA	Student and faculty mobility	18%	67%	49%	No
NLA	International relations	10%	71%	61%	No
NLA	Sports	7%	45%	38%	No
NLA	Research assistantships	3%	18%	15%	No

The table above shows that activities that are not strictly speaking related to linkage, such as internships and apprenticeships, graduate follow-up and job placement, have a greater presence in the same linkage portals, although these activities, according to the literature review, do not form part of the same. This behavior is the result of policymakers' limited knowledge of the subject, which transmits partial and mistaken conceptions regarding the practice of linkage with society. In addition, important differences were identified between what was established and what was executed. In 2023, only 48% of the planned activities were reported as effectively carried out.

A 38% were not reported, despite being considered in the regulations or institutional portals; and 8% were classified outside the linkage dimension, despite corresponding to it. The practice of including activities that are not recognized as "linkage" also persists (6% in 2023). Compared to 2018, there was a slight improvement in reporting (from 40% to 48%), but also an increase in unreported activities (from 30% to 38%), and a reduction in misclassified activities, both those wrongly excluded from the linkage category (from 12% to 8%) and those incorrectly included (from 18% to 6%) A more detailed analysis of each of the 20 declared activities reveals significant inconsistencies between the regulations and the practice of HEIs in terms of their linkage with society (Table 3). Although some activities such as social action, research-linkage and continuing education show high levels of consistency between what is regulated and what is reported, other key actions such as consulting, spin-off creation and participation in social and cultural life are often reported outside the dimension of linkage, despite being recognized in the regulations. This shows weaknesses in institutional management, as well as a fragmented understanding of the concept of linkage, which limits the visibility and impact of these activities.

Table 3. *Report by linkage activity*. **Source.** Own elaboration.

Action	Type	2018			2023			Correspondence
		Y [a]	YLA[b]	YLAo[c]	Y[a]	YLA[b]	YLAO[c]	
V	Social action	42	0	1	37	1	3	Yes
VT	Community service	21	0	5	42	1	0	Yes
VT	Continuing education	14	6	2	37	3	1	Yes
VT	Training	14	2	6	39	4	1	Yes
VT	Specialized services	8	2	8	21	4	5	Yes
V	Participation in social and cultural life	8	4	4	27	7	5	Yes
VT	Spin-off creation	7	4	5	11	6	8	Yes
VT	Consulting	4	4	2	9	7	9	Yes
VT	Technical support	4	0	0	13	3	9	Yes
VT	Technology transfer	2	0	7	13	6	6	Yes
VT	Research-linkage	3	1	5	40	2	0	Yes
VT	Patent application and procurement	0	0	0	6	4	0	Yes
NV	Internships	13	9	2	38	2	0	No
NV	Graduate follow-up	7	10	4	33	3	0	No
NV	Job placement	4	1	4	26	0	4	No
NV	Student and faculty mobility	2	2	6	33	6	0	No
NV	International relations	1	3	6	35	2	1	No
NV	Sports	1	0	2	22	7	4	No
NV	Research assistantships	0	0	0	9	7	0	No
NV	Networking	0	2	11	30	4	1	No

[a] The amounts correspond to the 60 HEIs

[b] Activities that HEIs report outside of linkage, even though they considered them to be within.

[c] Activities reported by HEIs as part of the linkage activities, although they considered them to be outside of it.

Of the activities carried out, social action, community services and continuing education are the most applied by Ecuadorian HEIs. As argued by Nunes & Machado (2018), in Latin America linkage has a different connotation than the approach in developed countries. In Latin America, linkage has been understood as cultural diffusion and social services to disadvantaged groups. Although there are more linkage activities, the concentration on only three types is due to the fact that the institutions that regulate higher education evaluate only these activities in their institutional accreditation models; it is observed that the State has a limited vision of the real scope of the processes of linkage with society by HEIs. This is explained by saying what needs to be done, but not establishing clear procedures to manage the linkage (Medina *et al.*, 2016). In order to ensure adequate management, a system is required that identifies categories, dimensions and indicators to measure the impact and efficiency of the linkage with society, in a manner more in line with what the literature indicates as linkage activities. By having a system that manages linkage, Ecuadorian universities are expected to comply with the relevant linkage criteria, moving away from a merely assistance trend. The partial understanding of the concept of linkage also leads to incorrect interpretations that result in the development of activities that cannot be considered as community linkage.

Conclusion

Although the linkage with society has gained institutionalization in Ecuadorian HEIs, weaknesses persist in its management, classification and execution. Concentration in a few activities, encouraged by state evaluation models, limits the diversity and depth of linkage. In addition, the lack of conceptual clarity leads to the inclusion of non-relevant activities within this dimension. It is urgent to establish a national classification and measurement system that allows for an integrated and effective management of university linkage, overcoming an assistance-based vision and moving towards a model of transformative interaction between university and society.

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Modeling university-rural community interaction from the design complexity of university social responsibility

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Introduction

One of the central concerns of university work is how academia should interact with the socioeconomic reality of its populations and, as a result, participate in improving the well-being of communities. From this perspective, it is proposed that the university can and should engage with vulnerable rural areas through modeled interaction schemes that offer a portfolio of community services (Rijalba, 2022a), leading to improved living conditions and focused on university social responsibility (USR).

The purpose of this study, then, is to design a knowledge transfer management model based on a minimum viable portfolio (MVP) framed within university USR and the systematization of the accumulated experience of academia in its interaction with rural communities (Procentese *et al.*, 2019). The goal is to establish an interaction model that ensures knowledge transfer through capacity building, participation, and community organization (Orellana *et al.*, 2022).

Fundamentals of the interaction model

Based on Rijalba's (2022b) research, the mechanisms of interaction between the University and rural communities have been identified with the aim of contributing to improving living conditions. According to this study, it is necessary for academia to participate in local development processes, for which a modeling proposal is developed based on the design of an interaction model that facilitates the management and transfer of knowledge and social technology in favor of community spaces. To this end, the objectives of the model, the premises and assumptions that support it, the current scenario of the reality to be transformed, the minimum viable portfolio of community services (Rijalba, 2022a), the interaction proposal, its operating mechanism, implementation strategies and expected results for which the method is used have been identified.

To support the proposed model, the relationship that should exist between academia and society has been identified, taking the university-rural community dyad as the object of study. This involves recognizing the university's accumulated experience in rural areas and investigating

what the minimum viable portfolio of community services should be, as well as determining how to develop and transfer social technology (ST) from university work (Rijalba, 2022b).

Conceptual bases of the university-business interaction model

An interaction model understood in this way constitutes an important social contribution to validate the interaction between universities and rural communities and is capable of contributing to improving their living conditions, provided that the transfer of knowledge is adequately managed based on a minimum viable portfolio (MVP) such as the one presented in Rijalba (2022a). The resulting conceptual corpus is centered on an interaction process that configures an innovative community ecosystem focused on aspects of community organization, capacity building, and citizen participation.

This turns out to be the conceptual and epistemic basis that allows for a scientific approach to a complex reality. This has not only facilitated the construction of interaction models but has also led us toward the path of recognizing and identifying community problems and their complexity, which means acknowledging community members' perceptions of their own reality. The university must interact with these realities based on the natural thinking emanating from communities and, based on this, manage the transfer of knowledge (Nava, 2023).

Along the same lines, this conceptual corpus has made it possible to recognize community members' evaluative responses to participate in capacity-building processes. This becomes especially important when relating such evaluation to the need to identify their own problems, leverage their knowledge, and seek participatory solutions. The capacity for interaction must be harnessed by the university, which, based on its accumulated experience and duly systematized, must be able to renew and strengthen existing ties, but also generate new, highly participatory connections (González, 2015) and (Rijalba, 2022b).

University-business link

The university-community link is a connection that must be built. Garbizo *et al*. (2020) argue that there is broad consensus that the university bases its work on three missions, namely, the formation of human capital, the generation of new knowledge, and the transfer of knowledge. Thus, the university must conduct actions that entail benefits for society, beyond the construction of knowledge, and the training of students must be visible to all (McBey, 2018). In this regard, Tracy (2021) points out that this link faces growing but weak demands in terms of availability of resources and vocation. This reality should induce us to rethink the aforementioned connection and understand it as a space for reconfiguration of the public with citizen and community participation, as inferred from Cevallos *et al.* (2025). Under this theoretical review, it is understood, then, that the modes of relationship, resource management and cultural practices, can facilitate or limit the exchange of mutual value that all innovation has to generate social value (Macay *et al.*, 2020). Therefore, it is about raising social wealth and knowledge from reality itself (Puig, 2017) and, in this task, it is necessary to search for alternatives to socioeconomic development from its connection with society, configuring a link that, according to Rijalba (2021b), is still weak in relation to historical education and community profiles.

According to Rijalba (2022b), the inhabitants of a territory behave as potential users and/or applicants for social goods and services where needs of common interest and particular interest are combined. The inhabitant behaves as a client in the sense that he or she seeks to satisfy one or more needs, so his or her behavior is aligned with the Customer Journey Map proposal referenced by Fierro (2019), according to which the customer experience map is a visual representation of the process that the beneficiary goes through to achieve an organizational objective. In a mapped trajectory, it is possible to identify needs and critical points constructed with the participation of the user (Bell, 2017).

To address this problematic reality, it was necessary to apply the inductive scientific method, since community behaviour and relationships must be recognized in order to infer social processes from their own reality. Along with this, the abductive component is used to construct a university-community interaction model that recognizes its strengths, but also its weaknesses. As we can see, hermeneutics and social cartography were present, providing sufficient elements to construct the transformation proposal derived from this research. This was materialized through what is known as the Method for the Application of Educational Innovation (MAIN), which is configured as a design method for educational innovation that allows for its planning, application, and dissemination.

Using these methods, it was possible to capture some of the community's complexity, as well as to identify sociocultural components, value-based responses to participatory and capacity-building processes, and community knowledge, with the aim of demonstrating forms of organization and bases of participation to address local problems. As a result of this process, the knowledge transfer management model for rural communities (MGTCCR) was established from the perspective of the economics profession, and strategies for managing the implementation of this management model were proposed Sanchez (2026) and (Rijalba, 2022b).

In summary, the methodological approach is based on design technology for highly complex community settings. The inductive method is prioritized to recognize community behavior and relationships and infer social processes from their own reality, but deductive and abductive methods are also used to facilitate the modeling of university-community interaction patterns, incorporating community strengths and weaknesses. This triangulation of methods achieves an approach to fractal analysis, given that we are dealing with a framework governed by irregular or fractured, yet recurring, patterns. The fractal method seeks to understand the complexities inherent in community relations, utilizing statistical and design tools and agile methodologies such as CANVAS, Learning by Doing, and KANBAS, among others, since traditional methods are often insufficient in these types of interactions.

The main outcome of this study is the design of the university-rural community interaction model, which should be understood as a framework whose content should specify the purpose of the transformation proposal, its premises, and assumptions. It should also include an analysis of its relevance, the minimum viable portfolio of community services, the interaction model itself, and its ex ante evaluation (Rijalba, 2022b).

Objective of the interaction model

Manage the transfer of knowledge to rural communities through university work to contribute to improving living conditions.

Premises and assumptions

The management model for knowledge transfer to rural communities, hereinafter MGTCCR (Rijalba, 2022b), requires premises and assumptions to enable its functioning logic. These are:

a. Communities not only have problems but also solutions.

b. A community's pre-existing knowledge must be recognized and utilized to promote endogenous and community development.

c. Capacity building and collaborative citizen participation contribute to improving living conditions.

d. Social innovation through human capital development and knowledge transfer.

e. Knowledge transfer constitutes the third mission of the university.

f. It is possible to create and transfer social technology through university work by identifying mechanisms for sustainable interaction.

Relevance of a university interaction model

The relevance of the management model for knowledge transfer to rural communities (MGTCCR) from the university perspective is justified by the need to build and implement university interaction models to address complex realities with a scientific perspective. Strengthening and renewing the connection with society must be addressed through academic spaces and the construction of an innovative ecosystem, in this case, a community one (Rijalba, 2022b). Here, the importance of the connection between university and society is raised based on the construction of a much broader and freer epistemic model that respects community knowledge and facilitates the understanding of community realities through complex and holistic approaches (McBey, 2018).

Current scenario to be transformed

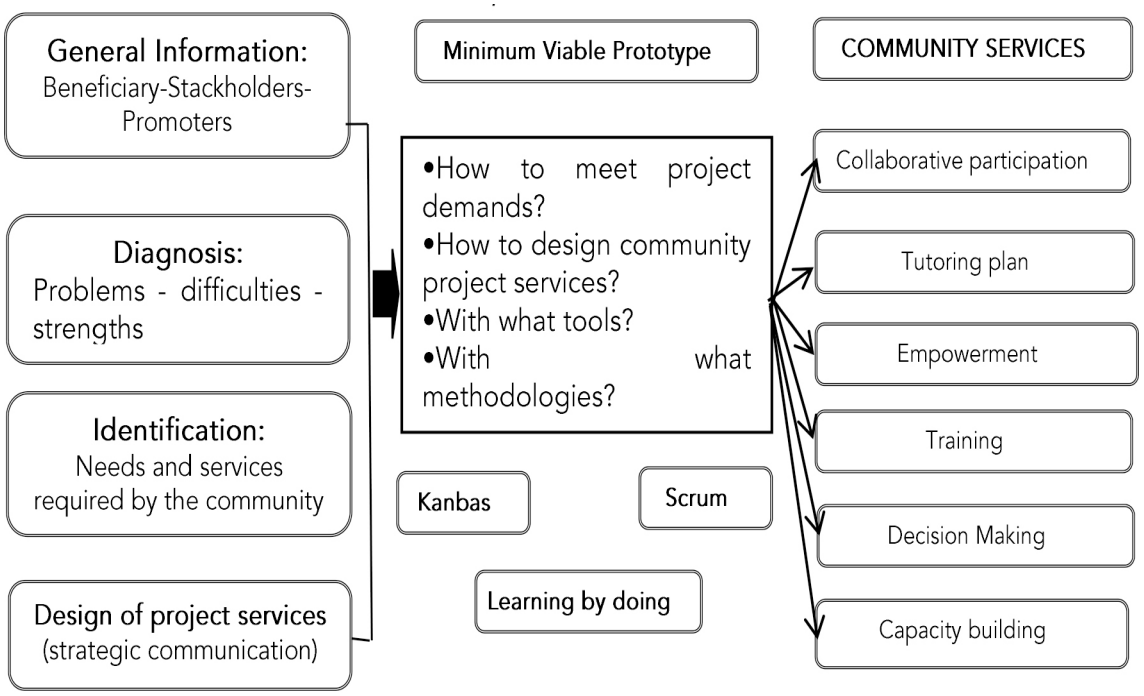
The rural community setting in Piura is not strictly different from that in the highlands of Latin America (Rijalba, 2022b). However, each territory offers specific characteristics of community relations, so the form of interaction must be related to the setting to be transformed. Rural settings tend to be characterized by high levels of community disorganization, limited transparency in public decisions, problems in the provision of public goods such as health and education, and a lack of participation of residents in community decisions. The greatest difficulty is related to the recognition of community problems (Rijalba, 2022a).

Once the scenario to be transformed is recognized, the minimum viable portfolio (MVP) prototype is designed, which must be realistic, consistent with the community vision, and must have a high level of participatory commitment. The minimum viable portfolio (MVP) considers a multidisciplinary design that transversally uses endogenous development models, design technology, and the complexity of community realities. This is reflected in Rijalba (2022a) and Rijalba (2022b), in line with that maintained by Moreno & Salcedo (2025). This is the scenario that must be transformed with strategies of learning by doing and learning by teaching to learn. That is, learning to recognize the difficulties in organizing, making decisions, and participating as a community in solving local problems.

Minimum Viable Prototype (MVP) Design

The Minimum Viable Prototype (MVP) of community services must identify the difficulties that the population involved has in organizing, making decisions and participating in the community in solving their problems (Rijalba, 2022a). In this challenge, using the well-known customer journey map echnique will allow for a mapped representation of the user or community resident experience (Figure 1).

Figure 1. Minimum Viable Prototype (MVP) of community services. Source: authors.



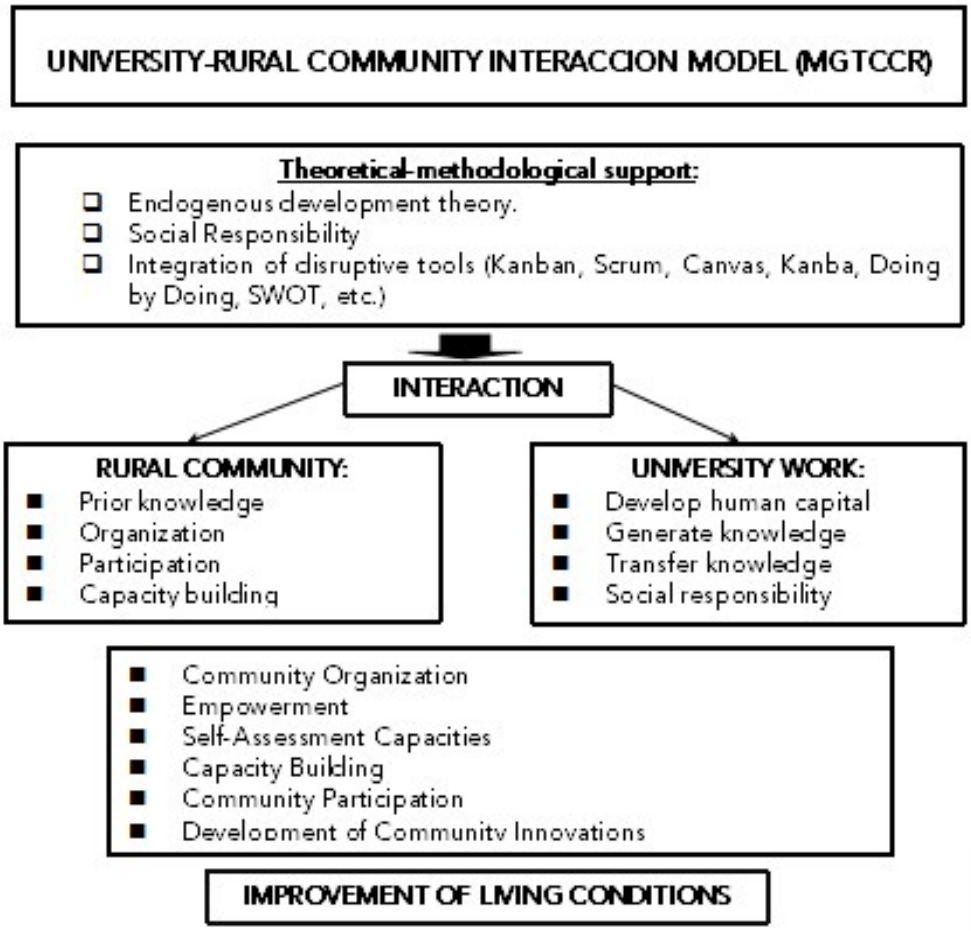
Based on this review, the prototype of the service emerging from the proposal to implement the community development project required in the rural setting is identified. Initially, a community project that provides training and capacity-building services to these populations. This construction is possible after several community interactions based on diagnoses that triangulate

SWOT techniques and agile methodologies such as CANVAS and KANVA. The purpose is to participatively build the Minimum Viable Portfolio of Community Services (Rijalba, 2022a).

The interaction model

The interaction model achieved has been called the Knowledge Transfer Management Model for Rural Communities, hereinafter MGTCCR. (Rijalba, 2022b). This must be identified from a concrete reality and planned with a visionary perspective, which requires recognizing the complexity of the community environment; that is, it must be understood how the set of activities aimed at achieving objectives interact to respond to the needs and aspirations of communities (Figura 2).

Figura 2. University-rural community interaction model. Source: authors.



Validation of the interaction model

The validation of the proposed model must be tested based on its social, economic, and financial viability, as well as its design relevance. Its implementation requires preliminary information regarding a participatory self-assessment at the community level, as well as the strength and

sustainability of the services considered in the minimum viable portfolio. This triangulation involves observation of community spaces, participatory workshops, and qualitative and documentary analysis to achieve constructive levels of depth.

This also involves identifying community relationships and evaluative responses from residents to engage in participatory and capacity-building processes. This is especially important when building an interaction model centered on fractal analysis and social mapping, as well as applying techniques for administration, design, and management of social projects (Rijalba, 2022b). From the strategic management of social projects, the model must be able to identify the most appropriate prototype for community spaces framed within change and innovation. To achieve this, it is necessary to establish the Minimum Viable Portfolio (MVP) of Community Services (Rijalba, 2022a).

From an academic perspective, this model should be inserted into the context of University Social Responsibility (USR), which should contribute to the design of the community resident profile by applying, for example, the Customer Journey Map technique as a basis for designing the MVP that fosters community participation. The model is part of a comprehensive and fractal design architecture of the components of community complexity. The goal is to achieve a final architecture based on learning-by-doing strategies, that is, learning by doing and learning by teaching to learn (Rijalba, 2022a).

Analysis of results

The central outcome of this research has been the development of a proposed university-rural community interaction model, which is highly valuable and constitutes a true social innovation. It is important to note that its relevance lies where community management is the responsibility of the beneficiaries themselves. The prototyping presented in this study allows for rapid testing and validation of contributions that may arise from feedback from residents. It also allows for the sustainability of the interaction model and a service MVP that must be updated with community participation and feedback processes that incorporate new community services, the activation of new change agents, and coordination with the strategic objectives outlined in local endogenous development policies. The sustainability of the model is based on the support provided by the university, local authorities, and the formation of alliances with institutions and civil society organizations (Rijalba, 2022a).

Conclusions

The results indicate that the design of university-community interaction models is viable, provided that it is recognized that complex systems interact with each other within every community. These generate observable, self-organizing, and adaptable patterns and evaluative responses, but also critical and fluctuating. Therefore, interdisciplinary, multidisciplinary, and transdisciplinary academic participation is required, as the model involves combining the accumulated and systematized experience of academia, the design of the MVP of services related to organization, capacity building, social participation, and the use of prior knowledge; as well as the visionary and innovative perspective of academia to achieve sustainable project interventions that contribute to improving community well-being. Future studies should explore

the institutional and regulatory aspects of university work, as well as the design of public policies framed within SDGs 1 and 4.

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Teacher Training, Curriculum, and Assessment Practices

Science Education in Vulnerable Contexts: Experiences of Pre-service Primary School Teachers in Santiago, Chile

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Introduction

Strengthening initial science teacher education has become an unavoidable challenge for faculties of education, especially when it comes to preparing professionals capable of teaching in contexts of high social vulnerability. Teaching science in marginalized communities demands not only disciplinary and pedagogical expertise but also an understanding of the role that school science plays in advancing social justice. Nonetheless, disparities in access and participation continue to affect children from disadvantaged communities in the scientific domain, and inequity in science education is not merely a curricular issue—it is also structural, political, and cultural in nature (Okeke & Ramaila, 2025).

Direct engagement with underserved communities enables future teachers to reframe the meaning of science teaching, fostering an ethical and critical stance toward conditions of exclusion (Turra *et al.*, 2015). In particular, immersive experiences in schools with high levels of poverty can bring about profound identity transformations in pre-service teachers, as they are confronted with new understandings of teacher autonomy, their commitment to equity, and their conception of science as a socially situated tool (Arroyo González *et al.*, 2025).

Furthermore, it has been argued that children historically excluded from scientific discourse can become active participants in knowledge construction when they are recognized as valid subjects within the school setting. In this regard, the classroom is proposed as a space for co-construction, agency, and justice (Venegas-Weber *et al.*, 2024).

From this perspective, the present study sought to explore and understand how a group of pre-service primary school teachers experienced their science teaching practicum, having implemented science workshops in schools located in vulnerable areas of Santiago, Chile. The intervention aimed to strengthen their pedagogical and disciplinary competencies while promoting ethical and context-sensitive reflections on the teaching profession in communities with limited access to educational resources.

Through interviews, participant observation, and reflective journaling, the study investigated the meanings that the future teachers attributed to their experience, as well as the professional learning outcomes that emerged from this situated interaction. The qualitative and interpretive analysis allowed for the identification of significant transformations in pedagogical, identity-

based, and ethical dimensions—reinforcing the idea that situated pedagogical practice is an irreplaceable formative resource. It is through acting within communities that pedagogical knowledge gains depth and meaning, especially when framed within a critical reading of place and its challenges (Anselimus & Lazaro, 2025).

This study is therefore situated within a line of research that seeks to articulate science education with the development of ethical, committed, and contextually grounded teaching. It contributes to the ongoing debate on how to prepare teachers who are equipped to confront, through practice, the structural inequalities that persist in the Chilean educational system.

Frameworks for Situated Science Education with a Focus on Equity

In recent decades, science education has shifted from an approach centered exclusively on content transmission to more integrative perspectives that acknowledge the political, social, and cultural dimensions of scientific knowledge. This transformation has been driven by growing awareness of the educational gaps affecting children from historically marginalized sectors, and by the recognition of the emancipatory potential of science when taught from a situated, dialogical perspective grounded in epistemic justice (Okeke & Ramaila, 2025).

Science Education and Social Justice

Access to quality science education cannot be understood merely as a matter of curricular coverage, but rather as a right intrinsically linked to citizenship and equity (Venegas-Weber *et al.*, 2024; Okeke & Ramaila, 2025). This critical perspective argues that teaching science in contexts of poverty requires challenging knowledge hierarchies, exposing forms of structural exclusion, and reimagining the classroom as a space for the collective construction of meaning. In this regard, the framework of legitimate presence proposes not only including marginalized children in scientific activities but also transforming the historical conditions that have excluded them from meaningful participation (Venegas-Weber *et al.*, 2024).

Similarly, the notion of critical scientific autonomy emphasizes that children—even in conditions of vulnerability—possess valid knowledge and lived experiences that enable them to interpret scientific phenomena and propose context-specific solutions. This stance calls for a pedagogical restructuring in which the teacher acts as an ethical mediator—recognizing, validating, and amplifying the voices of others, while creating opportunities for children to see themselves as active agents in the production of knowledge (AlAli & Al-Barakat, 2024).

Teacher Education, Equity, and Territory

From the perspective of initial teacher education, numerous studies have shown that practical experiences in under-resourced schools can disrupt pre-service teachers' prior certainties, opening spaces for reflection on the ethical and political meaning of teaching science (Turra *et al.*, 2015; Arroyo González *et al.*, 2025). These experiences help future teachers recognize that science is neither neutral nor decontextualized; rather, it can become a tool for transformation when connected to the interests, problems, and knowledge of local communities.

The concept of situated curriculum builds on this idea by proposing that science education should begin with the local environment—the landscape, the climate, and the resources available in the territory. Instead of replicating a decontextualized curriculum, it advocates for constructing meaningful content through dialogue with the social, cultural, and environmental contexts of the children. This approach not only facilitates learning but also strengthens the critical appropriation of scientific knowledge. In line with Talukder *et al*. (2021), pedagogical practices in historically marginalized territories cannot be understood apart from local knowledge systems and the lived trajectories of those who teach.

Moreover, it has been argued that the professional development of pre-service teachers improves significantly when training experiences include reflective mentoring, immersion in diverse realities, and opportunities to reframe the role of the teacher (Anselimus & Lazaro, 2025). Within this framework, extended practicum experiences and interventions in contexts of extreme poverty—such as those addressed in this study—enable the articulation of theory and practice, the confrontation of ethical tensions, and the development of a sense of mission that transcends the technical dimension of teaching (Arroyo González *et al*., 2025). As these authors note, conceptions of science learning are neither homogeneous nor fixed, but rather coexist and evolve dynamically depending on the context.

From this standpoint, it becomes essential to envision a coherent articulation between teacher education, territorial development, and social justice. This implies reclaiming the importance of strengthening the connection between academic knowledge and community realities (Okeke & Ramaila, 2025). Engagement in authentic formative processes—such as facilitating science workshops in marginalized communities—can trigger meaningful transformations in teachers' pedagogical practice by fostering reflective experimentation, collaborative learning, and the development of new conceptions of teaching (Anselimus & Lazaro, 2025; Turra *et al*., 2015). Therefore, in contexts of educational vulnerability, it is crucial to promote formative opportunities that challenge traditional models and cultivate more active, dialogical, and context-sensitive visions of science education.

Inequalities in Access to School Science

Finally, studies such as that of Sancassani (2023) reveal how socioeconomic and territorial inequalities directly impact the quality of science education. These disparities affect not only the availability of resources but also the opportunities for active learning, experimentation, questioning, and critical reasoning. Such findings challenge teacher education programs to ensure that all children—regardless of their background—can access a transformative scientific literacy.

This qualitative, interpretive study employed an instrumental case study design to examine the lived experiences and professional learning of pre-service primary teachers who implemented science workshops in socioeconomically vulnerable schools in Santiago, Chile. The design enabled a contextualized account of meanings, transformations, and reflections arising during practicum, foregrounding shifts in pedagogical knowledge, ethical awareness, and professional identity.

Five pre-service teachers (four women, one man) in the final year of a Primary Education program participated voluntarily. They designed and delivered science workshops to first- and second-grade children in public schools characterized by high social vulnerability. All provided informed consent; data were anonymized and treated confidentially.

Three complementary qualitative techniques were employed: semi-structured interviews, participant observation, and reflective journals.

Each participant completed an individual semi-structured interview after completing the practicum. The interviews, lasting between 45 and 60 minutes, were conducted in person and audio-recorded with prior consent. The interview guide comprised ten open-ended questions organized around four thematic axes: a) *Pedagogical learning* (e.g., How did you adapt science content for children in this context?); b) *Affective and emotional dimensions* (e.g., What emotions emerged while teaching in these conditions?); c) *Professional identity and vocation* (e.g., How did this experience shape your vision of being a science teacher?); d) *Ethical and contextual awareness* (e.g., What social or ethical challenges did you perceive in these schools?).

Participant observation was conducted by two researchers who accompanied the pre-service teachers during the implementation of the science workshops over a four-week period. Each teacher facilitated three to four sessions per class, each lasting approximately 60 minutes. Observations focused on pedagogical dynamics, teacher–student interaction, and contextual adaptation of scientific content. A structured observation table was used to record the following indicators: a) *Pedagogical mediation*: clarity of explanations, questioning techniques, scaffolding, and feedback; b) *Student engagement*: participation levels, curiosity, and collaborative behaviors; c) *Contextual adaptation*: use of local examples, resources, and environmental references; d) *Classroom climate*: respect, empathy, and emotional regulation.

Field notes were taken during each session and complemented immediately afterward with analytical memos capturing emerging interpretations and researcher reflections. Each pre-service teacher was observed a minimum of three times, allowing for cross-case comparison and temporal triangulation.

Each participant completed a reflective journal after every workshop session, producing between three and five entries per teacher. The journals followed a semi-structured format consisting of three sections: a) *Descriptive entry*: factual account of classroom events, activities, and reactions; b) *Analytical reflection*: identification of successes, challenges, and pedagogical decisions; *Personal and ethical reflection*: insights on emotions, dilemmas, and evolving perceptions of science teaching in vulnerable contexts.

All instruments (interview guide, observation protocol, journal template) underwent expert validation by three specialists (two in science education, one in qualitative inquiry); minor revisions improved semantic precision and contextual sensitivity. Source triangulation across interviews, observations, and journals strengthened credibility and supported identification of consistent thematic patterns.

Transcripts, field notes, and journals were analyzed inductively through open, axial, and selective coding with constant comparison. Atlas.ti 9 supported organization and auditability. Peer debriefing and member checking (two participants) enhanced analytic validity. The final synthesis integrated convergent and divergent perspectives, preserving the multiplicity of participant voices.

The findings derived from the qualitative analysis revealed significant transformations among the student-facilitators, both in the pedagogical and ethical-professional domains. Based on interviews, observations, and reflective journals, four main dimensions emerged that synthesize the effects of this situated formative experience: the development of specific pedagogical skills for science teaching, the emergence of critical awareness regarding educational equity, the redefinition of the teaching role in vulnerable contexts, and the understanding of the importance of situated pedagogy. These closely interrelated categories demonstrate that practicum experiences in educationally underserved territories enrich disciplinary understanding and foster a more critical, committed, and context-sensitive vision of science teaching.

Development of Pedagogical Skills in Science

One of the first changes perceived in the student-facilitators was their ability to translate complex scientific concepts into accessible and engaging explanations for young children in early primary grades. Through the use of tangible materials, drawings, local metaphors, and simple experiments, the pre-service teachers managed to adapt content such as the water cycle, ecosystems, or climate to the lived realities and experiences of the children.

Classroom observations revealed a growing mastery of formative assessment strategies—use of open-ended questions, immediate feedback, modeling of procedures—in alignment with multimodal and context-based inquiry approaches, as highlighted by Venegas-Weber *et al.* (2024), who emphasize the importance of translanguaging and interdisciplinary integration for science learning in primary education.

One participant noted: "I realized that if I don't connect the content to what they already know, it simply doesn't work... I had to learn to explain from their world, not mine." This finding aligns with the contributions of Talukder *et al.* (2021), who argue that situated teaching adapted to students' levels is key to improving the quality of science learning.

Critical Awareness and Commitment to Educational Equity

The experience in vulnerable schools encouraged pre-service teachers to reflect on the structural inequalities that hinder access to science education. Beyond material challenges—such as the lack of teaching resources—student-facilitators expressed ethical concerns regarding the invisibility of certain groups within the school discourse on science. One reflective journal entry stated: "Now I see that teaching science here is not just about explaining content; it's about opening up questions that had never been asked before."

This statement reflects an understanding of the classroom as a space for epistemic justice, aligning with the critical equity approach in science education proposed by Okeke & Ramaila

(2025), who advocate for contextually grounded instruction that recognizes the knowledge and experiences of historically marginalized students.

Participant observation also revealed that the workshops sparked curiosity and enthusiasm among the children, generating opportunities for dialogue, exploration, and autonomy. When students perceive that their questions, experiences, and knowledge are valued, their levels of participation and sense of belonging in school science increase (Anselimus & Lazaro, 2025).

Identity and Vocational Meaning of the Teaching Role

Another key effect of the experience was the redefinition of the teaching role. Faced with contexts of poverty, school disengagement, and limited institutional support, participants were confronted with questions about their vocation and the ethics of their future professional practice. This dimension was particularly evident in the interviews, where feelings of responsibility, frustration, hope, and commitment emerged.

One interviewee remarked: "I thought I was coming to teach science, but I ended up questioning why I want to be a teacher. This made me realize that being a teacher is also a form of resistance." This awareness resonates with literature on extended practicums and situated teacher education (Turra *et al.*, 2015), as well as recent studies on vocational development in diverse territories (Arroyo González *et al.*, 2025), which emphasize the formative potential of real-world challenges and ethical mentoring.

Within this framework, the experience helped to consolidate a sense of social mission among the pre-service teachers, who began to understand their role not only as transmitters of content, but as agents of change capable of influencing the educational trajectories of children in vulnerable situations.

Relevance of Situated Pedagogy

Finally, the experience highlighted the power of situated pedagogy in enhancing science learning. The workshops designed by the pre-service teachers incorporated elements from the immediate environment—the neighborhood's weather, trees in the schoolyard, local water sources—as starting points for scientific inquiry. This strategy helped to overcome the typical decontextualization of school content and created an emotional and cognitive connection with the children.

In this regard, one student-facilitator stated: "The children got excited when we talked about the sun or the rain... because it was their world. That's when I understood that teaching science is also about learning to see what's already close, but with new eyes."

This kind of pedagogy, which values territory and lived experience, enhances understanding of scientific phenomena while simultaneously strengthening students' cultural identity and self-esteem (AlAli & Al-Barakat, 2024; Venegas-Weber *et al.*, 2024). As noted by Aslam *et al.* (2024), transformative science pedagogy must connect disciplinary knowledge with cultural sensitivity, generating meaningful learning from real-world contexts.

Conclusions

The findings of this study support the conclusion that practical experiences in science teaching within vulnerable contexts constitute a highly valuable pedagogical resource in initial teacher education. Through a situated experience, pre-service teachers not only strengthened their technical and instructional skills but also demonstrated a critical awareness of educational equity, consolidated their professional vocation, and gained a deeper understanding of the value of a pedagogy rooted in the local territory.

From a didactic perspective, the opportunity to translate complex scientific content into accessible and meaningful language for children from disadvantaged backgrounds enabled the student-facilitators to internalize active teaching strategies and formative assessment techniques. These learning outcomes are enhanced when teacher education takes place in close contact with the school reality, fostering situated reflection on classroom practices (Talukder *et al.*, 2021; Aslam *et al.*, 2024). It is concluded that teacher education programs incorporating field-based science facilitation experiences benefit both the children who receive the workshops and the students who deliver them, fostering a reconstruction of pedagogical beliefs and teaching practices (AlAli & Al-Barakat, 2024).

On an ethical-professional level, the experience had a powerful and transformative effect. By interacting with children who have historically been excluded from school science, the student-facilitators redefined their teaching role as one of social change agents. This transformation aligns with the arguments of Arroyo González *et al.* (2025), as well as Turra *et al.* (2015), who maintain that engagement with vulnerability is not a threat to teacher formation, but rather an opportunity to build a more committed, reflective, and socially aware professional identity.

Likewise, the study confirms the relevance of situated and territory-based pedagogy. By using elements of the local environment as starting points for inquiry, the workshops promoted meaningful learning among children and helped reframe the territory as a legitimate space for the construction of scientific knowledge. In line with Okeke & Ramaila (2025), it is argued that initial teacher education should integrate pedagogical models that foster genuine encounters between school knowledge, scientific understanding, and the challenges of local development. Such integration would contribute not only to improving the quality of teaching but also to democratizing access to science as a social right.

Looking ahead, it is recommended that faculties of education systematically incorporate this type of immersion experience into their initial teacher education programs. This requires more than simply placing students in vulnerable schools; it involves supporting these processes with theoretical modules on science and social justice, guided reflective practices, and spaces for ethical mentoring. Such integration enhances the quality of teacher education and contributes to reversing the scientific exclusion affecting large segments of childhood in Chile and Latin America. Furthermore, in line with Venegas-Weber *et al.* (2024), it is emphasized that any innovation in science education must account for the complexity of pre-service teachers' pedagogical conceptions. Practical training in vulnerable contexts, when accompanied by

structured spaces for reflection, can serve as a catalyst for reconfiguring these conceptions toward more equitable and transformative models.

Ultimately, this study reinforces the idea that there can be no quality science education without educational justice—and that it is precisely in the most marginalized schools where future teachers can learn to see science—and teaching itself—as a transformative tool.

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Microcenters: Professional Development of Rural Teachers in Chile

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This research was born in the context of the Proyecto Fondecyt de Iniciación N°11220021 (2022) "Liderazgo Pedagógico de los encargados de escuelas rurales y la instalación de los servicios de educación," under the sponsorship of Pontificia Universidad Católica de Valparaíso.

Introduction

Teacher professional development (TPD) is defined as the participation of teachers in learning programs taught by external providers, either during their initial education or after they started their professional carrier. These programs provide knowledge, skills and practices that could potentially make a positive impact in the student's education (Fischer et al., 2018). Education should also promote reflection in order to bring changes to learning practices and contribute to the development of higher order thinking among students (Nasir & Sulaiman, 2015). Even when this summarizes the importance of TPD, it also presents unique challenges when it comes to teachers working in rural schools, be it the geographic distance or the usual state of their classes, where students of different education levels coexist. Consequently, some authors (Kline et al., 2013; White, 2008) point out that the TPD of rural teachers should take into consideration the geographic and sociocultural identity of the place where they perform their duties, and how those traits influence their teaching practices.

Considering the aforementioned, particularly the reference to external providers and the need of adjusting TPD to the geographical and sociocultural traits of rural schools, this study analyzes the Chilean TPD experience in microcenters. This model has two relevant traits for this research: peers are responsible for their training (not external agents) and the territory plays a fundamental role, considering that microcenters are largely defined by the geographic proximity to the schools involved. This study aims to identify what teachers think about microcenter meetings, as instances for TPD in the territory, and analyze how these perceptions vary between cycles of professional development. This research is part of a larger study and its importance lies in the chance given to us to analyze a TPD model between peers and based in a specific territory.

These opinions were collected through a questionnaire designed for the research, based on the traits of an effective TPD, provided by Linda Darling-Hammond (2017), and the functionalities assigned to microcenters by the current legislation. In this sense, the instrument considers a general assessment of the meetings and five dimensions: A) quality of contents, B) knowledge acquired, C) professional collaboration, D) effective training models, and E) contribution to reducing geographic isolation. Additionally, a segment for sociodemographic data was added, allowing the identification of the specific professional life cycles for the rural teachers. The research followed a descriptive quantitative research design. As previously stated, a

questionnaire was designed and implemented, validated through the expert judgment methodology (Escobar-Pérez & Cuervo Martínez, 2008). Experts were consulted on clarity, pertinence, and relevance of the dimensions and questions presented to the participants. The professionals in charge of reviewing every item of the instrument were eight experts in teacher education and TPD in rural contexts. For the analysis, a "Content Validity Index" (CVI) was used, determined by the ratio of experts who considered each item as important or extremely important (Du Wei et al., 2025). Thanks to this process, the relevance of each item was established, and adjustments were made when necessary.

This study was conducted in the Arica y Parinacota Region, with the informed consent of participants and pertinent authorities. Surveys were conducted in person and the anonymity of participants was protected. Afterwards, the data was transcribed and analyzed with the software SPSS. A total of 44 teachers, working in rural schools of different sizes, answered the survey. 40% (n=18) of participants were male and 60% (n=26) were female.

The survey was created using a Likert scale, giving participants five possible answers, where 5 represents "strongly agree" and 1 "strongly disagree." For the analysis of professional development life cycles, the proposal by Cristopher Day (2012) was used as the base, adding to it a series of subdivisions for the intermediate and veteran cycles, as shown in Table 1.

Table 1. *Cycles of Professional Development.*

Cycle of Professional Development	Number of Teachers	Percentage
Novice (0 to 3 years)	12	27.2%
Beginner (4 to 7 years)	6	13.6%
Early Intermediate (8 to 15 years)	9	20.4%
Late Intermediate (16 to 23 years)	7	15.9%
Transitioning Veteran (24 to 30 years)	3	6.8%
Consolidated Veteran (30+ years)	7	15.9%

Results are divided into two sections. The first one shows general results, while the second section presents an analysis based on professional life cycles.

General Results

Regarding the general overview of the microcenter meetings, one can notice a high concentration of positive answers. Most participants selected "agree" or "strongly agree" in each statement (see Table 3). This tendency shows how microcenter meetings are perceived positively, as spaces where helpful exchanges between pairs can occur. In addition, it can be a place where the feeling of being on a team can be built, easing the feelings of loneliness and isolation that often affect rural teachers. However, the first statement, related to the creation of an annual planning schedule, shows a division within the survey. This constitutes an opportunity for improvement: to achieve a better representation of the interests of all the microcenter members.

Table 3. *Microcenter Assessment*

Microcenter Assessment	5	4	3	2	1
Alongside my colleagues, we have developed the annual planning schedule for the microcenter meetings, which allowed me to include my own professional development needs	38.6	27.3	15.9	2.3	15.9
I feel part of a team of teachers that learns as a unit	27.3	54.5	9.1	4.5	4.5
I can rely on my colleagues, at any time, even when it is not part of their responsibilities	22.7	54.5	18.2	4.5	0.0
Thanks to the guidance of the Pedagogical Technical Advisors, I have been able to comprehend the policies of the Ministry of Education	18.2	61.4	20.5	0.0	0.0

Dimension A (Table 4) explores strengthening opportunities for didactic and disciplinary knowledge. The answers to these statements concentrate in the two upper levels of agreement. This appears to communicate, at least from the perspective of the teachers, that microcenter meetings have given them the opportunity to acquire new knowledge, which can then be applied in their classes.

Table 4. *Dimension A Results*

Dimension A. Centered Around Content	5	4	3	2	1
I have reinforced my domain over the math curriculum contents, resulting in an improvement for the learning process of my students	15.9	61.4	13.6	4.5	4.5
I have reinforced my domain over the language curriculum contents, resulting in an improvement for the learning process of my students	18.2	70.5	9.1	0.0	2.3
I have updated my pedagogical knowledge on assessments, resulting in the implementation of new assessment strategies in my classes	22.7	65.9	9.1	2.3	0.0
I have analyzed the school curricula, resulting in the tailored planification of my classes to my specific school context	31.8	59.1	6.8	2.3	0.0

Source: Developed by author.

In Dimension B (Table 5), the data reflects a mostly positive perception regarding the collaborative teaching practices that encourage active learning among teachers during microcenter meetings. Altogether, the results present a favorable scenario for professional learning between teachers in microcenter meetings, particularly apt for the encouragement of experimentation, collective reflection, and shared didactic tasks.

Table 5. *Dimension B. Integration of Active Learning*

Dimension B. Integration of Active Learning	5	4	3	2	1
Along with my colleagues, I have designed learning activities, which improved the quality of my classes	18.2	45.5	29.5	6.8	0.0
Along with my colleagues, I have examined the learning outcomes of my students, which helped me modify my teaching practices	25.0	50.0	18.2	6.8	0.0
I have been exposed to new learning methodologies that I have implemented in my classes, which improved their motivation to learn	25.0	63.6	11.4	0.0	0.0
I have analyzed teaching materials with my colleagues, which allowed me to use them to improve my students' learning experience	18.2	45.5	27.3	4.5	4.5

In Dimension C (Table 6), results follow the same tendency, showing a positive perception, though a less homogenous one. The item with the least positive score is the one dealing with the use of learning analysis methodologies for the encouragement of participation among students: 61.4% of the answers fall under "agree" or "strongly agree", 25% are neutral, and the remaining 13.6% correspond to "disagree" or "strongly disagree". Despite collaboration being a shared educational value, data suggest that its practical implementation is still insufficient in curricular work and the systematic analysis of learning outcomes.

Table 6. *Dimension C. Collaboration for Improvement*

Dimension C. Collaboration for Improvement	5	4	3	2	1
I have reflected about the pedagogical practices of my colleagues, which allowed me to improve my own practices	25.0	47.7	15.9	9.1	2.3
Along with my colleagues, we reviewed the school curricula and designed activities to suit our context	18.2	34.1	36.4	9.1	2.3

We have tested new teaching and learning strategies that could be implemented in our classes	20.5	47.7	18.2	9.1	4.5
Methodologies for the analysis of student learning are used, which facilitate the participation of all students	11.4	50.0	25.0	9.1	4.5

In Dimension D (Table 7), results are diverse in the assessment of peer learning oriented teaching practices and the implementation of effective models. The practice of witnessing classes in other schools shows the lowest agreement (40.95%), alongside a high rate of neutrality (29.5%) and disagreement (29.5%). These results could be explained by logistical and cultural impediments in the integration of a TPD model based in peer collaboration. This poses the need for the strengthening of institutional mechanisms that facilitate pedagogical visits and spaces for feedback among teachers.

Table 7. *Dimension D. Use of Effective Practice Models*

Dimension D. Use of Effective Practice Models	5	4	3	2	1
I share my teaching experience with my colleagues, which allowed me to improve my pedagogical practices	9.1	54.5	20.5	9.1	6.8
I have visited the schools and classes of my colleagues, which allowed me to see how their students work and replicate it in my class	15.9	25.0	29.5	15.9	13.6
Thanks to the experts I have learned new teaching practices, which I replicated with my students	20.5	45.5	22.7	6.8	4.5
I shared with my colleagues the teaching methodologies I have learned in courses and that have improved the learning of my students	20.5	50.0	22.7	4.5	2.3

In Dimension E (Table 8), results show a favorable perception of practices that mitigate geographic and professional isolation. 65.9% of participants "strongly agree" or "agree" that the implementation of collaborative projects allows them to break the social isolation of students and schools. In addition, 68.2% say they have received the support of their peers to finish administrative tasks, suggesting that networks between rural schools also play a role in alleviating teachers' workload, or rather overload. However, concerning the accountability of the Educational Improvement Plan, 59.1% of the participants reported an effective coordination with their colleagues, while 27.3% remained neutral, which may suggest a lack of institutionalization of such practices. Finally, it is imperative to highlight the importance participants gave to the

recommendations and advice of their peers in relation to how they should integrate into their local communities (77.2% agreed with this statement). This emphasizes the importance of the relationship between schools and local communities, based on their geographical and sociocultural features (Quiroga Lobos & Valenzuela Flores, 2025).

Table 8. *Dimension E. Geographic and Professional Isolation*

Dimension E. Geographic and Professional Isolation	5	4	3	2	1
Along with my colleagues, we have integrated collaborative projects, which allowed us to alleviate the social isolation of my students	27.3	38.6	18.2	11.4	4.5
My colleagues have helped me complete administrative activities of my school	34.1	34.1	18.2	6.8	6.8
Along with my colleagues, we have thought of ways to implement the Educational Improvement Plan within the stablished deadlines	27.3	31.8	27.3	6.8	6.8
I have received advice from my colleagues on how to work with the school community and encourage participation	29.5	47.7	15.9	2.3	4.5

Data Analysis According to the Professional Cycle

For this analysis, averages were calculated by item and then by dimension, grouping the results according to the professional cycle (Table 9).

Table 9. *Analysis According to the Professional Life Cycle*

Cycle 1 (Novice, 0 to 3 years)	The overall score of the microcenter was 3.83, which is considered positive. For this cycle, the best score was Dimension A (3.91). Dimensions C, D, and E show lower scores (less than 3.5), which suggests difficulties to collaborate and integrate external practices.
Cycle 2 (Early Intermediate, 8 to 15 years)	This cycle shows the highest scores in each dimension, particularly in Dimension E (4.32), suggesting that microcenter meetings can be a useful tool to deal with professional isolation. Dimension C (4.12) and D (4.16) scores should also be highlighted, which could be related to their perception of a successful integration into the professional community.
Cycle 3 (Late Intermediate, 16 to 23 years)	This cycle scores low on Dimensions C (2.25), D (2.25), and E (2.37). This suggests a setback in the collaboration or integration of new practices. The overall microcenter score is also low. This could be a group suffering from identity crisis or professional disconnection.

Cycle 4 (Transitioning Veteran, 24 to 30 years)	Every dimension in this cycle scored over 4 points, showing appreciation for the microcenter and collaboration. This group can be described as stable.
Cycle 5 (Consolidated Veteran, 30+ years)	As the previous cycle, scores are high in Dimensions A, B, C, and E. In addition, Dimension D scored just under Cycle 2. The stability of this cycle suggests a devotion to collaborative professional development.

The data indicates that teachers in Cycle 2 have the highest scores throughout all dimensions, which can be a consequence of the consolidation of their professional role. These results are backed by other studies, like the ones conducted by Ávalos (2011) and Leach and Bradbury (2024). On the other side of the spectrum, Cycle 3 (8 to 15 years) reports considerably lower scores, especially in the collaboration and use of effective models categories. This situation could be explained by burnout, professional isolation or disconnection from the group (González & Weinstein, 2014). Cycles 4 and 5 (veterans) present scores that range from stable to high, following what Day & Gu (2012) proposed on professional maturity and a sense of belonging to an institution at advanced stages of a teaching career.

Generally, results point to teachers' professional cycle as a meaningful factor in their perception and assessment of microcenters and collaborative work. Considering this, a way of reducing professional isolation could be to provide support during the advanced intermediate stage and to take advantage of the commitment shown by veteran teacher. Furthermore, these results urge the design of differentiated teacher professional development policies, contextualized to the teaching life cycle and the distinct features of the rural environment. Other studies have confirmed that collaborative instances among rural teachers reinforce their professional identity and encourage learning between peers (Muñoz & Torres, 2022; Leach & Bradbury, 2024). Other studies conducted in a Latin-American contexts highlight the need for the consideration of a teacher's development cycle as a key element to guide employee retention and professional development policies (González & Weinstein, 2014).

Conclusions

Data gathered in this study highlights the importance of microcenter meetings as instances of professional development between peers at different professional development cycles. However, it is important to note that one of the lowest scores was learning improvement for students. This data shows how important collaboration between TPD self-regulation system and external experts could be.

On the other hand, it is important to encourage intergenerational exchange and the reimagining of collaborative structures. Along with their formative dimension, these meetings fulfil a socially relevant role, they facilitate the acquisition of specific knowledge required to carry out administrative tasks, become part of a community, and reduce isolation and loneliness.

Lastly, the findings of the analysis of professional cycles in the TPD of rural teachers, as participants in the microcenter, suggest the need to strengthen the support they receive during their advanced intermediate stage, as well as to take better advantage of the commitment of veteran teachers. This calls for the creation of differentiated TPD public policies, ones that take the teaching life cycle and the specific characteristics of rural contexts into consideration.

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Chilean school curriculum and teacher participation: debts and challenges of educational policy

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Introduction

The design of a curriculum is fundamental in the teaching and learning process as it defines the knowledge that must be conveyed and guides how it is taught, establishing the methodologies, strategies, and pedagogical approaches to be used. According to Magendzo (2021), the curriculum is not simply a set of content, but also involves decisions about how those contents will be presented and taught, guiding pedagogical and assessment practices in the classroom.

In the Chilean context, the update of the school curriculum has been a subject of debate. The implementation of the current curricular bases has led to various interpretations and practices in the country's schools and classrooms. Therefore, it becomes crucial to understand how teachers perceive and address these aspects of the curriculum and how they incorporate them into their daily practice.

This chapter, the result of mixed-methods research, aims to analyze the conceptions and experiences of secondary school teachers in the Chilean educational system regarding the design, implementation, and monitoring of the national curriculum following its recent update. To achieve this, the study seeks to understand and relate conceptions and practices concerning curricular theory, characterize the instances of participation in curriculum redesign and update processes, and determine the networks of support and collaboration in the implementation of the new curriculum.

Curriculum theory and design: scope for participation and teaching

Curricular theory is a crucial field in education that focuses on understanding, analyzing, and improving the way curricula are designed, implemented, and evaluated in educational settings. Its importance lies in its ability to influence educational practice and the training of future generations. According to Smith (2000), curricular theory can be defined as the set of principles, concepts, and approaches that guide the design and development of curricula and educational programs. This definition highlights the importance of curricular theory as a fundamental guide in the structuring of teaching and learning.

Curricular theory is based on approaches and perspectives. It is essential in the formation of educational policies and in the pedagogical practice. The evolution of curricular theory has been a dynamic process that has responded to changes in society, education, and pedagogical theories. The curriculum, therefore, is the result of selecting from a broader universe of knowledge and know-how what will precisely constitute the curriculum. "Curriculum theories, having decided which knowledge should be selected, seek to justify why "that knowledge" and not "others" should be selected" (Da Silva, 1999, p. 5).

De Alba (2006) highlights the importance of situating curricular theory in a broader context, recognizing that curricula are not simply content to be transmitted, but are intrinsically related to power structures and social dynamics.

Tyler (1973) provided one of the most influential foundations in the conceptualization of the curriculum, proposing a scientific and technical approach to curriculum planning, identifying four fundamental questions that must be answered when designing a curriculum: What are the objectives of education? What experiences will provide an efficient acquisition of these objectives? How can these experiences be organized to be effective? And how can it be determined if the objectives have been achieved?

In order for curriculum development not to be an arbitrary process, Taba (1974) points out that three factors must be considered: the student, the learning process, and the demands of culture and society. For this author, the development of the curriculum is a task that requires ordered judgment, where the sequence of decision-making and the manner in which decisions are made are essential.

One of the main approaches to curriculum design in Latin America is the consideration of education as a means to address social inequalities and promote inclusion. Freire's perspective (2012) on the theory of "Popular Education", which is based on the idea that education can be a tool for empowerment and liberation. Its focus on literacy and critical awareness has influenced the way the curriculum is designed in the region.

Regarding the social and cultural dimensions in curriculum design, Gimeno Sacristán (2013) advocates for an approach that not only focuses on content but also considers the context in which it develops teaching and learning. The curriculum should aim, in its practical development, to achieve certain goals, even if they are not quantifiable (Gimeno Sacristán, 2013).

Participation in curriculum design directly influences the quality and relevance of education. According to Smith (2000), curriculum design is a complex process that requires the collaboration of various stakeholders.

Traditionally in Chile, curricular reforms were addressed by the Ministry of Education with designated teams, both internal and external, which dissolve once the process of developing a new curriculum and study program is completed; reforms historically did not include consultation processes with stakeholders inside or outside the educational system (Cox, 2011), even though the General Education Law (LGE, 2009) emphasizes the importance of citizen participation in educational decision-making, including curriculum design.

Curriculum policies in Chile. Challenges and tensions

In Chile, the Curriculum Development Table highlights "it is necessary to advance in the creation of devices and processes systematic information collection that allows for properly guiding curricular policy decisions" (Ministry of Education, 2016, p. 34).

The effective implementation of the curriculum foundations in an educational system is a critical process that goes beyond the adoption of normative documents; It involves translating educational policies into pedagogical practices in the classroom. That is, the curricular field does not only occur in its normative dimension, it also manifests in the daily practices and processes that teachers and administrators carry out in the school territory to achieve learning (Rodríguez, 2022, p. 59).

It requires well-articulated strategies, effective leadership, and the active participation of all educational stakeholders. For Rodríguez (2022) "The curriculum unfolds and transforms in the construction of relationships and meanings for all those who participate in the educational experience, in a process of permanent re-signification" (p. 60).

In accordance with the above, Terigi (1999) indicates:

> The curricular policies of recent years have created a more active link between teachers and the curriculum, tending to complicate the prescriptions about what should be taught in schools and establishing frameworks for both the personal and collective actions of teachers in defining the curricular projects of educational institutions. This link means that, in their professional practice, teachers carry out multiple tasks related to the curriculum. In fact, the teaching role is defined not only by the delivery of content proposed in the curriculum but also, depending on the characteristics of each school, by teachers' varying degrees of participation in the construction of institutional curricular projects. (p. 83)

In this line, academics and education experts have explored the policies that support the implementation of the curriculum, offering valuable perspectives on how to achieve a successful and meaningful integration with educational practice in different contexts. In this regard, Fullan (2002) highlights the importance of strong educational leadership in the curriculum implementation process, arguing that educational leaders must go beyond simply communicating curricular policies; they must inspire educators, engage the community, and establish a shared vision. This aligns with the notion that successful implementation is not just a matter of complying with regulations, but of building a school culture that embraces and internalizes the curricular foundations.

Spillane *et al*. (2001) suggest that school leadership, both at the managerial level and distributed among teachers, plays a key role in the interpretation and application of the curricular foundations. Effective support and guidance from educational leaders are essential to align teaching practices with the curricular expectations. Carrying out successful curricular changes requires a combination of effective leadership, professional development for teachers, and active participation of educators in the process.

In the current curriculum development policy in Chile, the State defines, produces, and proposes to the National Council of Education (CNED) a set of procedures and mechanisms to be articulated with other educational policies, seeking to ensure that these have a successful realization in the Chilean educational system (Ministry of Education, 2016). Specifically, there is a working group that generates this report where recommendations linked to the process of appropriation, adaptation, enrichment, and implementation of the national curriculum.

In the same vein, Rodríguez (2022) emphasizes that new challenges arise in the complex national institutional framework to face historical difficulties. The author suggests that:

> The main challenge is to create the conditions for central decisions about the educational processes to be generated in the contexts themselves, independently of the current authorities. This should be done with a clear, coherent, articulated framework that is sufficiently respectful of the communities and their professional capacities [...] allowing teaching capacities to emerge, in addition to correcting the difficulties of articulation and collaborative work among the various intervening institutions. (p. 69)

The policies for implementing the curricular foundations must address a diverse range of factors to be effective. From educational leadership that inspires and guides, to collaboration among teachers, adaptability to local contexts, continuous training, and active community participation. These policies must be holistic, aligned with both educational and broader social objectives.

Teachers play an essential role in shaping and adapting the curriculum, as they are the ones who interact directly with students and understand their needs and capabilities. Stenhouse's work (1991) argues that teachers should be active agents in the creation and adaptation of the curriculum.

This research was developed using a mixed methodology. This type of research combines elements of qualitative and quantitative research in a single study to address more complex research questions and understand various phenomena (Creswell & Creswell, 2017). The choice of a mixed methods study to investigate the conceptions and experiences of Chilean faculty regarding the design, implementation, and monitoring of the curriculum responds to the need to understand the complexity of these phenomena from diverse perspectives. Regarding the information collection techniques, a mixed questionnaire was applied, focusing on identifying the conceptions and experiences of secondary education teachers regarding the design, implementation, and monitoring of the new school curriculum.

Regarding the information collection techniques, this was carried out through the application of a mixed questionnaire consisting of 6 questions aimed at characterizing the participants, 29 questions on a Likert scale (rating scale), and 23 open-ended items related to the topics of curriculum theory, curriculum design, curriculum approaches, the teacher's role in the curriculum, and curriculum evaluation.

The sample was selected through purposive sampling, specifically obtaining responses from 66 volunteer secondary school teachers within the Chilean school system with a minimum of four years of professional experience. The interest in considering this population was because these

teachers, during the recent period of curricular reforms, have had to internalize and implement various changes in the classroom stemming from national public policies. Of the participants, 72% identify as female, 67% of the total work in public establishments, and the median years of professional experience is 10.

The Cronbach's alpha coefficient of the instrument was 0.841, derived from the analysis conducted in SPSS with 29 items, which indicates a high degree of internal consistency among the measured variables. This measure suggests that the questions or items of the instrument are highly correlated with each other.

Quantitative analysis

In line with the traditional approaches of theory and curriculum design, as discussed in the theoretical review of the study, 58.46% of respondents view the curriculum as a structured plan with clear objectives and defined strategies for teachers to follow, closely aligned with a technical rationality paradigm. Meanwhile, a smaller percentage recognizes it as a flexible instrument that should be adapted to each classroom.

Regarding teachers' conceptions about the approach present in the current curriculum, the trend indicates that participants believe the current curriculum emphasizes the transmission of content-based knowledge (46.7%), while a smaller percentage considers it to emphasize the development of students' skills.

Regarding the experiences and evaluation of public policies for the design and implementation of the current national curriculum, participants indicated that the guidelines for implementing the most recent curricular reform were primarily provided through documents published on official websites. In contrast, ministerial training sessions received the least level of engagement.

Finally, in response to the question "Who do participants turn to when they have doubts about curriculum implementation in the subject?" the predominant answers are: "To the Head of UTP or Cycle Director of the establishment" or "To colleagues in the same subject or related areas", without acknowledging the roles of state-affiliated support agents available for this purpose.

Qualitative analysis

In the qualitative dimension of the research, teachers were asked about their participation in the design and implementation of the current curricular bases, and for those who participated, they were asked to specify in which instance. In this regard, they agreed that this was done through online surveys. However, in response to the question: "Do you consider it was binding?", the consensus among the teaching staff is that it was not binding.

Some expressions explaining the above are: "Binding? Its design and ministerial implementation came from the discussion of technocrats and was top-down" (Teacher/3). "No. There are cultural and contextual aspects that were not considered in the implementation, which have profoundly harmed pedagogical work" (Teacher/7). "I was asked for suggestions, and that was it. Nothing proposed in the communal meetings was implemented" (Teacher/12).

Regarding the differences, they detected between the previous curriculum and the current one, it is noted that a content-focused approach is maintained, with the addition of learning objectives that are practically unattainable. Additionally, there is a mention of a change in the focus of evaluation towards a more formative approach: "There was a complication, the number of learning objectives increased. They are unattainable, many and very extensive" (Teacher/4). "There were changes in the conception of evaluation, with the new decree, evaluation is now formative and process-oriented" (Teacher/10).

To a lesser extent, there is a group of teachers who express a different view, emphasizing a shift in the focus promoted by the current curriculum compared to the previous one: "It seems to me that now it has a constructivist approach and is focused on the development of skills and on how we promote them in our subjects. But that is also paradoxical because the evaluations required in my area point to the old, to the content" (Teacher/8).

Finally, and in line with the objective of the present study, the changes and/or suggestions they would make to the new curriculum are explored. When asked, "What suggestions and/or changes would you make to the current curriculum?", the trend points to three aspects: incorporation of socio-emotional skills, change in the teaching approach promoting projects and experiential learning, and the incorporation of technologies and digital competencies, as evidenced by the following quotes:

"I would more strongly highlight the focus on socio-emotional skills; by being so centered on content and skills, we lose focus. We must not forget what the pandemic left behind." (Teacher/12). "It should be established that students work on interdisciplinary projects that reflect real-world problems because it remains vague, neither concrete nor clear in that purpose." (Teacher/3). "I think the updates fall short; the curriculum needs to be properly updated to include a more robust training in digital competencies and the use of technology" (Teacher/1).

Conclusions

Educational research views the curriculum as a dynamic and multifaceted entity that guides teaching and learning, thus, understanding the theory that underpins it will guide its development in the classroom and decision-making according to the needs of the contexts. Johnson-Mardones (2014) refers to the written dimension of the curriculum, understood as the document that regulates the content of schooling, shaping students' school experience and seeking to control teachers' work. Specifically, this study examined the conceptions and experiences of secondary education teachers in the Chilean school system in four key dimensions related to the current curriculum, its development, and implementation.

Firstly, there are the results related to the first variable, which addresses the conceptions about the curricular theories that underpin the current curriculum. The predominant concept of curriculum is framed within a technical rationality (Tyler, 1973). However, the results also showed a perception of this concept based on more progressive approaches, highlighting the flexibility provided for the curriculum to be adapted to realities (Magendzo, 2022). Regarding the role of

teachers, the results indicate that the participants consider their role in the classroom, as determined by the current curriculum, to be more of a planner, leaving behind roles such as leader, facilitator, mediator, and technician. In this aspect, a procedural approach in curriculum development is evident.

Secondly, in the aspect of experience and evaluation of public policies for design and implementation regarding the current national curriculum, regulations were mainly communicated through documents on official web pages. However, there were no ministerial workshops and training, as they would have expected. Thus, regarding curricular design policies, significant demands and challenges were identified, including limited outreach, restricted access, and insufficient professional support.

It is concluded that there was no participation in the design process of the current curricular bases. These results contrast with the claims made by MINEDUC, which has reported a constant increase in the available opportunities for participation by different entities, including teachers and current management positions, and reports high levels of participation across these instances. On the other hand, it is interesting to note that the trend in creating support networks for implementing the new curriculum is recognized among peers within the school community, strengthening collaborative work among peers. In this regard, the contributions of De Alba (2006) and Magendzo (2022) stand out, as they emphasize the importance of recognizing how the curriculum is subject to power structures, political interests, and social dynamics, as well as shaped by its intended audience.

Finally, the voices of teachers help identify key aspects for innovating the curriculum by incorporating elements from the knowledge that emerges from the contexts, challenges, and issues of the 21st century. Future updates or curricular adjustments face the challenge of creating spaces for participation that genuinely influence curriculum design, incorporating the experiences and needs of educational communities. This reaffirms Alicia de Alba's assertion: she draws an analogy between curriculum design and a battleground, referring to the tension between hegemonic forces and the groups that resist them in defining the knowledge to be passed on to future generations, and raising the implicit question: should the curriculum serve the labor market, or should it foster holistic education?

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Challenges for prospective feedback in teacher training: an inductive thematic analysis throughout tenets and practices

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Introduction

Feedback and its potential on students' learning has been noticeable developed within international educational discourse (Wiliam, 2018). Nevertheless, a significant body of research also converges to show some issues encountered by teachers when trying to enact this pedagogical strategy in their lessons (O'Donovan *et al.*, 2016; Ruiz-Primo & Brookhart, 2018). In higher education, strikingly, corrective approaches to feedback have been documented by literature, which accentuate both the amendments and the improvements of the particulars within students' tasks, with the teacher exerting the main role by telling pupils about the strengths and weaknesses of their work (Boud & Molloy, 2013; Boud & Soler, 2015). This assumption has raised important constraints as it cannot be asserted that students will understand teachers'comments and statements and infer aspects of quality that they might use to improve their work (Sadler, 2007, 2010). Thus, in line with Sadler's ideas, the opportunities for pupils' exploration of quality must be expanded while the learning task is undertaken. The author argues that feedback should be linked with the notion of scaffolding which might be conceived as a transitory pedagogical device, and it should progressively come to an end until learners' autonomy is achieved. This process can be reflected in the apprentices' capacity to capture the principles that should be kept in mind for future tasks, in their self-monitoring abilities, namely, making informed complex judgments on their own work (Sadler, 2007, 2010). However, Sadler (2007) also upholds the idea that the original meaning of this term has been diverted in practice, as it has become a very detailed and structured process of leading the pupils through each step with the teacher managing questions and delivering tasks. This problematic view of how feedback is applied resonates with a transmission approach, which, unlikely will stimulate students'engagement within learning challenges (Carless, 2022). Indeed, the UK national survey results illustrated pupils' critiques around the ways that feedback is delivered by teachers (O'Donovan *et al.*, 2016). These findings help to understand the claim that a shift is needed from conceiving feedback as a strategy that is provided to pupils, towards a co-constructed and interactive process amongst students, teachers and peers, giving opportunity for apprentices to exercise an active role within a multi-directional, dialogic and ongoing process (Carless,2019, 2022).

Contextualising this enquiry

This chapter goes through the first development phase steaming from a wider three-year research project sponsored by the Chilean National Agency for Research and Development. It regards to higher education, seeking to gain better insights on theoretical and practical standpoints about feedback, that might particularly help teacher training. Bearing this in mind, the first thought to tackle this challenge was influenced by what literature in higher education has consistently reported about the discrepancies between the potential benefits of feedback on pupils' learning and its actual impact in practice (O'Donovan *et al.*, 2016).Feedback processes, indeed, has been characterised by dilemmas, misunderstandings and variable effects when it is instantiated within lessons (Carless & Boud 2018; Molloy *et al.*, 2020). Following this first glance, a second relevant argument drawing from research encouraged this work, this is related to the need for revisiting feedback meanings and conceptualizations (Boud & Molloy, 2013; Carless, 2022) as it has been stated earlier,the models and approaches that lead different ways to undertake feedback might have distinctive effects on pupils' learning.Then, these lines of interest are materialised within the Chilean national context, trying to figure out how we are responding to these new feedback insights. Consequently, the initial step of the project involved a review of relevant national and international literature on the issue. Thus,the current chapter illustrates this theoretical journey, and it shares the analytical process undertaken within an inductive and iterative logic trying to capture lessons for the hereafter interventions. Thereby, it addresses the following research questions: i) What are the developments regarding feedback notions and mechanisms within national literature? ii) What are the core advancements regarding feedback conceptualisations and practices within international literature? iii) What are the main identified lessons from this analytic review process to strive for further empirical research?

A qualitative research approach was adopted, grounded on a descriptive-interpretative framework. This was supported by a systematic documentary analysis technique, which combined qualitative narrative review methods (Demiris *et al.*, 2019) with an inductive thematic analysis (Braun & Clarke,2006). The study sought to identify diverse standpoints and advancements regarding educational feedback in higher education, by revising scientific literature. The research design was structured from an initial comprehensive reading of the studies, which progressively led to the development of interpretative categories. Then, intertwined with this process, the inductive outlook employed involved a three-level literature examination, that is to say: Chilean contributions, Latin American articles and international papers.

The documentary corpus was comprised of scientific articles, book chapters, theses, and systematic reviews on feedback. These contributions were selected by considering inclusion criteria such as thematic relevance according to the research questions, indexation in mainstream databases, higher education level, being peer-reviewed articles or book chapters considering both Spanish and English Language, and texts published within the last ten years (2014–2024). The search was conducted between February and March 2024, using electronic databases such as Web of Science (WOS), ERIC, ScienceDirect, SciElo, Latindex, Redalyc, Dialnet, and Google Scholar.

The analytic process was carried out within an iterative outlook and with a back-and-forth movement of discussion throughout the material from different contexts. Matrices were devised containing key information as authorship, indexation, purpose of the study, methodological design, participants, discipline, type of feedback reported, teacher and students' role within feedback, main findings, the remaining gaps and keywords. In doing so, the search for national contributions yielded 20 papers that met the inclusion criteria, a process that continued with a focus on latin american research which increased the number of analysed articles to 27. Until this point, similarities and differences were grasped in a systematic and consistent manner, which helped to understand that within scientific literature from both national and Latin American contexts, the pervading notion of feedback focused on observing how feedback is provided by teachers, this with little opportunities for pupils' engagement. Therefore, the exploration method was expanded by considering international literature written in English language. At this stage, the analytical lens was sharpened by adding as inclusion criteria studies that showed how pupils dealt with feedback looking for related approaches, conceptualisations and practices. This broadened the documentary corpus to 76 articles.

The designed matrices were scrutinized and discussed repeatedly enabling the researchers to refine and worked out contradictory viewpoints. This also facilitated the inductive thematic analysis applied, by allowing the coding and grouping of the emerging findings into meaningful categories. This within an iterative process that combined open and axial coding phases. The *Atlas. ti* software was used to organise those codes and to bring on comparative visualizations. This can be described as a multilevel contrasting method grounded on the resulting categories from national and international literature until valuable insights and directions to conduct future empirical research were revealed.

This section addresses the prime findings according to the first and second research questions stated. Thereby, a reference is made around feedback conceptualizations and practices that were found within the analysed national and international literature. Some of the selected studies are used to illustrate the themes and to explain the emphasis that came across the coding process, this, embracing a qualitative narrative technique (Demiris *et al.*, 2019)

Developments regarding feedback notions and mechanism within national literature

Table 1 below shows the dimensions emerged from 20 studies encompassing a range of feedback conceptualisations and practices from a formative assessment stance:

Table 1: "Feedback dimensions within national literature"

Dimensions	Approaches to feedback (%)	Main codes (%)
Feedback conceptualizations	Retroactive 78% Proactive 22%	Correcting/grading 89% Projective/dialogic 11%
Feedback practices within teaching training	Technical 66% Instrumental 34%	Reviewing tasks 76% Self-peers /teachers 24%
Feedback through written comments	Product-basic errors 57% Gender / disciplinary focus 43%	Pieces of writing 67% Thesis 'drafts-others 33%

As shown in table 1 the first dimension to address feedback revolved around the notions held by teachers and their students. Contreras & Zúñiga (2017) highlighted the following: i) feedback conceived as correcting by spotlighting strengths and mistakes, although, the errors took the first place. This was understood in a retroactive sense and with a positive or negative orientation according to task results. ii) Feedback that addresses the self by giving personal compliments. It might involve judgments that were regarded to grades or evaluative comments. iii) Feedback visualised as projective improvement, more aligned with a formative purpose, trying to convey to pupils some general principles that they might use to enhance subsequent work. Further studies from the same contributors add other conceptualizations to the notions formerly described as: iv) feedback that serves the purpose of specifying those aspects of learning that have not yet been achieved (Contreras & Zúñiga, 2018), and v)feedback understood as dialogue, but, within a restrictive or misinterpreted meaning, as it was related with the high frequency through which teachers made comments, posed questions and gave individual recommendations to pupils , however, the students remained exerting a passive role(Contreras & Zúñiga, 2019). Looking at these set of articles, the authors recommended to conduct qualitative inquiries to gain more insights into the singularities and complexities of teachers' feedback concepts in higher education, likewise, they advised, specifically, exploring in more detail the idea of projective improvement regarding feedback since it was the least frequent emerged concept.

The second dimension identified throughout the enquiries was consistent with a line of interest about feedback practices and views within teaching training programmes. Gallardo-Fuentes *et al*. (2017) reported contrasting views about formative assessment and feedback, amongst students-teachers, graduates and practitioners. This regarding Physical education Pedagogy. The findings showed a limited pupils 'involvement within assessment and stated that there was a long way to go concerning self and peer-assessment and with respect to shared assessment. Later, Orrego *et al*. (2019) brought to the fore the students-teachers and the academics viewpoints in relation to knowledge, criteria and frequency of use of corrective feedback within an undergraduate English teaching programme. The main results displayed a relevant distance between the participants' representations on the subject and those notions coming from the extant literature. Thereafter, research carried out by Maldonado-Fuentes *et al*. (2020) compared undergraduate students' assessment viewpoints from three different pedagogical disciplines,i.e.Early Childhood Education, General Basic Education, and English. The prime

outcomes confirmed a technical concept about assessment largely documented in previous research, however, the authors commented that this result was slightly distinctive in respect of the feedback notion, as pupils linked it with reviewing, reminding, learning, and summarizing. According to the authors, this might imply an understanding of the idea of different effects of feedback, which, in turns, should encourage further examination. Next, a study undertaken by Torres & San Martín (2021) explored the usefulness of feedback for students enrolled within one Special Education Teaching Training Programme. They stated that students' everyday feedback practices were carried through complex scenarios, involving different actors, peers, peer-tutors etc. Likewise, it was defined in an instrumental sense with little opportunities to develop learners' autonomy.

The third dimension within the analysed contributions were focused on written comments devised by teachers on their students' writing tasks, in a higher education context. Arancibia *et al*. (2019) depicted what thesis supervisors, as experts, emphasised while commenting their pupils' work in progress. The content of these messages addressed quantity, clarity, coherence, correcting lingüistics issues and drafting. On the same line, the comments were aimed at the early adoption of the genre characteristics within the student's drafts. In a similar vein, Cuevas *et al*. (2020) reported on teacher's expectations with regards to their pupils' interpretations and understanding about the written comments provided by them into the writing assignments. The authors accounted the results pertaining to two different areas, namely, engineering teachers who wanted their students to demonstrate knowledge acquisition consistent with the task demands and education teachers, who verified good quality tasks in relation to spelling, coherence, and content. The contributors added that, both groups of teachers thought that pupils positively valued feedback although not necessarily liked to face written assignments. Tapia *et al*. (2023) characterised comments that were elaborated upon writing texts in the context of their university training subjects. This study comprised different disciplines (Natural science and Health, Engineering and Technology and Social Sciences). The prevailing results illustrated that teachers focused their comments to generic discursive aspects of the writing, and the comment mode was modified in terms of, or responded to each disciplinary area.

Advancements regarding feedback conceptualisations and practices within international literature

Table 2 below displays the prime dimensions emerged from 49 studies comprising a range of feedback notions and practices from an outlook of sustainable feedback.

Table 2: "Feedback dimensions within international literature"

Dimensions	Approaches to feedback (%)	Main codes (%)
Feedback conceptualisations	Influence future learning 65% Promote pupil's agency 35%	Sustainable feedback: 62% Dialogic feedback: 38%
Practices linked to feedback literacy	Clarifying quality criteria 56% Self -regulation capacity 44%	Exemplars/rubrics 53% Self-Peer review 47%
Use of exemplars	Making judgments ability 54% Autonomous learning 46%	Analysing exemplars 71% Exemplars/peer review 29%

The first dimension comes out from studies that attempted to position students in an active role within feedback processes, namely: i) Sustainable feedback, a concept that encompasses a focus on dialogue, on the students' ability to self-regulate their own work, hence, to their self-monitoring capacities(Boud & Molloy,2013; Boud & Soler,2015). This, in turn, entails to equip students not only to fully understand the task at hand, but beyond that, to influence their forthcoming learning. Following Boud & Molloy's (2013) stance, it pertains to a prospective outlook to feedback as it requires to overcome the narrow goal of simply completing the assigned task that is being commented, this is to say, moving forward to gaining insights that can be used in future work. ii)Dialogic feedback, a definition inextricably linked to social constructivist view to assessment (Carless, 2022). Thereby, it fosters pupils' agency by enabling them to pose questions, expand their understanding through different routes as asking questions, seeking clarifications of quality aspects and ideas, making comments and judgments to their peers' work (Carless & Chan, 2017, Carless, 2019).

The second dimension that arose from research had to do with students' feedback literacy that was defined as "the understandings, capacities and dispositions needed to make sense of information and use it to enhance work or learning strategies" (Carles & Boud, 2018, p.2). This implied that the practices settled out to enhance feedback within lessons were oriented by this notion. Carless & Boud (2018) developed a framework that considered four essential features such as: the students' appreciation of feedback, the ability to develop evaluative judgment, how to handle feelings and emotions derived from positive or negative criticism, and pupils' capabilities to act upon feedback comments. Then, these authors suggested two learning activities to materialise these constituting aspects of feedback literacy as peer feedback or peer review and the use of exemplars. Then, the study by Tai *et al*. (2018) unfolds pedagogical practices characterized by their potential to particularly develop the learners' capacity in making judgments. Some of these practices were centred around self-assessment, peer assessment and peer review, utilising rubrics, and using exemplars. The authors introduced a caveat concerning the meaning and purpose of these activities to strengthen this pupils' critical capacity. They suggested evoking two components that operate in an integrated and complementary way, related to the understanding of what constitutes quality and the application of that understanding in the specific exercise of judging a task or that of others. In this sense, their study illustrated that the rubric's value will not be determined by the standards listed therein, but rather by the iterative process in which the students articulate these quality criteria and co-constructs other notions that until that point remained tacit.

The third dimension of relevance throughout inquiries foregrounded the use of exemplars. This in our evolving understanding can be interpreted as a core pedagogical strategy to develop pupils feedback literacy. Carless & Chan (2017) explored the dialogic use of exemplars with a sample of science teachers and their students at the University of Hong Kong. The results showed that analysing exemplars helped learners to gain a deeper understanding of what aspects defined quality task. This, the authors added, can lay the foundations for pupils to gain experience in making judgments about quality as the opportunities for contrasting their own views with the others' opinions can be expanded. Later work highlighted the iterative nature of these process, allowing students to capture not only specific recommendations for improving the current task, but also more general principles for addressing other learning challenges in the

long term (Carless, 2019). Moreover, literature also reported dissimilar views about the benefits of exemplar use, framed within dialogic feedback (Tai *et al.*,2018). Furthermore, it has also been advised to settle further research trying to isolate whether the effects on learning are due to exemplars implementation only or it can be associated with a combination with other strategies(To *et al*. 2022).However, in spite of these considerations, research also converged that a pupils great value of the use of exemplars prevailed (Carless, 2022), as stated by To *et al*.(2022)stated within their review of 40 empirical exemplar-based studies: "Students' consistently positive perceptions of the usefulness of exemplars represent an argument for their increased use" (p.1175)

Conclusions

In this section two important lessons are shared in light of future empirical research, this in harmony with the third research question that oriented this inquiry. First, evidence about feedback conceptualizations showed that within the national context, most of the studies revealed an orientation to observe how feedback is provided by teachers, this, with little opportunities for pupils' engagement. Likewise, feedback was explored upon a formative outlook. By Contrast, within international literature, Feedback notion was approached within a sustainable assessment perspective. According to Boud & Soler (2015) this last concept might be traced back to formative assessment (Wiliam, 2018).However, the authors, also point out that unpacking the conceptualization on sustainable feedback requires to make a distinction from other theories, as its overarching feature regards to influence lifelong learning. Therefore, what is learnt is that subsequent studies should consider stages and methods giving opportunities for participants to externalise and discuss their feedback views. Likewise, it would be suggested using the terms sustainable feedback and prospective feedback interchangeably (Boud & Molloy ,2013)to characterise practices grounded on a collective approach, which engages teachers, students and peers, discussing quality elements, to strengthen the processes of interpretation of these criteria and the progressive development of the necessary skills to elaborate informed judgments, seeking a greater role in their learning process.

In terms of feedback practices the inquiry revealed that national literature addressed the development of feedback messages or comments in different disciplinary fields in higher education and teacher training following a corrective outlook. However, international studies, took a different perspective, as the practices explored and suggested were oriented by the feedback literacy notion, to designing and proving activities to equip students for exerting an active role within this process. These findings became the second lesson from this inquiry as sufficient evidence was found that the use of exemplars as an enabling activity to position pupils within feedback needs further exploration. All in all, these ideas enlightened our work in Chile to design a research project that intertwine theory and practice close to a prospective feedback approach.

Acknowledgements*: " This work was funded by ANID/FONDECYT Iniciación 11251455"*

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Significance Of Language Teacher Identity Negotiations Based on Gender and National Identities Of Ecuadorian English Teachers

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Introduction

Identity is fragmented, multiple and expansive. Identity formation is conditioned not merely by the inherited traditions of culture, external exigencies or power, but also on the individual's agency, ability and willingness to exercise them (Kumaravadivelu, 2012). In a globalised world, tribalism, nationalism and globalism exert their influences on an individual's psyche. Language is intrinsically related to one's identity: an individual's definition of self and their place in the society. This intricacy means that second language teachers and learners experience complex identity negotiations. Second Language classes are places where often adult individuals have a unique opportunity to describe anxieties about the complex process of identity formation. An interplay of nativeness and non-nativeness provides a compelling narrative to rethink the competencies that one expects from language teachers beyond the theoretical and pedagogical assumptions. English language teacher education has assumed a uniform expectation of teachers' capabilities. Global ascendancy of English means that these expectations are set outside of the cultural and contextual settings of a classroom. This assumption and uniformity of expectations constitute a teacher's definition as a professional. This is the de-facto base of knowledge for ELT (English Language Teacher) education.

However, non-native speakers outnumber native speakers of English three to one (Medgyes, 2011), and eighty percent of all English language teachers are non-native English-speaking teachers (NNESTs) (Canagarajah, 2004). Considering this, negotiations of teachers' professional identities as the language that they teach and practice represents the very ideas of globalisation and colonisation becomes complex while convoluting the forming identities of the learners.

The dichotomy of NESTs and NNESTs – Identity Negotiations

Linguistic identity of a teacher has been uncompromising in its definition as a native speaker or a non-native speaker (Moussu & Llurda, 2008). Native speakers are often presumed to be monolingual and non-native speakers are defined by their perceived deficiencies in English. This dichotomy of Native English Speaker Teacher (NESTs) and Non-native English Speaker Teacher (NNESTs) exists in common parlance (Ellis, 2016), even as multicompetence has been accepted.

Wenger (1998) states that formation of identity is a result of the amalgamation of two processes. First, identification, where individuals derive their position based on the sense of belonging that they attribute to a particular setting. Engagement, imagination, and alignment are the sources of Identification. Second, negotiation of meanings, where identities are derived from contexts. This looks at the individual's contributions to the invested meanings. However, these derived meanings might get skewed as NNESTS in this case find themselves in situations where they cannot claim these derived meanings to which they have contributed actively dur to asymmetrical power relations resulting in their alienation and domestication of dissent. (Tsui, 2007; Kumaravadivelu, 2012; Morgan, 2016; Wenger, 1998).

Bronfenbrenner's Ecological systems theory

Brondenbrenner's Ecological Systems theory (Bronfenbrenner, 1979) is used for understanding human development and identity formation. It looks at developmental psychology of a human and closely follows one's growth from an individual to a competent member of the society. The primary tenet of his belief that society has the greatest influence on an individual's development. In the context of an Individual's identity negotiation, the immediate context of a second language learning can be considered. As Social Identity theory corroborated by Kumaravadivelu (2012) states, one's identity could be concluded as a result of social interactions. Kevin Lewin (Lewin, 2013) presented the classical field theory in which he proposed that behaviour is the outcome of the interactions between a person and their environment. It concerns an influence that works both ways: an individual shapes their environment, and an environment shapes an individual (Bronfenbrenner, 2000; Saarinen, Ruoppila, & Korkiakangas, 1994). Lewin's definition of behaviour (2013) was transformed into a development formula by Bron- fenbrenner (2000). He extended the definition and included the time factor:

$$D_t = f(t-p).(P.E)(t-p)$$

Here, *t* represents the time during which the observed development, *D* takes place. The period or periods during which the person and environment-related powers act in concert to produce the result that is observed at a specific point in time is represented by *t-p*. This indicates that the mechanism causing the developmental change is not instantaneous but rather occurs over time and may alter over time in a manner akin to that of the formula's other components. Process of second language acquisition and the individual's negotiation of identity can be incorporated into the formula as components that impact the outcome of development of identity. The approach emphasizes the evolving individual, the educational setting, and the environment, with their intricately entwined roles, behaviours, and processes. However, as previously said, the focus of this theory is not on education as a phenomenon; rather, pedagogy and education science.

System structures in Bronfenbrenner's theory

According to Bronfenbrenner, an individual actively interacts with circles of the environment, and they effect one's socialisation and development (Bronfenbrenner, 1979; Saarinen et al., 1994). Three key presumptions are included in this. Firstly, the individual is a dynamic agent who actively shapes their surroundings. Secondly, The environment forces them to adjust to its

demands and limitations. Finally, the environment is perceived as a collection of various entities arranged with reciprocal relationships between them, as well as micro-, meso-, exo-, and macrosystems.

Identity Activation: Self-Categorization and Self-Esteem

This paper has so far given two ways to conclude that the environment in which an individual resides is related to their identity development. It examines how NNESTs define their identities using Bronfenbrenner's Ecological Systems Theory (2000) and then focuses on the negotiation of meanings proposed by Wegner's paper (1998) on Identity formation. There has been no formal attempt made during the formative years of an NNEST to properly establish their identities through education.

Reflective self is capable of objectively detaching oneself from its surroundings. Based on its relationships with immediate social categories and classifications, it may then categorise, and assign meaning and significance to itself (Stets & Burke, 2000). From the theoretical perspective of social identity, this process is called self-categorization (Hogg & Ridgeway, 2003) and from that of identity theory this is called identification (McCall, 1966). This resonates with the interactions between exosystems and microsystems as proposed in the Ecological Systems Theory Bronfenbrenner (2000).

Social Identity theory suggests that an individual's identity is shaped by their membership in a social category or group which is shaped by their exosystems and interactions with their macrosystems. This process involves self-identification highlighting the distinctions and similarities. Social identity is also shaped by comparison, which results in a more selective application of this highlighting leading to self-enhancing outcomes like a heightened self-esteem which is a process that NNESTs go through in navigating the workplace's social hierarchy. A NNEST's identity negotiation is made difficult due to the presumable domesticated dissent in a non-equal opportunity environment (Morgan, 2016). Contrasting classifications can be found in this microsociety in which a person finds themselves: native vs. non-native - powerful vs. weak (Abrams & Hogg, 2006).

Cognitive and motivational processes become relevant only when identity is activated. Social identity examines the circumstances that lead to this activation based on social classifications. Identity theory, contrarily, addresses roles and the expectations associated with them in each social structure, discusses dedication to a specific identity as the catalyst for activation (McCall, 1966; Stets & Burke, 2000). Increased psychological influence to join a group can result from a salient social identity (Oakes, 1987). Self-esteem and self-efficacy are the motivational processes which are triggered on identity activation. (Abrams & Hogg, 2006). The significance of self-esteem within a social group is its effects on an individual's performance (Stryker, 1980).

Gender roles in Ecuadorian Society

Article 61 of the Ecuadorian Constitution guarantees equality of opportunities for all people. While Ecuadorian women have been granted the right to vote since 1929, the first in Latin America, in practice, they have rarely enjoyed the equality and parity that the article 61 mentions

(Rodríguez & Cedeño, 2024). The participation of women at Ecuadorian work place remains sub optimal. The cult of marianismo that Spanish conquistadors promulgated continues to this day. Marianismo exalts women to be, "... virginal and pure like Mary". They were culturally expected to be good wives and mothers, educators, which typically included self-sacrifice and putting one's family and its survival above all else (Chaidez, 2022; Poor, 2018). Ecuador's independence from Spain did not lessen the patriarchal aspects of its society.

Gender Identity in English Language Teaching

Despite the fact that English teaching field has generated about 30 new teaching methodologies since the 1960s, the inclusion of gender issues and diversity has been delayed while several humanities disciplines extended and deepened the horizon of gender issues (Thornbury, 2017). Butler (1990) has placed gender on a broad spectrum by highlighting that gender is an act that we undertake every day through language since without discourses and expressions, gender per se does not exist, and gender is conceptualized within binary logic and essentialism. Gender is thus artificial because it is socially and historically produced. Therefore, discourses shape and precede gender, people do not intentionally conduct gender acts.

Teacher's professional Identity

One perspective on a teacher's professional identity is developing one's professional identity is a continual process in which a teacher's personal and professional selves eventually meld together (Kumaravadivelu, 2012; Stets & Burke, 2000; Wenger, 1998). A second perspective states professional identity simply refers to how educators categorize themselves as a profession or how educators view the obligations they bear. According to the third viewpoint, professional identity is made up of a variety of sub-identities that come to life as teachers recount their life stories in order to reconcile their personal and professional selves. However, there isn't a single definition of professional identity that everyone agrees upon. In higher education, there hasn't been much research done on professional identity (Hafeez, 2023)

A non-experimental descriptive method is used for this research. Data collection was done in three stages, first a survey, then an interview and finally a post interview questionnaire. Bronfenbrenner's ecological model (Bronfenbrenner, 2000) and the Multigroup Ethnic Identity Measure (MEIM) (Phinney, 1992) provided references to create the questions for the survey. The MEIM typically includes items that assess two main dimensions: Exploration measures the extent to which individuals have negotiated their identities and engaged in activities that are relevant to their group; Commitment measures the extend of an individual's investment and how the individual feels towards the group they belong.

The research tried to superimpose the ideas of interactions between the different spheres of Ecological systems. The survey received a total of 26 responses. During the interview, which was conducted later on 4 participants (2 male and 2 female), identity activation was ensured to trigger self-esteem motivational process (McCall, 1966; Stets & Burke, 2000). Once interviews were concluded, a post interview questionnaire was provided to the interviewees. This test was based on Rosenberg Scale (Rosenberg, 1965), to measure their self-esteem as triggered by the activation of their NNEST identities.

The survey results indicated that the respondents showed a moderate exploration (2.7/5) and commitment scores (2.5/5). A moderate exploration score indicates that an individual is somewhat engaged in exploring their background. The sense of community of the Ecuadorian populace is somewhat ambivalent. A number of *routes to community* have been constituted by the provincial inhabitants of the Ecuadorian Andes with the help resources locally available to them. They formulate their identity and political agenda within the power structures present in the wider circuits. In projects of nation building by the Ecuadorian state has been profoundly implicated by this *recommunalisation* of the Andean society, occurring in local scale mobilisations around ethnic politics by indigenous community organisations (Radcliffe, 1999).

A moderate exploration score indicates that the individual partakes in activities related to uncovering more about their community. However, these efforts could not have been consistent or intensive. Apart from being situational, we cannot conclude their deeper interest. When considering the individuals' awareness about their community's background, as NNESTs, they might not have in-depth understanding or expertise. Their participation in organisational events or discussions could be occasional. Their identity formation is in a developmental phase, where they might be exploring what their background means to them at a personal level yet, they have not been able to fully integrate this into their concept of self.

Thereby, it could be theorised that an individual feels a reasonable yet weak attachment to their communities. Radcliff (1999) postulates that Ecuadorian state's constant effort in modernisation and applying neoliberal polices which started in the 80s and reinforced in the 1992-96 period, hadn't resulted in erosion of communal ties. Paradoxically, it resulted in the resurgence of political activity among the populace, especially the indigenous populations. Forging a national identity happens though complex conversations and representations derived from numerous socio-spatial developments and micro-identities. As such a uniformity or a national umbrella is not a possibility.

A neoliberal idea of modern, nonethnic community of nationhood was just radicalised at the behest of the agenda of *blanquirniento* (whitening) and when the idea of *mestizaje* was institutionalised from the military state of the 1970s to the post-1980s liberal democracy. The surveyed teachers' age and background concur with this idea resulting in a moderate commitment score on an MEIM scale (Quintero & Silva, 1991; Stutzman, 1981). When considering an individual's sense of belonging, one could interpret that the individual feels a moderate connection and emotional attachment to the NNEST community. As LTI is integrated to the overall sense of self, the commentary on the cultural and historical context of Ecuador is relevant. The individual might give importance to their NNEST background; however, it is not often considered as the defining aspect of who they are. Individuals at this middle stage of identity development can thrive if more opportunities of engagement, education and social support are provided.

Interviews reinforce that self-esteem of NNESTs was linked to visible associations with native speakers, this "Ecua-gringo" dynamic was discussed previously in the studies of the author of this article (Kandappankattil Narayanan, 2022). Interestingly, interviews suggested that women's docility may facilitate openness to acculturation. This raises questions about whether this

malleability is a paradoxical result of *marianismo* or it is a conscious choice made by an empowered individual in search for a higher status (Chaidez, 2022; Poor, 2018). A sense of domesticated dissent emerged strongly from the interviews. Unfairness in the process of selection of NNESTs for employment was mentioned on multiple occasions. The epistemic dependencies in teacher training and self-marginalisation of NNESTs discussed by Kumaravadivelu (2012) can be observed in the interviews. Another interesting finding from the interview is the apparent inequity in Spanish classrooms where the power structures are reversed. However, this unfairness is the result of the power structures far more established in English Language Teaching and has roots in such concepts as language objectification (Morgan, 2016; Reagan, 2004; Volšinov, 1973). In conclusion, interviews reiterated the need for further emphasis on LTI in English Teacher Training programs, especially considering the moderate commitment and exploration scores found in the survey.

The responses to Rosenberg Self-Esteem (RSE) Scale post interview pointed at a moderate self-esteem, represented by scores ranging from 11 to 20 (Rosenberg, 1965). A moderate score is considered as evidence to a healthy level of self-esteem. The individuals with this score possess a balanced view of themselves. They acknowledge their strengths and weaknesses. NNESTs studied are aware of the challenges; however, none of them resigned to self-deprecating low levels of self-esteem. The respondents showed a realistic view of their abilities and limitations. They show resilience and adaptability. They resorted to identifying their individual strengths, not focusing on the setbacks they could face as NNESTs. They are adaptable and open to feedback, which can help them grow and develop. They maintain robust interpersonal relationships. Additionally, they are capable of critical self-reflection. They identify what needs to be done and they accept constructive criticism without impacting their self-worth. In summary, a moderate self-esteem score on the RSE Scale reflects a realistic, well-rounded, and adaptable concept of self. It also reflects a good foundation of self-worth and negotiated identities while allowing space for growth and self-improvement.

Conclusions

This research emphasizes the importance of advocacy for better access to resources that expedite deeper exploration and understanding of LTI of NNESTs. This has the potential to support both exploration and commitment. As it is evident, the idiosyncrasies of Ecuadorian reality and politics convolute and explicate local challenges in replicating curricula made outside of Ecuador. Consequently, ELT curricula should be adapted to the needs of the teachers. Teachers should be encouraged to do reflective practices to further the engagement with and attachment to one's identity. Providing more opportunities for engagement, education, and social support from an education policy level can help deepen teachers' exploration of their identities and strengthen their commitment towards it, thus enhancing their overall ethnic identity.

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Subject-Specific Teaching Methods, Active Learning, and STEAM Methodologies

Geometry Didactics in Early Childhood Education: Contributions to Initial Teacher Education

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This text stems from the doctoral thesis in Mathematics Education at the Universidad de Los Lagos, Osorno, Chile, 'Didactics of mathematics in the training of kindergarten educators: strategies and methodologies for the teaching of geometry'.

Introduction

The research aims to contribute to the debate on initial teacher education in Early Childhood Education, by offering empirical evidence on the potential of the Theory of Didactical Situations (TDS) to articulate the teaching of geometry in early childhood with the development of professional competences in future early childhood teachers.

Early mathematics education has gained growing interest due to its impact on the cognitive, social and cultural development of young children (Sarama & Clements, 2009). However, international research shows shortcomings in the initial education of early childhood teachers, both in disciplinary mastery and in didactical mastery, which restricts the design of meaningful pedagogical experiences (Alsina, 2020; Esen et al., 2012). In Chile, the National Diagnostic Assessment (2021–2022) has shown low performance in the area of mathematics (55–60%), while classrooms devote very little time to this area, around 9% of instructional time (Undersecretariat of Early Childhood Education, 2021). Within this reality, the teaching of geometry has been reduced to visual tasks, overlooking its potential to develop spatial thinking, geometric reasoning and mathematical language (Gutiérrez, 1991). This gap reveals the need to strengthen teacher education from perspectives that articulate theory, practice and critical reflection.

Brousseau's (2007) Theory of Didactical Situations (TDS) offers an adequate framework, since it places knowledge in problematic scenarios that promote action, formulation, validation and institutionalisation, thereby fostering the social and cultural construction of knowledge. In this context, the research set out to analyse how these didactical phases are manifested in the design and implementation of geometry situations developed by students of Early Childhood Education with Transition 2 children. The purpose is to provide empirical evidence on the relevance of TDS as a resource for initial teacher education and for the meaningful teaching of geometry in early childhood.

Training in Didactics of Mathematics for Future Early Childhood Teachers

In the international context, authors such as Alsina (2020) have expressed concern regarding the absence of mathematics education in the university studies of future early childhood teachers, reporting a specific "Agenda for action" (Alsina, 2020, p. 384) that would make it possible to

improve the current situation of Mathematics and its didactics, and to establish perspectives and actions for its achievement in the coming years.

For their part, Goldrine et al. (2021) show that studies in Türkiye reveal insufficient knowledge for the teaching of mathematics among early childhood teachers, both in pre-service and in-service education. In Brazil, the preparation of teachers of young children (up to 5 years of age) follows a traditional structure, that is, from theory to applications within mathematics itself, and without sufficient preparation to interpret, solve, analyse and assess problem situations.

In the Chilean context, the situation is not different: the results of the National Diagnostic Assessment (END) applied to Early Childhood Education (or initial education) programmes show a concerning performance in mathematics. In 2021, the percentage of correct answers reached 55.9%, a figure that rose slightly to 57.7% in 2019. Although a slight increase is observed, these results are insufficient to guarantee a positive and sustained impact on the teaching and learning of mathematics in early childhood (Ministry of Education, 2021, 2022).

Consequently, the initial education of early childhood teachers becomes a key element in guaranteeing quality education from the earliest years. At this educational level, mathematics, and particularly geometry, plays a fundamental role in the development of spatial thinking, in observing one's environment, and in acquiring mathematical language.

Theory of Didactical Situations (TDS)

In view of the needs identified in the teaching of mathematics in early childhood education, a proposal of Didactical Situations for the teaching of early geometry was developed, taking Guy Brousseau as the theoretical reference. The theoretical assumption proposed by the Theory of Didactical Situations (TDS) is that it is not possible to transmit knowledge directly. It was therefore proposed that didactics should use a specific model of mathematical activity whose main objective would be to define a mathematical knowledge through a situation that would enable students to learn indirectly.

The view underlying this theory is that the teaching and learning of mathematical knowledge, rather than being something purely logical-mathematical, involves a collaborative construction within an educational community; it is a social process. Through discussion and debate on how a mathematical problem can be solved, individuals activate strategies to arrive at its solution which, although some of them may be erroneous, are paths that enable them to gain a better understanding of the mathematical theory presented in class. The elements that compose it are: Didactical Situation, A-didactical Situation, Phases and Effects (Brousseau, 2007).

The didactical situation is conceived as the network of relations between the teacher, the student and the knowledge. Within this framework, the role of the teacher is not to transmit knowledge directly, but to propose a carefully designed a-didactical situation that will enable the learner to learn through adaptation. To do so, the teacher constructs a milieu and poses a problem that arouses the intention to act, generating in the student actions on that milieu. The result of this interaction is the elaboration of a knowledge, understood as a strategy that enables the problem posed to be solved. According to the Theory of Didactical Situations, this knowledge is personal

and situated, unlike the savoir, which has an impersonal and decontextualised character. Consequently, once the a-didactical situation has been concluded, it is the teacher's responsibility to undertake the process of institutionalisation, making explicit the relationship between the knowledge constructed by the student and the formal knowledge to be taught (Acosta et al., 2010, p. 177).

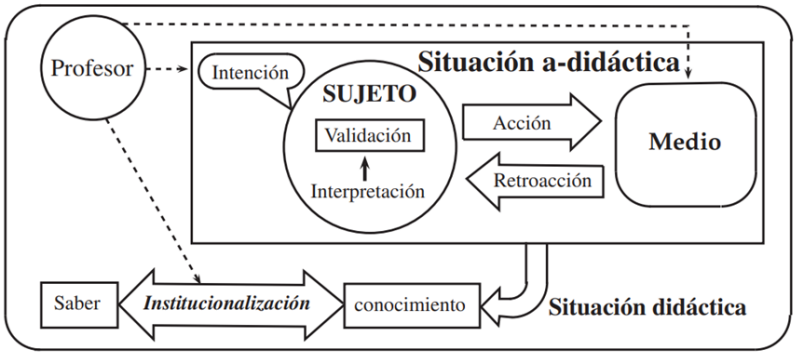

Figure 1. Relationship between Didactical Situation and A-didactical Situation. **Source.** Acosta et al. (2010, p. 177).

In the Theory of Didactical Situations (TDS), the milieu may be presented in material form — such as logic blocks, geometric solids or drawings — or in intellectual form, through problems, tasks, situations or even interaction among the pupils themselves. In this way, the milieu constitutes the set of material and intellectual elements of reality on which students act in order to solve a task. Teaching is sustained in the dynamic relationship between the teacher, the student and the knowledge, a bond that constitutes the core of every didactical situation.

The study was conducted within a qualitative and interpretative approach (Hernández et al., 2014), aimed at understanding the meanings, practices, and processes associated with the teaching and learning of geometry in early childhood education. This approach made it possible to explore in depth the interaction between trainee teachers and young children, as well as the mediations emerging from situated pedagogical practice, considering the contextual and sociocultural richness of the school environment.

The design adopted was a Lesson Study (LS) (Braga et al., 2018; Hart et al., 2011), a collaborative methodology for teacher professional development that enables the systematic analysis and improvement of teaching practices through the planning, observation, analysis, and redesign of didactic experiences. This design allowed the phenomenon to be addressed from a situated perspective, linking initial teacher education with real educational practice. The sample was intentional and non-probabilistic, comprising two complementary units of analysis:

1. *Trainee teachers*: Fourteen (14) students enrolled in the Early Childhood Education degree programme at a state university in the Los Lagos Region, who were in their seventh semester and completing their professional teaching practice in municipal schools. The participants were organised into three working teams (two of five members and one of four), responsible

for planning and implementing didactic experiences under the supervision of the academic instructor.

2. *Children*: Forty-five (45) boys and girls aged between 5 and 6 years, belonging to the Transition Level 2 (NT2) in three municipal schools in the same region. This age group is characterised by the consolidation of oral language, emerging literacy, and the development of logical-mathematical thinking. The schools presented sociocultural diversity and heterogeneous pedagogical resources.

The process was developed over one academic semester (March–July 2025) and integrated the four classical phases of the Lesson Study (Hart et al., 2011): 1) Collaborative planning of the didactic situation "Designing the Geometric City", designed on the basis of the Theory of Didactic Situations (TDS) by Brousseau (2007); 2) Implementation and classroom observation, conducted by the students and the academic tutor through participatory observation with systematic recording of interactions and children's productions; 3) Reflective analysis of the collected evidence, discussion of findings, and theoretical contrast; 4) Redesign and institutionalisation of learning and didactic strategies.

The data were obtained through four complementary sources: a) Structured field notes, produced by the academic tutor and student observers, focused on interactions, geometric language, and teacher mediation; b) Audiovisual and photographic recordings, used for micro-interactional analysis of gestures, manipulations, and verbal expressions; c) Students' reflective journals, in which they recorded perceptions about planning, implementation, and emerging learning; and d) An ad hoc observation matrix, aligned with the TDS phases (action, formulation, validation, and institutionalisation).

Each instrument was validated by experts in mathematics education and adjusted prior to application.

The analysis was carried out through thematic coding (Miles et al., 2014), taking the TDS phases as a priori categories. The procedure involved three stages: 1) Comprehensive reading and segmentation of the records, identifying units of meaning linked to the phases of action, formulation, validation, and institutionalisation; 2) Triangulation of sources and analysts (Denzin, 2012) between the academic researcher and the students, ensuring interpretative validity; and 3) Theoretical–empirical contrast, integrating the findings with contributions from the specialised literature on early geometry education (Godino et al., 2007; Radford, 2014).

The research complied with the ethical principles of educational research involving children: informed consent from families, institutional authorisation from schools, data anonymisation, and confidentiality protection. Voluntary participation and the safeguarding of children's rights were emphasised, in accordance with national regulations and the guidelines of the Ethics Committee of the Universidad de Los Lagos.

The findings are presented in an integrated manner across two axes: (a) manifestations of children's learning during the didactic situation "Let us design the geometric city" and (b) pedagogical decisions and professional development of the trainee educators, articulated

according to the phases of the TDS and aligned with the methodological procedures and instruments applied (field notes, audiovisual records, reflective journals, and observation matrix). These results confirm that the design of meaningful didactic situations fosters deep and contextualised learning, in which embodied exploration and dialogic mediation are decisive for the construction of geometric thinking (Godino et al., 2007; Alsina, 2020). The experience demonstrated that TDS constitutes an effective framework for integrating action, language, and reflection in early mathematics education.

From the perspective of initial teacher education, progression through the phases of TDS became a formative scaffold that supported the development of professional competencies associated with planning, observation, and pedagogical reflection. The students assumed a dual role: both designers and implementers of learning experiences, and simultaneously, researchers of their own practice (Braga et al., 2018). During collaborative planning, participants demonstrated the ability to formulate open-ended didactic problems and anticipate possible children's responses, although in the initial sessions they exhibited difficulty in using formal geometric vocabulary with accuracy. This aspect was progressively improved through peer feedback and the guidance of the teacher educator. During implementation, the students demonstrated advances in pedagogical mediation by adjusting instructions, diversifying materials, and recognising the need to respect children's exploration time. In the reflective phase, they emphasised the importance of observing without intervening prematurely, acknowledging the value of error as a source of learning. These transformations demonstrate the effectiveness of Lesson Study as a situated professional development mechanism, as it enabled the resignification of pedagogical practice and strengthened the reflective professional identity of the trainee educators (Ávalos, 2019; Marcelo, 2011).

Furthermore, triangulation of the evidence collected (field notes, reflective journals, audiovisual records, and observation matrices) enabled the identification of patterns of pedagogical action and discourse that were coherent with the theoretical categories of the TDS. In particular:

Table 1. Correspondence between the phases of the Theory of Didactic Situations and the evidence observed in children and trainee teachers.

TDS Phase	Indicators observed in children	Evidence of teacher mediation
Action	Free exploration and construction of three-dimensional figures using blocks and recycled materials.	Provision of open materials and broad instructions.
Formulation	Verbal description of shapes and comparisons between structures.	Introduction of geometric vocabulary and guiding questions.
Validation	Argumentation about stability and correspondence of shapes.	Facilitation of discussion and request for justifications.
Institutionalisation	Graphic recording of constructions and connection with curricular concepts.	Concept systematisation and reflective closure.

These findings support the thesis that geometric learning is constructed through dialogic processes of exploration and social validation, rather than through direct instruction (Artigue, 1995; Radford, 2014). It was also verified that the phases of the TDS function as a formative structure for both children and trainee educators, configuring a process of reciprocal learning.

Among the tensions observed was the initial difficulty experienced by the students in employing precise geometric terminology and in establishing connections between empirical observation and formal language. It was also noted that unequal availability of material resources across schools affected the equity of learning experiences, underscoring the need to promote accessible and sustainable didactic resources.

The primary contribution of the study lies in evidencing TDS as an epistemological and methodological framework applicable to early childhood education, enabling the articulation of theory and practice. The findings reveal that didactic situations constitute spaces for co-construction of knowledge, where educators learn to teach by observing how children learn.

Furthermore, the study provides empirical evidence to inform the improvement of initial teacher education in early mathematics, proposing a balance between disciplinary knowledge and situated pedagogical reflection, in line with contemporary action-research approaches (Shulman, 2005; Wenger, 2003).

Conclusions

The study made it possible to verify that the implementation of the didactic situation "Let us design the Geometric City," grounded in the Theory of Didactic Situations (TDS), constitutes a significant contribution both to children's geometric learning and to the professional development of future early childhood educators. The experience demonstrated that girls and boys are capable of constructing mathematical knowledge through exploration, communication and symbolic representation, provided that activities are framed within problematising, playful and culturally contextualised situations (Brousseau, 2007; Godino et al., 2007; Alsina, 2020).

From the perspective of initial teacher education, progression through the phases of action, formulation, validation and institutionalisation enabled the students to reflect on their own practice, strengthen their didactic competence and understand the importance of pedagogical mediation as the articulating axis between theory and experience. Lesson Study was confirmed as an effective formative mechanism, as it fostered collaborative planning, critical observation and the restructuring of teaching strategies (Hart et al., 2011; Braga et al., 2018).

In relation to difficulties and emerging learning, tensions were identified concerning the use of formal geometric language and the articulation between disciplinary and didactic knowledge. These limitations were addressed through collective reflection and guided feedback, which supported progress towards a more rigorous use of mathematical terminology and a stronger understanding of the institutionalisation of knowledge.

Furthermore, the findings of previous research are reinforced (Edo, 1999; Sarama & Clements, 2009; Radford, 2014) in demonstrating that geometric thinking develops progressively when

action, language and symbolisation are integrated within meaningful learning environments. The methodological proposal presented contributes to moving beyond traditional approaches focused on the memorisation of shapes, showing that geometry can become a space for reasoning, creativity and the cultural construction of mathematical knowledge.

Looking ahead, this research offers relevant projections for the field of early childhood mathematics education, aimed at: (i) deepening the systematic incorporation of TDS within initial teacher education; (ii) developing pedagogical resources that integrate play, exploration and mathematical reflection; and (iii) generating comparative studies across institutions and territories to evaluate the sustainability and transferability of this model.

At the level of educational policy, the results emphasise the need to position mathematics didactics as a structuring axis in early childhood teacher education, promoting programmes that balance disciplinary and pedagogical knowledge, and which acknowledge the importance of initiating robust, meaningful and culturally situated mathematical processes from early childhood (Ávalos, 2019; Casanova, 2025).

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Argumentation and understanding of homotopies in higher education

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Introduction

Homotopies are one of the fundamental concepts of algebraic topology, one of the most abstract areas of mathematics and one of the most challenging in the university curriculum (Chirinos *et al.*, 2025; Dieudonné, 2009; James, 1999). Homotopies are included in the undergraduate mathematics curriculum, and this research is important because it addresses an issue that is rarely dealt with at the advanced mathematics level: students' mathematical reasoning when working with abstract concepts such as homotopies.

Research in mathematics education has reported difficulties among students in understanding mathematical concepts (Dorier, 1998; Sierpinska, 2002), and these difficulties intensify when faced with mathematical proofs and demonstrations (Astorga & Parraguez, 2019; Kartika *et al.*, 2024), which are tools frequently used by mathematicians. Homotopies are no exception to what this research reveals, as undergraduate mathematics students at a university in Peru showed low grades in some semesters, highlighting the abstract nature of the subject.

Likewise, various researchers who have addressed mathematical argumentation have highlighted its importance for learning (Chirinos *et al.*, 2025; Corneli *et al.*, 2019; Schwarz, 2009), the promotion of critical thinking (Baker, 2009), and understanding from a pedagogical perspective (Sommerhoff *et al.*, 2021).

To analyze the students' argumentative process, the research was based on Toulmin's argumentative theory (1958), who developed a model for analyzing the structure of arguments based on six components, where validity depends on each specific area of knowledge (García-Cruz, 2020; Toulmin, 1958).

However, following the approach of Rodríguez *et al.* (2023), this study considered only three elements. Thus, any argument is based on specific information (data) that supports a claim (conclusion) and requires elements that justify and strengthen the argument, called warrant (Rodríguez *et al.*, 2023; Toulmin, 1958). Guarantees are rules or properties that allow the transition from one statement to another; in other words, they represent the body of justifications that enable the data to support the conclusion.

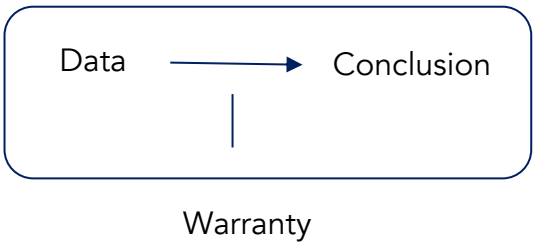


Figure 1. Basic structure of argumentation (Rodríguez et al., 2023; Toulmin, 1958)

On the other hand, to understand the different ways in which undergraduate students approach homotopies in various contexts, Sierpinska's theory of mathematical concept comprehension was used. According to Sierpinska, understanding a mathematical concept requires the articulation of practical thinking and theoretical thinking, which she called synthetic geometric thinking, structural analytical thinking, and arithmetic analytical thinking (Astorga & Parraguez, 2019; Parraguez *et al.*, 2023; Sierpinska, 2002). Each of these modes of thinking is a pathway to the different meanings of the mathematical object.

For Sierpinska, understanding a mathematical concept through the synthetic geometric (SG) mode involves working with graphic representations. This SG mode is associated with practical thinking (Astorga & Parraguez, 2019; Parraguez *et al.*, 2023; Sierpinska, 2002). Likewise, the analytical-structural mode (AS) is a theoretical way of thinking, in which the object is defined through properties, axioms that characterize that mathematical object (Lizana, 2024; Parraguez *et al.*, 2023). The arithmetic analytical mode is ruled out, as homotopies are not arithmetic in nature (Sierpinska, 2002).

It should be noted that Brower was the first mathematician to establish the formal definition of homotopy, which is currently used: two functions are homotopic if there exists a continuous mapping such that continuously deforms the image of f into the image of g (Dieudonné, 2009; Eynde, 1992; James, 1999).

Toulmin's argumentation model (Toulmin, 1958) is based on justifications that allow the conclusion to be validated from the data. These justifications reveal a structural complexity that corresponds to what Sierpinska proposed in her theory of mathematical concept comprehension (Sierpinska, 2002). These two theories will constitute the theoretical basis for analyzing the comprehension of homotopies.

The synthetic geometric mode of the concept of homotopies is manifested through the graphic representation of the family of homotopic curves that can be deformed into one another (Eynde, 1992; Marquis, 2006). The structural analytical mode of the concept of homotopies manifests itself through the structure of homotopy (Dieudonné, 2009; James, 1999) given by the definition itself, such that the homotopic application must be well defined, continuous, and satisfy the conditions at 0 and 1.

The objective of this research was to determine the components of the argumentative structure that enable undergraduate mathematics students at a university in Peru to understand

homotopies. The research adopted a qualitative methodology and a case study with an interpretive approach. Data were collected from two undergraduate mathematics students at a Peruvian university, selected on the basis that they were taking the course Introduction to Algebraic Topology or had recently taken the course (previous semester). Both students (referred to as S1 and S2 to preserve anonymity) voluntarily expressed interest in participating after being informed of the research objective and signing the corresponding informed consent form.

A questionnaire consisting of five open-ended questions was designed to explore both the reasoning and understanding of homotopies in different mathematical contexts. These questions were referred to as tasks. The questionnaire underwent content validation by five experts: two doctors of mathematics and three doctors of education, who evaluated the relevance, clarity, and adequacy of each task.

The questionnaire was administered in person and individually, twice to each student. The responses were recorded in writing by the students. For the purposes of this research, the results corresponding to two of the five tasks are presented, selected to reveal both argumentative aspects and modes of comprehension. These are the first results obtained from my doctoral research work in education.

Task 1: Imagine that $f:[0,1] \to R^3$ it is a path and $\bar{f}:[0,1] \to R^3$ defined by $\bar{f}(t) = f(1-t)$ is the inverse path of f

a) Consider that f is homotopic to g relative to $\{0,1\}$. ¿Is it possible that $\bar{f}$ is homotopic to $\bar{g}$ relative to $\{0,1\}$? Justify your answer.
b) Consider thar $\bar{f}$ is homotopic to $\bar{g}$ relative to $\{0,1\}$. ¿Is it a possible that f is homotopic to g relative to $\{0,1\}$? Justify your answer.
c) Draw a graphical sketch of the items (a) and (b)

Task 2: If $f:X \to Y, g: X \to Y$ are continuous functions such that f is homotopic to g then the homotopy relation is an equivalence relation. Prove the statement: identify the hypothesis and conclusion, then justify each of the steps you will consider for your proof, and specify the properties and definitions you used.

In order to analyze the students' responses, indicators were defined. These indicators made it possible to identify the argumentative components and the students' modes of understanding. Table 1 shows the indicators established and the theoretical frameworks that underpin the research.

Table 1. *Indicators of the Toulmin component and modes of thinking*

Component and modes of thinking	Indicators
Data	Identify the hypotheses of the task. Identify X, Y topological spaces. Identify that f, g, h are continuous. Identify that f is homotopic relative to g (Task 1a). Identify $\bar{f}$ is homotopic relative to $\bar{g}$ (Task 1b). Identify that f is homotopic to g and g is homotopic to h.
Conclusion	Recognize the thesis of the task. Recognize that $\bar{f}$ is homotopic relative to $\bar{g}$ (Task 1a). Recognize that f is homotopic relative to g (Task 1b). Recognize that f is homotopic to f (reflexive) Recognize that g is homotopic to f (symmetric) Recognize that f is homotopic to h (transitive)
Warranty- Mode AE	Define homotopic application. Construct homotopic application for reflexive, symmetric, and transitive. Verify the correct definition of the application. Verify continuity.
Warranty- Mode SG	Make a graphical representation of homotopy.

The students' written responses constituted the units of analysis. An interpretive analysis was conducted using two complementary theoretical frameworks: Toulmin's argumentative model to identify data, guarantees, and conclusions, and Sierpinska's theory to recognize students' modes of thinking. The analysis was conducted by triangulating interpretations between the theoretical frameworks and the students' responses.

From a theoretical perspective, the responses of two undergraduate mathematics students from a Peruvian university to two tasks presented in the questionnaire are presented. Table 2 summarizes the responses of the two students.

Table 2. *Summary of the analysis of student responses*

Case	Answer Task 1	Answer Task 2
Student E1	It identifies as a hypothesis the homotopy between functions f and g, and as a conclusion, the homotopy between functions $\bar{f}$ and $\bar{g}$. In the guarantees, it is in AE mode, defining a homotopic application based on the homotopy between f and g. However, it does not verify the correct definition of the application or the continuity of the application that will deform $\bar{f}$ into $\bar{g}$. It graphically represents the homotopies, placing itself in SG mode.	It is classified as AE thinking because it uses the property of equivalence relations. Not only was one argument needed to demonstrate the equivalence relation, but three independent arguments were needed: reflexive, symmetric, and transitive. They did not use SG thinking.
Student E2	Identify the functions $\bar{f}$ and $\bar{g}$ as hypotheses, and the functions f and g as conclusions. In the guarantees, it is placed in AE mode of thinking, defining a homotopic application based on the homotopy between $\bar{f}$ and $\bar{g}$. It does not verify the correct definition of the application or the continuity of the application that will deform f into g.	Similar to student E1, he used AE mode and structured three arguments. However, he did not verify the correct definition of the application or the continuity of the homotopies in the first two arguments.

It can be observed that student E1 in Task 1 used two arguments, one argument for case (a) and another argument for case (b). The student managed to determine the components of the argument. In case (a), they considered the relative homotopy between f and g as data, and identified the relative homotopy between $\bar{f}$ and $\bar{g}$ as their conclusion. For the guarantees, they demonstrated the existence of a relative homotopy between $\bar{f}$ and $\bar{g}$ by defining the application $\bar{H}$ and verifying the conditions of the homotopy. However, they presented a limitation in that they did not verify whether the application is well defined.

Similarly, for case (b), he recognized the relative homotopy between $\bar{f}$ and $\bar{g}$ as data, and as a conclusion, he considered the relative homotopy between f and g. For the guarantees, he demonstrated the relative existence between f and g , although he defined the homotopy between f and g, he did not verify whether the application is well defined. On the other hand, for case (c), he made a graphical representation of the relative homotopy for both cases (a) and (b), which shows the continuous deformation between both curves, thus evidencing the SG mode, but he did not provide a written description of the graph.

Figure 2. Reproduction of E1's response to task 1

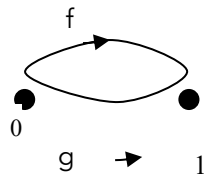
a) Assuming that $f \sim g \ rel \ \{0,1\}$, homotopy exists $H: [0,1] \times [0,1] \to R^3$ such that $H(t,0) = f(t), H(t,1) = g(t), H(0,s) = f(0) = g(0), H(1,s) = f(1) = g(1)$.

It is defined as $\bar{H}: [0,1] \times [0,1] \to R^3$, $\bar{H}(t,s) = H(1-t,s)$, then
$\bar{H}(t,0) = H(1-t,0) = f(1-t) = \bar{f}(t)$, $\bar{H}(t,1) = H(1-t,1) = g(1-t) = \bar{g}(t)$,

$\bar{H}(0,s) = H(1,s) = f(1) = \bar{f}(0) = \bar{g}(0), \bar{H}(1,s) = H(0,s) = f(0) = \bar{f}(1) = \bar{g}(1)$.
Therefore $\bar{f} \sim \bar{g} \ rel \ \{0,1\}$

b) We have to $\bar{f} \sim \bar{g} \ rel \ \{0,1\}$ then homotopy $\bar{H}: [0,1] \times [0,1] \to R^3$ exists such that $\bar{H}(t,0) = \bar{f}(t)$, $\bar{H}(t,1) = \bar{g}(t)$, $\bar{H}(0,s) = \bar{f}(0) = \bar{g}(0), \bar{H}(1,s) = \bar{f}(1) = \bar{g}(1)$. The application is defined $H: [0,1] \times [0,1] \to R^3$, $H(t,s) = \bar{H}(1-t,s)$, then
$H(t,0) = \bar{H}(1-t,0) = \bar{f}(1-t) = f(t)$, $H(t,1) = \bar{H}(1-t,1) = \bar{g}(1-t) = g(t)$,

$H(0,s) = \bar{H}(1,s) = \bar{f}(1) = f(0) = g(0), H(1,s) = \bar{H}(0,s) = \bar{f}(0) = f(1) = g(1)$.
Therefore $f \sim g \ rel \ \{0,1\}$



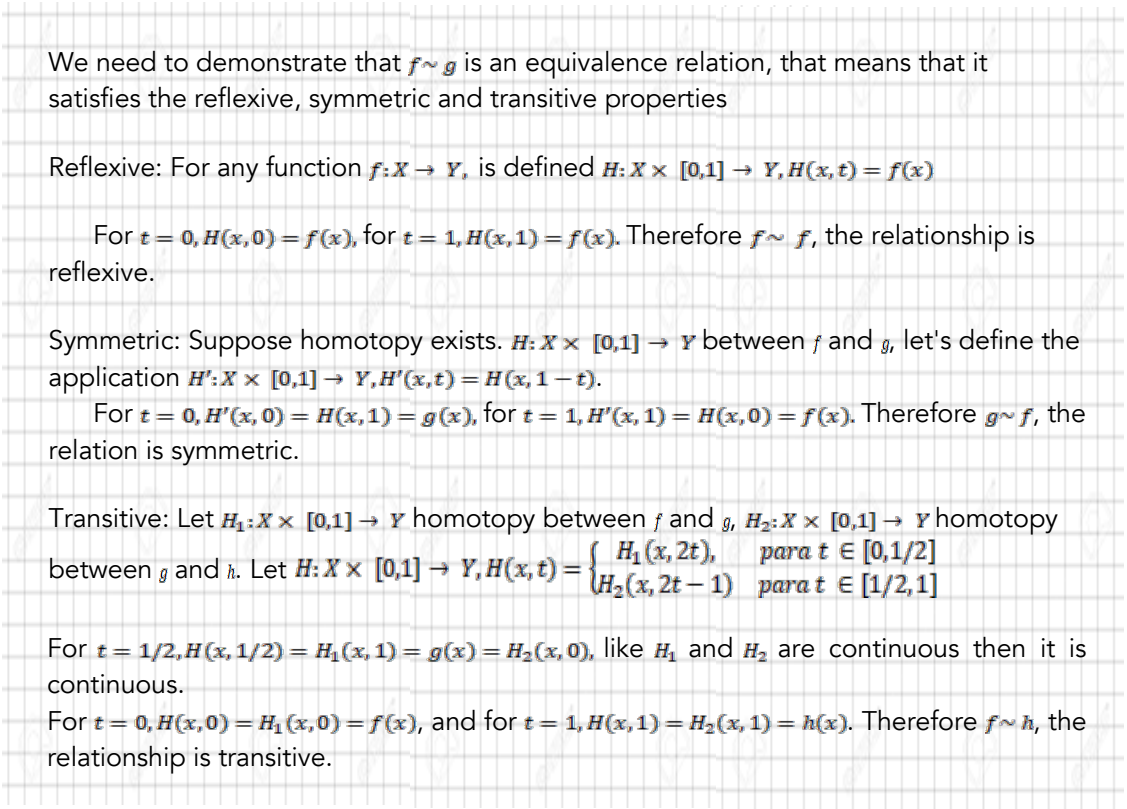
Student E2, faced with task 2, structured their demonstration based on three specific and independent arguments, which are determined by three algebraic properties: reflexive, symmetric, and transitive. Each of these arguments needed to be constructed and validated independently: reflexivity, which establishes a relationship between an element and itself; symmetry, which verifies the relationship between elements in two directions; and transitivity, which maintains consistency between chains of relationships.

In the first argument, he took as data the continuous function f defined from X to Y and as conclusion that f is homotopic to f. For the guarantees, he defined H(x,t)=f(x), verified the homotopy conditions, placing himself in AE mode. In the second argument, he considered as data that f is homotopic to g and as a conclusion that g is homotopic to f. For the guarantees, he defined H and verified the homotopy conditions. However, he did not verify the continuity of H in the first two arguments, which represents an obstacle to understanding homotopy.

In the third argument, as data, he considered that f is homotopic to g and that g is homotopic to h, and as a conclusion, he determined that f is homotopic to h. For the guarantees, student

E2 defined homotopy, verified the conditions and continuity of H at the point t=1/2. The student was unable to verify the correct definition of the application.

Figure 3. Reproduction of E2's response to task 2



We need to demonstrate that $f \sim g$ is an equivalence relation, that means that it satisfies the reflexive, symmetric and transitive properties

Reflexive: For any function $f: X \to Y$, is defined $H: X \times [0,1] \to Y, H(x,t) = f(x)$

For $t = 0, H(x,0) = f(x)$, for $t = 1, H(x,1) = f(x)$. Therefore $f \sim f$, the relationship is reflexive.

Symmetric: Suppose homotopy exists. $H: X \times [0,1] \to Y$ between f and g, let's define the application $H': X \times [0,1] \to Y, H'(x,t) = H(x, 1-t)$.

For $t = 0, H'(x,0) = H(x,1) = g(x)$, for $t = 1, H'(x,1) = H(x,0) = f(x)$. Therefore $g \sim f$, the relation is symmetric.

Transitive: Let $H_1: X \times [0,1] \to Y$ homotopy between f and g, $H_2: X \times [0,1] \to Y$ homotopy between g and h. Let $H: X \times [0,1] \to Y, H(x,t) = \begin{cases} H_1(x,2t), & para\ t \in [0,1/2] \\ H_2(x,2t-1) & para\ t \in [1/2,1] \end{cases}$

For $t = 1/2, H(x,1/2) = H_1(x,1) = g(x) = H_2(x,0)$, like H_1 and H_2 are continuous then it is continuous.

For $t = 0, H(x,0) = H_1(x,0) = f(x)$, and for $t = 1, H(x,1) = H_2(x,1) = h(x)$. Therefore $f \sim h$, the relationship is transitive.

Both students demonstrated an ability to recognize data and draw conclusions from their arguments. With regard to guarantees, the fundamental component of the argumentative structure, the students demonstrated heuristics associated with the mathematical structure of homotopy, thus placing themselves in AE mode. For his part, student E1 demonstrated heuristics associated with the graphical representation of homotopies, placing himself in SG mode.

However, students' application of mathematical definitions, theorems, and results did not demonstrate a deep understanding of the concept of homotopies; students showed some obstacles to understanding homotopies. This manifested itself in difficulty verifying continuity and failing to verify the correct definition of the application. This showed that although students understand the structure of the concept of homotopy, they have not yet fully internalized the formal characteristics of this mathematical object.

Conclusions

In relation to the objective of determining the components of the argumentative structure that enable the understanding of homotopies, the results show that undergraduate mathematics students are able to recognize the data (hypothesis) and conclusion (thesis), which are elements of Toulmin's argumentative model. However, they had greater difficulty with the warrant component, which requires rigorous justifications between data and conclusion, constituting an obstacle to understanding properties and concepts related to homotopies. The analysis revealed that guarantees, the third element of the argumentative model, are based on two modes of thinking that respond to the very nature of the definition of homotopies, which are the synthetic geometric mode and the structural analytical mode. Understanding homotopies requires the articulation of both modes, although students showed a greater predominance of the SA mode.

I recommend that future research expand the study with a larger sample of participants and conduct longitudinal follow-up on the development of argumentation and understanding of homotopies. It would also be valuable to explore which teaching strategies favor the argumentation of abstract concepts such as homotopies, which could benefit many teachers in improving their classroom teaching methods.

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Benchmark Pedagogical Model Using Project-Based Learning, Flipped Classroom, and EduScrum Methodologies

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This text arises from the Internal Call for Educational Innovation 2023 project 24INTER-487 of the Universidad Autonoma de Occidente, "Developing a benchmark pedagogical model using Project-Based Learning, Flipped Classroom, and EduScrum methodologies at the Universidad Autonoma de Occidente"

Introduction

According to Matti *et al.* (2002), the learning process in engineering is an interaction between the new knowledge the student acquires, the mental model they construct, and the reality in which they will have to confront the new knowledge. How affirmed the authors, this relationship can be extended to all area of engineering knowledge, they proposed a perfect learning process in six discrete steps.

The authors commented, initially, motivation arises when the student perceives a conflict between what they know and what they need to know. Their mental models are insufficient to handle the situation and therefore need to be modified. Orientation: The objective of orientation is to create a preliminary data structure and concepts necessary to resolve the conflict invoked in the motivation. Internalization: Existing mental models must be changed with new knowledge; for the internalization process, traditional teaching methods such as lectures and textbooks are appropriate. Externalization: Using newly internalized knowledge to solve real-world problems, change reality, or create something new. The externalization phase connects new knowledge and its application; the interaction between internalization and externalization creates understanding. Evaluation: New knowledge is assessed based on experiences confronting real-world problems. Control: In this final step, the student evaluates their learning process. Successful externalization is a prerequisite for achieving the evaluation of what has been learned and the success of the learning process. However, the authors consider that traditional teaching-learning methods for operations management are not ideal for the development of externalization, as theoretical and lecture-based approaches do not allow students to integrate what they have learned with problem-solving in real-life scenarios.

In the current context of higher education—characterized by the need to foster meaningful learning, complex competencies, and student autonomy—active methodologies such as Project-Based Learning (PBL), Flipped Classroom, and EduScrum have emerged. These methodologies propose a paradigm shift from teacher-centered instruction to a student-centered approach, in which learning is constructed through experience, collaboration, and the practical application of knowledge (Sotomayor *et al.*, 2021).

Project-Based Learning (PBL) is a pedagogical approach rooted in constructivism that promotes learning through the development of projects connected to real-world contexts. According to Martí *et al*. (2010), this methodology enables students to actively engage in the planning, implementation, and evaluation of a project with practical relevance, fostering the development of cognitive, social, and attitudinal competencies. PBL has its antecedents in progressive education of the 20th century, with authors such as John Dewey and William Kilpatrick, who emphasized learning through experience and reflective action. Dewey (1916) argued that knowledge is constructed through interaction with the environment, while Kilpatrick (1918) defined the "project method" as an educationally purposeful activity that promotes autonomy, cooperation, and problem-solving.

Currently, PBL is conceived as an integrative methodology that connects theory and practice, and positions the instructor as a mediator and guide in the learning process (Martínez, 2018). Numerous studies have demonstrated its effectiveness in higher education, especially in fields such as engineering, where it facilitates conceptual understanding, knowledge transfer, and the strengthening of professional skills (McQuade *et al*., 2020). According to Sotomayor *et al*. (2021), the main benefits of PBL include increased student motivation, improved academic performance, and the development of transversal competencies such as teamwork, communication, and critical thinking. Its implementation requires rigorous planning that considers guiding questions, sustained inquiry, authenticity, reflection, and public presentation of the final product—elements that ensure the quality of the educational process.

The Flipped Classroom model introduces a transformation in educational practices by reversing the traditional sequence of the teaching process. It relocates theoretical exposition outside the classroom through multimedia resources and reserves in-person sessions for collaborative, experiential, and problem-solving activities (Brame, 2013). The concept was introduced by Alison King (1993), who proposed moving from the teacher-as-expositor model to a facilitator-of-learning role. Later, authors such as Lage *et al*. (2000) and Bergmann and Sams (2007) consolidated the Flipped Classroom by incorporating technological tools that enabled students' autonomous preparation before class.

In university settings, the Flipped Classroom is associated with active pedagogy, meaningful learning, and student autonomy. According to the TPACK model (Technological, Pedagogical, and Content Knowledge), its effective implementation requires the balanced integration of technological, pedagogical, and disciplinary knowledge, enabling instructors to design interactive and contextualized learning experiences (Hall & Lei, 2020). Likewise, the SAMR model (Substitution, Augmentation, Modification, Redefinition) guides the progressive incorporation of technologies to transform teaching and promote higher-order learning (Puentedura, 2014). Among the pedagogical benefits of the Flipped Classroom are the possibility of personalizing learning, fostering student responsibility, enhancing collaborative work, and leveraging class time for the practical application of content (Carpena & Esteve, 2022). These features make it an ideal strategy for active and digitally mediated learning environments.

EduScrum, meanwhile, is an educational adaptation of the agile Scrum framework, originally used in software development. Its creator, Willy Wijnands, implemented it in educational

contexts with the aim of making students active agents of their own learning through self-organization, collaborative work, and continuous improvement (Medina Rojas *et al.*, 2017). Inspired by the principles of the Agile Manifesto (2001), EduScrum promotes flexibility, transparency, and adaptability in the educational process. In this model, the instructor acts as Product Owner and facilitator, while students assume defined roles within teams that plan, carry out, and review their work through iterations called sprints. This approach fosters shared responsibility, self-assessment, and cooperation, strengthening key competencies such as communication, creativity, and problem-solving (Voštinár, 2024).

EduScrum is structured around three pillars: transparency, which ensures visibility of processes and objectives; inspection, which involves the constant evaluation of progress; and adaptation, which allows for the adjustment of strategies to improve learning outcomes. Its application has been shown to increase student motivation and engagement, while also improving group dynamics and team efficiency (Tudevdagva *et al.*, 2020). As such, this methodology represents an innovative alternative that combines agile organization with active learning, offering an effective pathway toward autonomous and collaborative education.

By analyzing the interface between active learning methodologies and EduScrum—primarily Project-Based Learning and the Flipped Classroom—(Teixeira Lopes & Aquere, 2022), several similarities become evident. These include the focus on the 'customer' in Scrum versus the 'student' in EduScrum, the prioritization of value-added content, and the emphasis on transparency and inspection.

In the context of the Flipped Classroom authors as Tudevdagva *et al.* (2020) evaluated the effectiveness of EduScrum as an active learning method, highlighting its ability to improve organization and collaboration in educational projects. The authors integrated EduScrum and the Flipped Classroom, demonstrating that the combination of these two methodologies significantly improves the learning experience in higher education. Students positively valued the method, highlighting its ability to foster collaboration, self-management, and the integration of theory with practice, and emphasized that it promotes more meaningful learning. On the other hand, Martínez (2018) integrated EduScrum and PBL, concluding that the importance of doing so is that when both are used, EduScrum complements the shortcomings of PBL and vice versa.

The Model

The objectives of this study are: (1) To conceptualize the reference pedagogical model supported by PBL and mediated by Flipped Classroom and EduScrum to strengthen teaching, learning, and assessment. (2) Design teaching, learning, and assessment strategies that involve PBL mediated by Flipped Classroom and EduScrum to structure the reference pedagogical model. (3) Implement the reference pedagogical model in a three-course pilot implementation of the Industrial Engineering Program to validate its relevance.

For this, a search was initially conducted for research that proposes the integration of the aforementioned methodologies to achieve the reference model. The selected subjects were then analyzed to design activities aligned with the PBL approach. Finally, the strategy was applied to three courses, integrating the three methodological approaches. The intervention

included the design of classroom activities, prioritizing collaborative work, autonomy, and the development of contextualized projects.

To evaluate the results and assess the pedagogical (teaching) and social (learning) components, along with the teaching activities that mediate them, a measurement instrument was designed and submitted to expert judgment to validate its content and construct. Its internal consistency was verified using Cronbach's alpha coefficient, according to the methodology proposed by Hernandez *et al.* (2014). This technique consists of estimating the degree to which the instrument measures the variable of interest, based on a qualitative evaluation conducted by qualified individuals.

To construct the instrument, the main dimensions, variables, and indicators to be addressed were previously defined. Based on the central variable—measuring the impact of a benchmark pedagogical model supported by Project-Based Learning mediated by the Flipped Classroom and EduScrum—the operational deployment was developed, establishing the dimensions necessary for its evaluation. To comply with Face Validity, six experts were selected and sent the designed instrument along with a questionnaire via Google Forms. They were asked to evaluate the various dimensions, variables, and indicators (questions) presented in the designed instrument, as to whether they considered them adequate or relevant, sufficient, and clear for evaluating the impact of the Flipped Classroom teaching strategy. If any expert rated any of the relationships proposed in the instrument as moderately adequate or inadequate, they were asked to suggest changes that, based on their expertise, should be made. Once the experts' comments were incorporated, the instrument was adjusted.

Subsequently, a measurement of the reliability of the validated instrument was carried out, with the internal consistency method based on Cronbach's Alpha, which allows estimating the reliability of the measuring instrument through a set of items that are expected to measure the same construct or theoretical dimension.

The measurement of reliability through Cronbach's Alpha assumes that the items (measured on a Likert-type scale) measure the same construct and that they are highly correlated. The closer the alpha value is to 1, the greater the internal consistency of the analyzed items, according to a scale proposed by George and Mallery (2003). For its measurement, the instrument was applied to a group of 18 students, then, using Minitab software, Cronbach's Alpha coefficient was calculated without excluding any cases, resulting in a value of 0.970, which corresponds to excellent internal consistency, meaning that the instrument as a whole reliably measures what it was designed for.

The reference model was developed based on a thorough theoretical review and research team´s prior experience. The proposed model is presented in Figure 1. The unified model presented emerges from the integration of EduScrum and Flipped Classroom methodologies, implemented within a Project-Based Learning (PBL) framework. This approach combines the agile and collaborative structure of EduScrum—with defined roles, iterative cycles of planning, active learning, reflection, and improvement—with the Flipped Classroom focus on self-directed preparation through digital resources.

Unlike traditional models or those that apply these strategies independently, this representation offers a cyclic and integrated methodological sequence where teacher facilitation, student agency, and assessment are interwoven throughout each Sprint. Notable features include the reflective portfolio focused on competency development, the structural incorporation of gamification, and a formative evaluation process embedded throughout all stages. Furthermore, the model highlights the multiple dimensions of teaching work and promotes continuous improvement through individual and team feedback. In this way, topics or courses are transformed into structured and adaptive learning projects, aligned with principles of active, agile, and collaborative education.

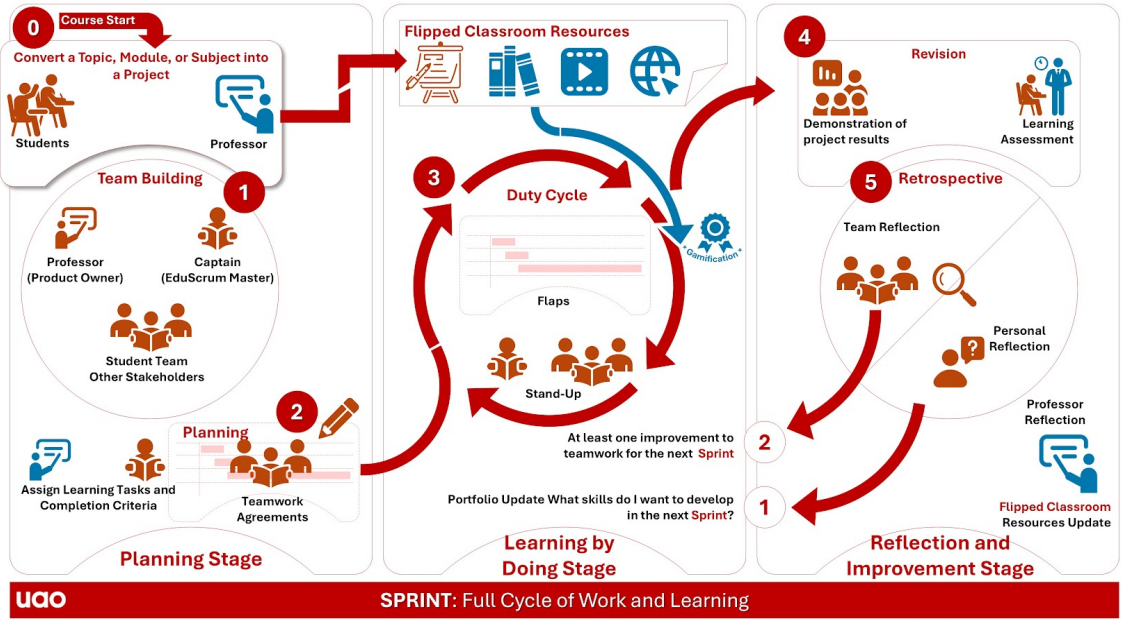

Figure 1. EduScrum Methodology proposed with Flipped Classroom and PBL.

Source: Adapted from eduScrum (2023), How eduScrum Works. https://eduscrum.org/how-eduscrum-works/. It was made with PowerPoint.

Three courses from the industrial engineering program were selected to implement this model. Facility Layout is a seventh-semester course with 14 students enrolled; Logistics is an eighth-semester course taught to 41 students in two groups (25 students in the day and 16 in the evening); and Simulation is the eighth-semester course, also for 40 students (20 in the day and 20 in the evening), for 95 students in total.

For all three courses, learning activities were designed, the designed model (Figure 1) was disseminated, explaining implementation details, and activities were scheduled for both in-class and at-home learning. Students received detailed instructions. Based on this information, they were required to create the EduScrum Board and the Backlog of work to be completed, which was shared with the professor. Weekly meetings were held where students presented their progress on assignments until the final report was completed.

The results of the instrument application are summarized in Figure 2. Out of 95 students, 62 responses (65%) were obtained to the 45-item questionnaire.

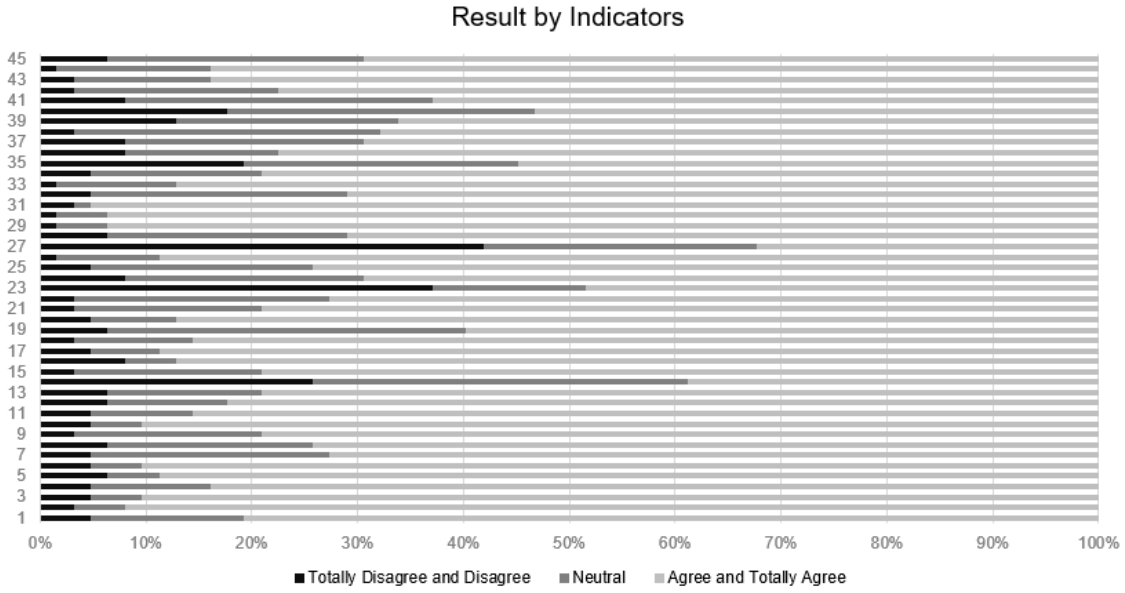

Figure 2. Summary of student responses to the instrument.

Regarding questions related to the coherence between course objectives and learning activities, students highly appreciated the results. 91.93% considered the activities aligned with the objectives, while 90.32% positively valued the course organization. Likewise, the materials provided (videos, guides, readings) were rated as useful by 83.87% of respondents, highlighting the appropriate selection and use of teaching resources. The use of digital platforms, as well as the implementation of EduScrum practices, received significant acceptance. Most of these tools exceeded 70% acceptance, indicating that students not only understood their usefulness but were also able to integrate them functionally into their learning process.

Collaborative work in sprints was positively perceived by 72.58% of students. Although this percentage remains high, a considerable proportion of neutral responses (22.58%) suggest differences in the level of participation or commitment within the teams. Strategies implemented for time management, organization, and decision-making were also recognized as facilitators of learning.

On the whole, 67.74% of respondents perceived the methodology's impact on academic performance as positive, while 69.35% valued the active pedagogical strategies employed. Nevertheless, these results reveal a greater diversity of opinions, with significant percentages of neutral (22.58%) and mildly disagreeing (8.06%) responses, possibly reflecting individual adaptation challenges to the new methodological dynamics.

Finally, 83.87% of students expressed satisfaction with the educational experience offered. However, when comparing this experience with traditional methodologies, the level of

agreement dropped to 53.23%, suggesting that, while the experience was positive, there are still expectations or favorable assessments of other, more conventional pedagogical approaches. Furthermore, 66.13% would recommend implementing this methodology in future courses, while the remaining percentage was neutral (20.97%) and disagreed (12.90%).

Conclusions

The development of the conceptual model integrated concepts from PBL (Martínez, 2018), FC (Brame, 2013), and EduScrum (Tudevdagva *et al.*, 2020), achieving a cyclical model that favored teamwork, communication, and independent work among students. It focused on effective integration strategies, as proposed by Carpena and Esteve (2022), and placed knowledge in real-life problems that fostered students' mental models (Matti *et al.*, 2002).

Additionally, the model was implemented in engineering courses, where strategies were designed that contributed to the understanding of the topics and facilitated the application of this theoretical knowledge to problem-solving outside the classroom. As Sotomayor et al. (2021) commented, students are more interested in situated problems and develop important soft skills in their training. To validate the proposal, a consistent instrument was used (**α**=0.970) which resulted in the students perceiving the model's implementation positively (83.87%), emphasizing its benefits for active learning, skill development, and autonomy. They believe that the integration of the three methodologies favors the practical application of content, improves teamwork organization, strengthens conceptual understanding, and promotes collaboration. However, they identify certain aspects that could be improved, such as the overload of independent work, difficulties in group dynamics, and the need for greater theoretical support and teacher guidance. This is a reflection that students need to face the independent work that the implementation of a virtual classroom entails in a more organized way, as Hall and Lei (2020) warn.

As this is the first implementation experience, the results are considered highly positive and allow us to identify areas for improvement that should be taken into account in future implementations to consolidate this innovative pedagogical proposal as a meaningful and transformative practice within the curriculum. The value of self-management and collaborative work should be promoted among students, following the guidelines of Eduscrum (Stewart et al., 2009) and its integration with active and situated learning that applies PBL (Martínez, 2018).

Overall, the model is valued as innovative, useful, and aligned with the principles of active learning. These findings suggest that, while the model fosters autonomy, it should still be supported by consistent and well-structured pedagogical guidance. It is recommended that the model be further applied and expanded to other courses to evaluate its impact on student satisfaction and academic performance.

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Development and Validation of a MATLAB-Based Simulator for Fluidized Bed Characterization in an Academic Laboratory Setting

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Introduction

Studying bed fluidization is essential for understanding its industrial applicability in processes like drying, classification, reactors, and leaching across metallurgical, chemical, pharmaceutical, and oil/gas sectors. However, teaching complex phenomena like fluidization faces three barriers: (1) difficulty visualizing dynamic variables (porosity, ΔP), (2) limitations of equipment in educational laboratories, and (3) disconnect between mathematical models and real behavior. To address this, we integrated an interactive MATLAB® simulator into an active learning-based didactic sequence where students: (a) predict behaviors via theoretical models, (b) validate hypotheses through physical experimentation, and (c) refine understanding via parametric simulation. Various techniques support this process, including numerical methods, experimentation, spreadsheets (Microsoft EXCEL®), and simulation applications (MATLAB App Designer®). Creating such applications helps compare theoretical behavior (under ideal conditions) with experimental results, enabling discrepancy analysis and solution proposals. This work examines theoretical/experimental behavior of a Nylon 66/water fluidized bed (Universidad Metropolitana, Venezuela), analyzing pressure drop (ΔP), minimum fluidization velocity (Vo), and fluidization type via MATLAB App Designer® simulation. Objectives: Determine Vo, bed height, and ΔP using Ergun's equation; identify fluidization type via Froude number; and compare experimental, theoretical, and simulated results.

This pedagogical approach aligns with engineering education frameworks emphasizing active learning (Prince, 2004; Kolmos *et al.*, 2014) and experimental-simulation integration (Hmelo-Silver, 2004; Borrego *et al.*, 2021; Sotiriou, *et al.*, 2021; Contreras, *et al.*, 2020), while leveraging fundamental fluidization principles (Wen & Yu, 1966).

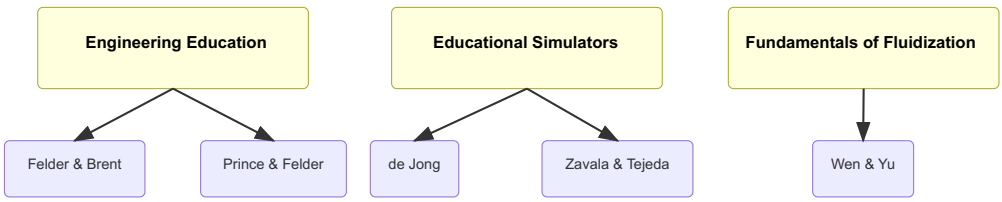


Figure 1. Key theoretical foundations: Active learning frameworks (top) and fluidization fundamentals (bottom).

Simulators

Simulators are tools that allow for the design and development of a computerized model, enabling an understanding of the behavior and strategies used to operate a system and/or process. (García-Gonzalez *et al.*, 2018)

Likewise, using simulators engages students in learning as they are responsible for operating the simulator, observing, and analyzing the results obtained. Similarly, they address the lack of experience in the phenomenon under study that scientific theories aim to explain. (Contreras, Carreño, 2012).

Fluidization

Fluidization is a process where small solid particles are suspended by an upward-moving fluid current, which can be either a liquid or a gas.

When lifted by the upward fluid flow, the movement of these suspended particles varies depending on the fluid type, the flow rate intensity, and the fluidization column's design (long and narrow).

Pressure drop

It is important to note that when fluid or gas moves at low velocities through a porous bed of particles (such as in a packed bed), it cannot cause movement of these particles. The main explanation for this phenomenon is the loss of energy as the fluid passes through the tiny channels of the bed to be fluidized, thus causing a decrease in pressure.

In this regard, a commonly used expression to quantify this pressure drop is the Ergun Equation, which describes the laminar and transition flow regions in its original format. However, different adaptations of the Ergun Equation accommodate any Reynolds number, presenting the following equation (Buchwald *et al.*, 2020):

$$\text{Equation 1: } \frac{\Delta P}{L} = \frac{150 * Vo * \mu * (1-\varepsilon)^2}{\varphi_s^2 * Dp^2 * \varepsilon^2} + \frac{1.75 * \rho * Vo^2 * (1-\varepsilon)}{\varphi_s * Dp * \varepsilon^3}$$

Where: $\frac{\Delta P}{L}$ is the pressure drop per unit length of the packed bed (Pa/m), P is the pressure drops within the bed (Pa = kg/m*s^2), Vo is the minimum fluidization rate (m/s), **ρ** is the density of the fluid (kg/m^3), μ is the dynamic viscosity of the fluid (Pa*s or kg/(m*s)), Ɛ is the bed porosity, Dp is the average particle diameter (m), ϕs is the sphericity of the particles

Equipment Technical Information

Below are listed the physical parameters to be considered during experimentation, which are necessary for subsequent calculations:

Table 1. Fluidization column information from the Separation Processes Laboratory at Universidad Metropolitana

Dimensions	Value	Unit
Average particle diameter	0.00371	m
Column diameter	0.1524	m
Density of Nylon 66	1140	kg/m^3
Initial bed porosity (ϵo)	0.419	-

Equipment Description

The fluidization column in the Separation Processes Laboratory at Universidad Metropolitana (figure 2) consists of a column packed with an irregular and somewhat non-spherical bed of Nylon 66 particles. This column is connected to a water tank and a pump that drives water into the tower.

The fluid enters the bottom of the column through two pipes and exits at the top. The system is equipped with digital sensors to measure pressure at the top and bottom of the column and a flow sensor on the inlet pipe at the bottom.

Two mercury manometers are used to observe pressure differences and, through mathematical calculations, to manually determine the flow rate for comparison with the value provided by the digital flow sensor. After the liquid inlet valve is opened, a measuring tape is available to decide the bed height within the column.

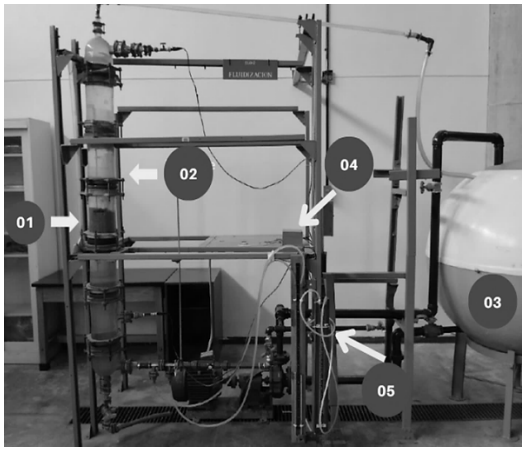


Figure 2. Fluidization column of universidad metropolitana

Based on the above, the equipment consists of:

1. Bed: Composed of Nylon 66 particles with an average diameter of 0.371 cm.
2. Glass Column: Through which water will flow, causing the fluidization (suspension) of the bed.
3. Tank: Which must be at least half-filled with water.

4. Arduino connects to the computer via a USB cable and allows data logging using Microsoft Data Streamer.
5. Mercury Manometers: These allow measuring inlet and outlet pressures in mmHg.

The system also includes two digital pressure sensors that measure inlet and outlet pressure in psi. Furthermore, a ruler is located alongside the glass column (and in front of the bed) to measure the bed height during experimentation.

Steps for Experimentation

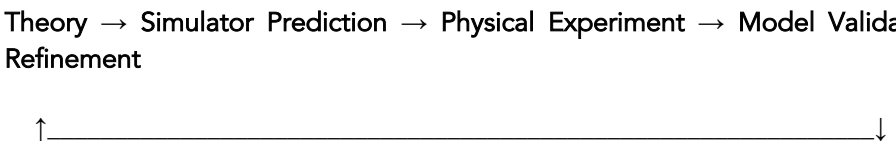
To experiment, the following steps were necessary:

1. The Arduino was connected to a laptop or PC using its USB cable.
2. Microsoft EXCEL® was opened, Microsoft Data Streamer was enabled, and the Arduino was activated. This enabled recording inlet and outlet pressure values (psi) and flow rate (L/min).
3. The initial bed height and inlet and outlet pressures were measured using the mercury manometers (readings in mmHg).
4. It was ensured that the tank was at least half-filled with water. If the water level was lower, it was filled accordingly.
5. The pump was turned on, and the water flow entering the column was regulated to allow for a minimum flow.
6. The flow rate gradually increased until the bed began to rise due to the fluid's effects. This was done slowly and carefully to avoid errors and to take accurate and precise measurements.
7. Each time the flow rate increased, the bed height and pressures were measured using the mercury manometer. These manually measured pressures were compared with the digital measurements taken by the Arduino.
8. Steps 6 and 7 were repeated, consistently increasing the flow rate until the valve reached its maximum. After this, the flow rate gradually decreased until it was completely shut off, taking measures as this occurred.

Teaching focused methodology

Figure 3 captures the core iterative cycle of our approach. This methodology structures student activities into three scaffolded phases, each targeting specific cognitive domains (Table 2).

Figure 3. Core iterative cycle.



This integrated workflow—where students progress from theoretical models (1) to simulator predictions (2), physical validation (3), and conceptual refinement (4)—embodies Kolb's

experiential learning principles [Kolb, 2015]. The feedback loop enables misconception correction while reinforcing theoretical fundamentals.

Table 2. Integrated learning phases.

Phase	Student Activity	Tool	Learning objective
Pre-lab	Simulate variable effects		MATLAB® App
Laboratory	Record pressure, flow rate, and bed height		Physical column + Arduino
Post-lab	Adjust simulator parameters		App + experimental data

Results of the experimentation phase

The experiments were conducted by six different groups (JG1-JG6) between January and December 2023 to investigate the behavior of a fluidization column within the Separation Processes Laboratory at Universidad Metropolitana. The key variables examined included superficial velocity, pressure drop, porosity, and average bed height. Calculations were performed to determine minimum fluidization velocity, average velocity, particle Reynolds number, and Froude number, thereby characterizing the fluidization regime.

The theoretical minimum fluidization velocity was determined to be 2.43E−3 m/s. Furthermore, the experimentally observed low superficial velocities were attributed to bed obstruction caused by the high density of Nylon 66 particles, necessitating increased water flow for particle mobility.

Graphical analyses of pressure drop (calculated using Equation 1, considering the data obtained experimentally) versus superficial velocity (Figure 4) revealed an exponential increase, diverging from the constant pressure drop after minimum fluidization velocity, as McCabe *et al*. (1991) described. This discrepancy may be due to challenges in manometer readings at higher flow rates. However, Group JG2's results aligned with the theoretical model, demonstrating a constant pressure drop post-minimum fluidization, thereby validating the expected behavior of the fluidization column.

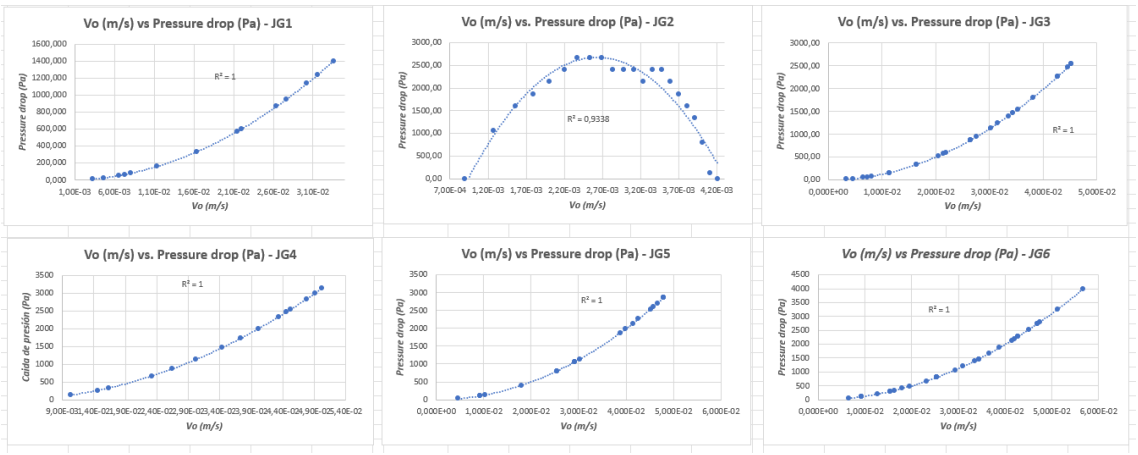


Figure 4. Pressure Drop vs. Water Surface Velocity Graphs

The bed porosity was calculated from initial porosity, minimum bed height, and experimentally determined average height. The graphs, showing the relationship between minimum fluidization velocity and porosity (Figure 5), indicated that most groups (from JG3 to JG6) exhibited a direct relationship between superficial velocity and porosity, with porosity increasing as fluid flow induced greater particle separation. However, groups JG1 and JG2 did not show this proportional growth, which may indicate experimental errors. The linear fits for groups JG3-G6 yielded high correlation coefficients ($0.8 > R^2 > 0.9$).

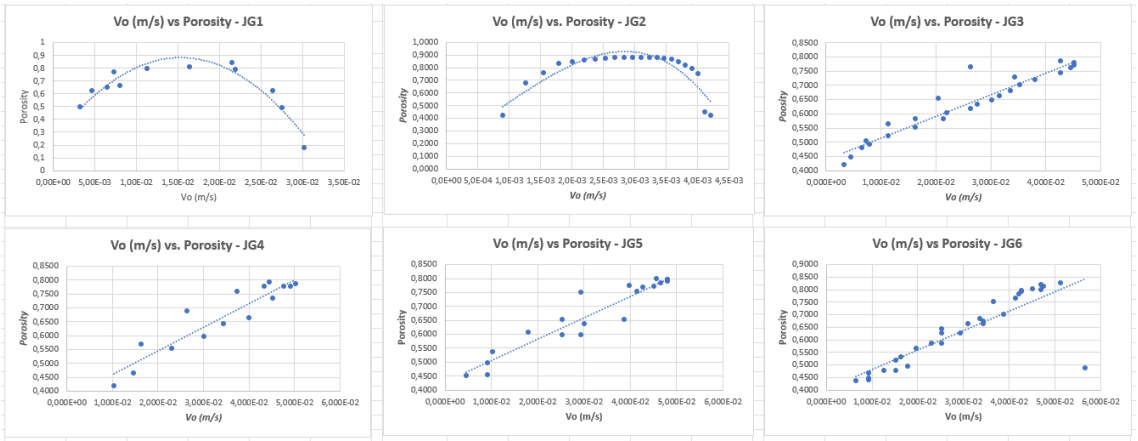


Figure 5. Bed Porosity vs. Superficial Water Velocity Graphs

The graphical representation of bed height (Figure 6) indicated minimal variation at low velocities, remaining constant until the minimum fluidization velocity was attained. When compared to theoretical models, discrepancies observed in the bed height graphs for groups JG1 and JG2 suggest potential experimental errors, such as incorrect valve manipulation or bed height measurement.

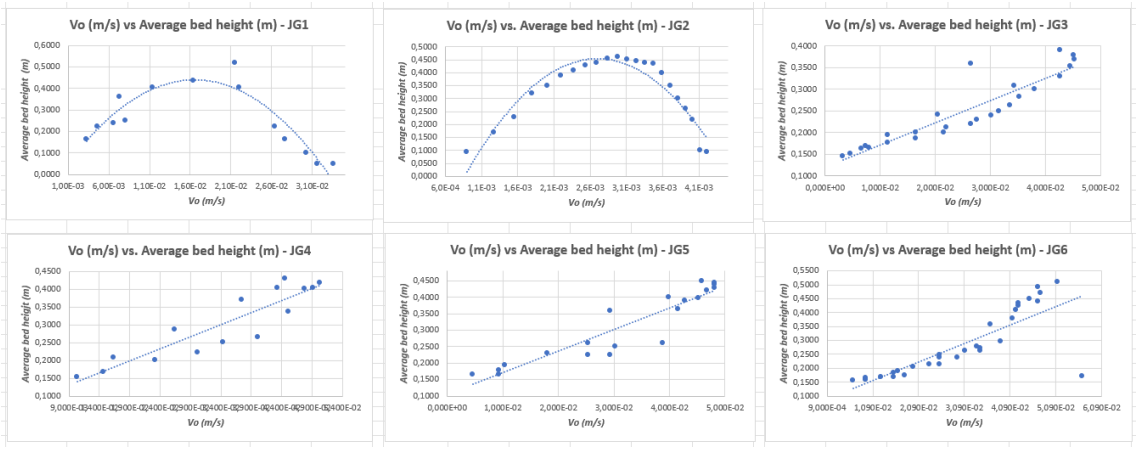


Figure 6. Graphs of average bed height vs. superficial water velocity

The fluidization process was identified as particulate, corroborated by a calculated Froude number of 1.62E−4 (less than 1), indicative of vigorous particle movement at increased flow rates.

Finally, the relationship between average fluidization velocity, average pressure drop, and bed height was graphically represented (Figure 7), illustrating the increase in pressure drop with increasing superficial gas velocity through an initially packed bed.

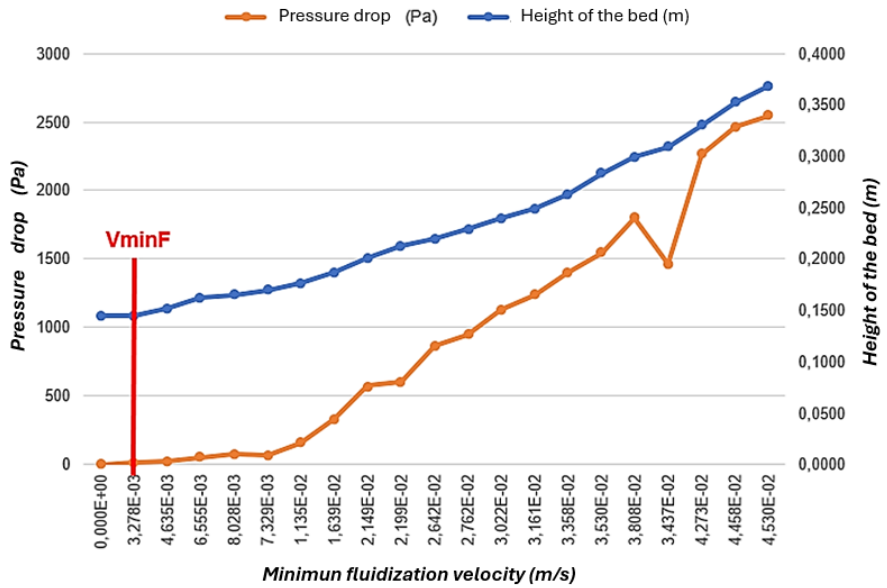


Figure 7. Relationship of average fluidization velocity (m/s) to pressure drop (Pa) and fluidized bed height (m)

Thus, a minimum fluidization velocity of approximately 3.278E−3 m/s is obtained by taking the average of the six measurements. This is the minimum velocity required for the bed to begin fluidizing, at which point the drag force on the particles equals their weight.

Simulation results

Knowing the theoretical models by which pertinent calculations would be performed using the experimentally obtained data, a draft code was first designed in MATLAB® to ensure the calculations were correct and the results matched those obtained from calculations in Microsoft EXCEL®.

In this regard, this code allows the user to input experimental values for flow rate and fixed bed, subsequently obtaining values for column area, bed porosity, fluidization column inlet velocity, average fluidization velocity, Reynolds number, minimum fluidization porosity, Archimedes number, Reynolds number for minimum fluidization, minimum fluidization velocity, pressure drop at the minimum fluidization point, minimum fluidized bed height, and Froude number.

Subsequently, the application was designed using MATLAB App Designer®. Initially, the interface was created, and then it was adjusted to be a functional application where the user can input data and obtain numerical and graphical results. This allows the user to input flow rate and fixed bed values while maintaining fixed values for properties such as the particles that make up the bed. Finally, it provides value for pressure drop (in kPa), water inlet velocity (m/s), minimum fluidization velocity (m/s), Reynolds number, Froude number, and the type of fluidization, minimum pressure drops (in kPa), and minimum bed height (m).

Regarding the graphs obtained in MATLAB® through the simulation, behaviors similar to those obtained experimentally and corroborated by the previously mentioned theory were observed.

Analogously, the results obtained by simulation were compared with the experimentally obtained results:

Table 3. Experimentally obtained results

ΔPmin (kPa)	Froude Number	Fluidization Type	Vo (m/s)
33.63	1.624E−4	Particulate	2.431E−3

Such that these almost coincide entirely with those obtained by simulation:

Table 4. Results obtained by simulation in MATLAB®

ΔPmin (kPa)	Froude Number	Fluidization Type	Vo (m/s)
33.51	1.612E−4	Particulate	2.422E−3

In this regard, the percentage error between the results obtained was calculated, considering the values generated through the simulation as reference theoretical results:

Table 5. Percentage errors of experimentally obtained values

ΔPmin (kPa)	Froude Number	Vo (m/s)
0.36%	0.74%	0.39%

The minor differences observed can be attributed to the precision of decimals and the number of significant figures used by both programs. Despite these variations, the results are sufficiently close to validating that the mathematical models applied in the simulation and their respective programming are accurate and consistent with those obtained in EXCEL®. This supports the effectiveness of the approaches used and confirms the reliability of the fluidization experiment results conducted in the Process Laboratory at Universidad Metropolitana.

On the other hand, taking the mathematical model established by Wen and Yu (1966), and subsequently calculating the Froude number and the Vo, the following results are obtained:

Table 6. Results obtained using the mathematical model of Wen and Yu

Froude Number	Fluidization Type	Vo (m/s)
0.003421	Particulate	0.001116

Obtaining numerically different values from those obtained with the mathematical models used previously yields the same type of fluidization as experimentally observed, by obtaining a Froude number less than 1.

Educational Impact

Learning assessment:

- 42 students completed pre-test/post-test on fluidization concepts.
- Learning gain in conceptual questions:
  a) 47% (relative improvement in student performance)
  b) Reliability $p<0.01$ (<1% probability this improvement occurred by chance)
- Satisfaction surveys:
  "The simulator helped understand the relationship between ΔP, flow rate, and bed height better than theoretical classes" (95% agreement)

Developed competencies:

1. Experimental vs. theoretical data analysis
2. Parameter optimization in physical models
3. Critical thinking when addressing discrepancies

This approach aligns with social constructivism (Vygotsky, 1978): students co-construct knowledge through interaction with simulators and peers. The Zone of Proximal Development expands by enabling exploration of physically inaccessible scenarios (e.g., liquid-phase fluidization).

Conclusions

The integration of a MATLAB-based simulator into an active learning framework has proven to be an effective strategy for teaching fluidization in an academic laboratory setting. The results indicate that the fluidization process in the Nylon 66/water system exhibits particulate behavior, with a minimum fluidization velocity of 0.002422 m/s and a Froude number of 0.0001612, consistent with theoretical expectations. These findings were validated through both experimental measurements and computational simulations, showing a high degree of agreement between theoretical predictions, simulation outputs, and physical experimentation, with percentage errors below 1%.

This pedagogical approach not only enhances students' conceptual understanding of fluidization but also significantly improves their ability to analyze and interpret complex engineering phenomena. The implementation of the simulator led to a 47% improvement in students' performance on conceptual assessments ($p < 0.01$), demonstrating its effectiveness as a learning tool. Furthermore, the use of simulators increases student motivation and engagement, allowing them to explore system variables interactively and compare virtual results with real-world data, thereby bridging the gap between abstract theory and practical application.

The methodology fosters the development of essential competencies such as critical thinking, parameter optimization, and the analysis of discrepancies between theoretical and experimental outcomes. It also prepares students to tackle real-life engineering challenges by strengthening their analytical and practical skills in processes widely used across industrial sectors. The integration of simulation tools with traditional experimental approaches aligns with constructivist learning theories and supports experiential learning by enabling students to explore scenarios that may not be physically accessible in a standard laboratory environment.

Based on these findings, it is strongly recommended that simulators be systematically incorporated into engineering education curricula as essential complements to conventional teaching methods. Their potential to enhance conceptual understanding, promote active learning, and facilitate knowledge transfer makes them valuable assets in the training of future engineers. Future research should focus on evaluating the effectiveness of similar tools across

different engineering disciplines and exploring their applicability in interdisciplinary and inter-institutional educational contexts.

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Steam to training 21st-century talent

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This text arises from the Research project (SIP20251136) of the National Polytechnic Institute of Mexico, "Sustainable Solutions through STEAM"

Introduction

Today's students will be the educated talent that shapes the future, so it is of utmost importance that they receive comprehensive training in all human dimensions ((Morales, 2020), as well as in the development of an integrative collective commitment with a responsible and ethical approach that enables them to make decisions for the common good on a daily basis, as well as complex decisions that resolve situations that have been overlooked due to a failure to assume the costs or risks. (Martínez, R. 2020) The current social, ecological, and economic crisis is related to biased decisions and a lack of sustainable commitment that achieves balance.

Education has evolved in each era, in this digital and technological era where students will have jobs closely related to technology because the industry is in its fourth revolution, locating it as Industry 4.0 (Garrell, A. &., 2020) due to its digital, technological and interconnection emphasis which are moving towards Industry 5.0. We also classify current education as Education 4.0, which has the objective of training students with knowledge, technological, digital and socio-emotional skills to constitute Talent 4.0. (IPN, 2019) Education 4.0 has the urgent need to use active strategies that allow the development of knowledge and skills that provide the opportunity for new ways of learning, recognizing new learning spaces where students are the makers and creators of knowledge accompanied by teachers who guide and design the learning experience.

The STEAM Methodology offer a different opportunity to learn through transdisciplinary to generate sustainable solutions in a short time.

As mentioned by (Guanotuña Balladares, y Torso, 2024) Methodology, STEM-STEAM methodology requires designing educational experiences that incorporate the principles of constructivism and active learning. This includes collaborative projects that integrate STEM disciplines and artistic components, along with the use of innovative technologies. As mentioned, (Sanchez Ludeña, E., 2019) active methodologies, particularly tinkering, are the most suitable for developing STEAM competencies. The maker movement is closely linked to the development of STEAM skills and competencies.

As (Sainz, 2019) mentions, STEAM promotes the inclusion of students in the practical world of science, bringing them closer to the relationships between STS (Science, Technology, and Society). It also helps foster student autonomy in their learning. According to (Ortiz-Revilla, J., Sanz-Camarero, R., & Greca, M., 2021), STEAM represents a rapidly expanding educational approach, aligned with the educational needs of society. STEAM can incorporate other active

learning strategies, as mentioned (Ruiz, 2017) using Problem-Based Learning, Cooperative Learning, Flipped Classroom, and Educational Robotics for project design. The training of science collaborators is not limited to scientific knowledge, as (Villanueva Marcial, Y.M., Chirinos Lechuga, R., Guzmán Zarate, V.H., & Salas Carlock, S., 2024) point out. The importance lies in a comprehensive education that values the development of knowledge, skills, competencies, and attitudes for adaptation, communication, teamwork, proactivity, entrepreneurship, etc. In this same sense (Aguilera, D. & Vílchez-González, 2024) STEAM works on preferred disciplinary integration from a specific context, with those of a historical or cultural nature being the most used.

These methodologies also contribute to collaborative work, as well as the management of other strategies such as in situ learning, learning with ICT, among others and develop soft skills. These skills are included in the 21st Century Skills that (UNESCO, 2021) they propose and that aim to train citizens as well as improve the well-being of the individual and organizations. In that same sense, it is intended that the talent of the 21st century have training in Citizenship equity, Gender Equality, Globalization, Diversity and above all, learn to live together as mentioned (UNESCO, 2021)

STEAM seeks sustainable innovation proposal that also include social aspects to improve solution of the SDGs: 4 Education, 5 Gender Equality, 10 Reduction of Inequalities and 16 Peace, Justice and Strong Institutions.

Education for teh 21th Century

According to UNESCO (UNESCO, 2021), 21st-century education seeks to develop citizens who live in well-being and learn to live together. 21st-century skills are also known as the "4 Cs": Critical Thinking, Creativity, Collaboration, and Communication, as these are considered essential skills. The following figure shows 21st-century skills, including the afore mentioned.

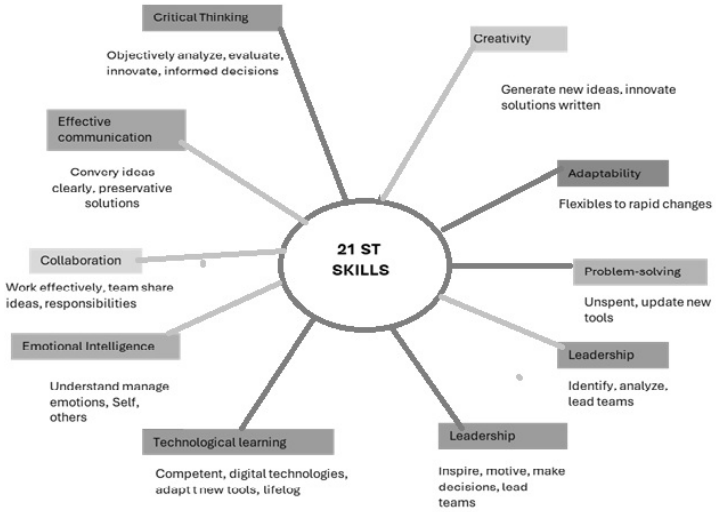

Figure 1. The 21st Century Skills for the 21st century

UNESCO's approach underscores that these skills are interconnected and crucial for fostering peace, sustainable development, and global citizenship in the 21st century. They aim to equip individuals not only for the workforce but also for active and responsible participation in society. UNESCO creates four categories for 21st-century skills: Elements of Citizenship, Globalization and Diversity, Skills for Citizenship, and Gender Equity and Living Together (Values) As can be seen, the social and human factor is favoured. Social skills will be crucial and necessary to develop in the talent of the future. These include values such as respect, responsibility, honesty, empathy, solidarity, tolerance, diversity, and the development of happiness, among many other important human aspects.

STEAM is the acronym corresponding in English to the acronyms S- Science- Technology, E- Engineering, A- Arts and M- Mathematics. This Methodology proposes, through established roles, to develop a project collaboratively with scenarios like those experienced in the working world. The (NSF, 2017) National Science Foundation creates the STEAM program to promote the study of science and guarantee new professionals who solve and create innovative solutions. Also, STEAM provides collaborative transdisciplinary work in diverse teams. As shown below in the following figure

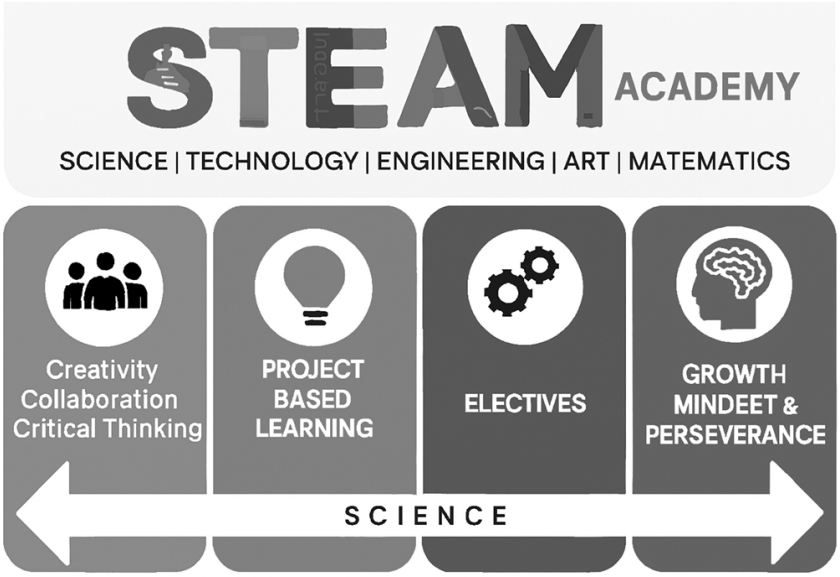

Figure 2. Advantages that STEAM provides

This methodology develops STEM skills, which means having skills in science and technology among other skills, as well as the knowledge of the different disciplines required to achieve new solutions STEAM promotes Soft Competencies that will allow the individual to relate adequately form teams, self-direct, regulate and manage their knowledge. STEAM promotes the development of critical thinking and develops or strengthens the required work skills: the research process, diagnosis and proposal of solutions, work methodology, definition of

objectives, prevention, conflict resolution, team management, and coordination of activities. (Sanches Vazquez, A., & Guman Perez, S., 2022)

STEAM use active strategies that allow the development of knowledge and skills (M. Marbán, J., Muñoz-Escolano, J. M., Maroto, A., Arce, M., & Alsina, Á., 2019) that provide the opportunity for new ways of learning, recognizing new learning spaces where students are the makers and creators of knowledge. In these new spaces, prototypes, devices, works of art, educational campaigns, programs, apps, videos, and a host of products are created that provide innovative, sustainable solutions. Innovations that come from STEAM processes are integrative, contain multiple applications of knowledge, in addition to having an objective and sustainable character when considering the problems posed through the SDGs. Students develop their judgment when innovating and questioning whether this innovation benefits society, the environment, and the economy, which should be considered as a new approach to the training of Talent that will be integrated into the world of work.

STEAM, as mentioned by (Sainz, 2019), promotes the inclusion of students in the practical scientific world, bringing them closer to the STS (Science, Technology, Society) relationships, and also helps to foster student autonomy in their learning.

The STEAM Methodology proposes combining knowledge from disciplines that contribute to solving the SDGs, so it will also be necessary to combine the social knowledge included in the 2030 Agenda. Therefore, the Humanities have been included, and STEAM + H is applied—just to mention the Humanities—to History, Sociology, Anthropology, Psychology, Literature, Communication, among many others. (Sanchez Gomez, E., & Hernandez Paniagua, L 2020) The research aims to demonstrate how the development of STEAM projects provides excellent opportunities to generate knowledge, technological and digital skills, as well as socio-emotional skills that shape 21st-century talent. It seeks to demonstrate that STEAM provides the opportunity for collaborative work by combining knowledge and contributions from different disciplines, generating sustainable innovative solutions. (Sánchez Ludeña, E, 2019)

The STEAM-PBL Methodology facilitates project development by providing an action guide that allows the team to go through the creative process as many times as necessary to achieve better results. The STEAM methodology was applied in the classroom, where they worked in collaborative teams. The work of the students who formed transdisciplinary teams is described, contributing their knowledge to develop viable, innovative, sustainable solutions that contribute to the problems posed by the students. From this analysis, the students begin processes of developing their own thinking and their environment in which they can intervene.

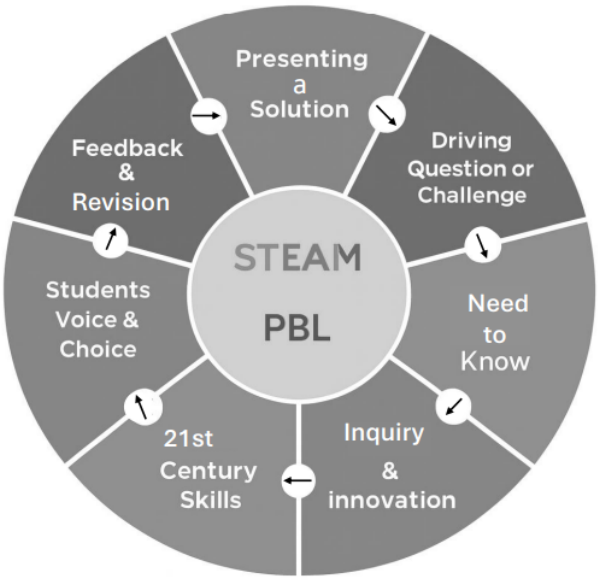

Figure 3. STEAM – PBL Methodology (Yarzabal Coronel, N., Alvarez Cedillo, J., Avila-Avila, L., & Martinez Bejarano, G 2021)

This research demonstrates the benefits of the application of STEAM it is conclusive to conclude that STEAM are the strategies that provide the opportunity to build learning. Effective, in addition to providing the opportunity to develop the skills of the participants and the generation of viable sustainable proposals.

The results demonstrate that STEAM generates innovative, sustainable solutions that are therefore ethical, applicable, and real-world solutions to address the SDGs outlined in the 2023 Agenda. STEAM provides a collaborative opportunity not only in terms of integrating and working with diverse communities through transdisciplinarity, but also through intercultural learning. This means that students will be able to gain diverse, even global, perspectives that can be applied in key decision-making positions in the near future.

For the development of STEAM talent, this is a very enriching experience. Working collaboratively, students learn to work similarly to their professional lives with real-life problems. They are able to integrate diverse knowledge and create new knowledge. They also achieve the search for and inclusion of disciplines that contribute to comprehensive, sustainable solutions to the problems of the 21st century. STEAM is an excellent opportunity for the development of knowledge as well as recognizing other disciplines that intervene in one's own knowledge, so an engineer recognizes that he needs knowledge of Neurology or Psychology so that his innovation is more efficient.

The results of the implementation are described below. STEAM offers a valuable opportunity to include and recover knowledge from different disciplines in order to propose a comprehensive sustainable solution. Participants work in a collaborative environment very similar to the way they

work in the company through multidisciplinary teams from different areas. The Hackathon offers the opportunity to experience the challenge of the situation to be solved in a short time, provides resources, facilities and with the application of the STEAM-ABP methodology, how to build the solution is provided.

The combination of STEAM Methodology is reinforced with PBL Project-based learning that provides order to the development of research, with the objective of motivating others, who are far away, in learning STEAM areas. Students are active agents who develop projects collaboratively, being supervised by teachers or educators in these areas. The latter are normally passive agents etc.) to help students understand and complete the tasks proposed in each phase of the project. With STEAM, relevant sustainable contributions are achieved because it is a methodology based on environmental projects, developed in groups. The results of these events demonstrate that students learn, collaborate, innovate, design, assemble, create technological inventions, social interventions among other innovations.

STEAM is a great strategy that provide the opportunity to learn quickly, in a real way and give the possibility of bringing together other strategies to contribute to the learning and development of the skills of the participants.

While developing research through STEAM-ABP, it proposes the path where learning is built, skills such as digital, technological and socio-emotional skills are developed, as well as the opportunity to use active strategies that the student takes as resources to create. the possible solution.

The development of research through the STEAM-PBL methodology is carried out with the PBL structure of Project-Based Learning, supported by the following strategies mentioned below:

Learning with ICT, research is carried out through digital means, which presents the opportunity to analyze, synthesize and create their own knowledge, in addition to digital media not only as a source of information through the management of search engines, repositories, etc. ICTs are also tools for programming such as the use of Turbo C, Python, C++ programs, among others. As well as for Design with programs like Vision, Project, even AutoCAD for your prototypes.

Presentations to explain your proposals in CANVA, Prezzi etc. in addition to Video Editing with CapCut, or Image editing with Adobe Photoshop Express, for Photoshop, Corel or Procreate drawing among others. For data analysis during the Hackathon, the management of the databases is carried out, initially allowing the use of Excel, Macros to robust databases, performing data mining even forays into Data Science. These are just some examples of Technology to which circuits, sensors, displays, mini robots and robots could be added that are even designed using 3D printers for their prototypes.

Research in Action The participants find information that they convert into knowledge when applying it, thus they also find answers to possible solutions to the challenge and finally the knowledge acquired through research, they adapt to the design of the solution, they adjust Therefore, it can be said that research is put into action in addition to developing awareness and critical thinking with the acquired knowledge that is developed.

In situ learning, participants build their learning in different ways, acquire and at different times share theoretical knowledge, apply it, achieving greater meaning. They investigate, analyze and apply, converting information into knowledge. They learn to interact with different talents and knowledge, also managing to integrate knowledge from different disciplines. In terms of technology, the students will learn according to their interest, seeking the best tools or programs. The participants learn to use the program and get the most out of it, achieving favourable results, it should be noted that it also allows them to engage in collaborative learning, as well as the development of socio-emotional skills to achieve compliance with the agenda and the generation of the proposal.

Another of the successful results of the application of STEAM this way the participants demonstrate their learning and the application of this to design the proposals by applying their knowledge in addition to generating sustainable awareness.

There are also other successful results from the application of the STEAM-PBL Methodology in a Hackathon, the achievements of collaborative groups of students are highly efficient; integration of different disciplines such as STEAM that contribute to the innovative solution. It is worth highlighting that the advances in technological skills are very notable when applying programming, data science, as well as other applications that use the Internet and of course the development of Socio-emotional Skills is relevant. Below, the achievements of the students are listed in terms of the development of Socio-emotional Skills, such as critical thinking, leadership, resilience, assertiveness, empathy, social awareness, among others, as well as developing Communication Skills that are very valuable for solving problems. problems and for the implementation of improvements.

It is worth mentioning that according to the experiences lived in different STEAM events, only two young people out of 300 participants have presented some type of anxiety and expressed discomfort due to the accelerated and exhausting pace of the event, while the majority, 96% to be exact, He feels motivated and expresses that he prefers to work under pressure with the challenge of achieving the goal and being rewarded for his contribution.

It is evident that STEAM and the Hackathon together are powerful strategies for building learning, as well as developing skills and creating innovative sustainable solutions.

Conclusions

STEAM is a excellent opportunities for training 21st-century talent through collaborative transdisciplinary work.

It can be concluded that the development of talent through skills development in STEAM projects is confirmed and evident. It demonstrates the enriching value of collaborative work, as well as the application of sustainable actions and values from ethics and other humanities disciplines that influence the creation of innovative, sustainable solutions.

STEAM IS powerful strategies of Education 4.0 for the construction of effective and accelerated learning, as well as an opportunity for the development of STEAM skills, technological, digital,

and socio-emotional skills, thereby developing Talent 4.0, which responds to the demands of Industry 4.0

STEAM can undoubtedly be considered as active strategies where students are the creators of the activities where they achieve the design, elaboration, presentation, argumentation and improvement of innovative proposals for sustainable solutions.

These strategies provide the opportunity for transdisciplinary work with the contribution of different disciplines through STEAM in addition to collaborative work very similar to the current reality in the workplace. The participants live an enriching experience at different levels, including the staff, having the opportunity to recognize what they can create with their knowledge and skills, which generates an increase in confidence in the participants and improves their self-concept, which motivates them to continue learning in order to apply their knowledge.

STEAM is the best option for developing Talent 4.0, a highly sought-after skill in a technological era where students are required to quickly apply their knowledge and effectively solve problems in the workplace with a proficient command of 21st-century skills to ensure the common good, social well-being, and sustainability. The application of the STEAM-PBL Methodology has allowed collaborative student groups to achieve highly efficient results. Students learn on-site, conduct action research, and explore the use of ICTs, in addition to testing their knowledge in different disciplines such as STEAM, which contributes to the creation of innovative and sustainable solutions. ICT-based learning is particularly notable when observing the advances in technological skills when applying programming, data science, and other applications that use the internet. Socio-emotional skills are developed, such as emotion management, stress and frustration management, critical thinking, assertiveness, empathy, and social awareness, as well as communication skills for conflict resolution and the development of a much-needed sustainable consciousness.

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Flipped classroom practices for learning criminal law

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Introduction

The context that Chile experienced during 2019 and 2020, due to the health emergency caused by COVID-19, prompted universities to evaluate their teaching practices and the strategies for teaching and learning that they were using. Since students did not seem to participate in classes, achieving very low learning outcomes, it was necessary to reformulate the curriculum's learning and assessment activities for university degrees. In this regard, universities focused on redesigning innovative curricular activities, with tools that were not only technological but also pedagogical, employing active teaching and learning methodologies through pedagogical support, with technology as a means (Sáez, 2025), adding value to the learning activity and implementing authentic assessment (Pérez-Lorca & Farías, 2020). This required curricular redesign utilizing active strategies for disciplinary learning outcomes (López-Altamirano et al., 2022).

Despite many changes in university education over the past century—such as a focus on learning outcomes, competency-based approaches, and the use of active, participatory methodologies with authentic assessments—the field of Law has remained largely resistant to change. Legal education and its instructors often continue to rely on traditional lecture-based teaching and memory-based assessments. These methods emphasize the repetition of concepts, characteristics, principles, classifications, and doctrinal schools, rather than deeper understanding or application.

The research question is: What effects does the application of an active and participatory methodology called flipped classroom, combined with authentic assessment, produce on the learning of Criminal Law students, from the perspectives of the students themselves and their educators?

Based on the hypothesis that active and participatory teaching methods—such as the flipped classroom—promote deeper and more lasting learning, this study proposes that such approaches enhance understanding of Criminal Law across different curriculum levels. These methods strengthen students' conceptual and relational grasp of the subject matter and foster motivation and the development of discursive, argumentative, and critical thinking skills. The flipped classroom methodology also allows incorporation of other participatory practices at different stages, such as case studies, projects, collaborative learning, gamification, and authentic assessment. This study evaluates the effects of applying this methodology on student learning in Criminal Law courses, based on perceptions from both students and instructors across different curriculum stages.

This research employs a qualitative, descriptive, and exploratory methodology using primary and secondary sources. It monitors experiences from three Criminal Law courses at different curriculum stages in a private, accredited Chilean university, using semi-structured interviews with students and professors.

Participants and Methodological Application

Students interviewed were enrolled in the 4th, 5th, and 9th semesters of the Law degree program and had previously completed Criminal Law courses taught through traditional lecture-based instruction. The flipped classroom methodology was implemented consistently during one intervention semester across all sessions. Student learning was evaluated in three sequential stages:

1. **Pre-class research:** Students, organized in groups, conducted preliminary research with instructor-provided materials, including selecting a legal case, identifying relevant jurisprudence, and reviewing doctrinal sources related to the assigned topic.

2. **In-class group work:** Students applied the professor's theoretical content to the selected case, critically analyzed judicial rulings and doctrinal perspectives, and formulated their own case theories.

3. **Group presentations and feedback:** Groups presented their analysis and conclusions to the class. The instructor facilitated feedback and comparative discussions between groups that had selected the same or similar cases.

Eighty students were invited for interviews; fifty consented and participated. Most responses were from 5th-semester students. Although perceptions were similar across cohorts, 9th-semester students demonstrated deeper, more nuanced understanding. Four faculty members (one full professor, three assistant professors) involved in methodology implementation were also interviewed.

Interview Topics

Student interviews explored:

1. Understanding of the flipped classroom methodology in the Criminal Law course.

2. Identification of the methodology's key components.

3. Perceptions of pre-class research's contribution to learning outcomes.

4. Evaluation of in-class discussions and their role in deepening understanding.

5. Effectiveness of oral presentations in consolidating knowledge and clarifying doubts.

6. Impact of instructor feedback and peer interaction on learning.

7. Comparison of flipped versus traditional learning experiences.

Faculty interviews focused on:

8. Assessment of the flipped classroom as an innovative pedagogical approach.
9. Perceived benefits for student learning.
10. Comparative reflection on flipped classroom versus traditional teaching.

Data from student and faculty interviews across the three Criminal Law courses—covering nearly the entire undergraduate field—suggest that the flipped classroom fosters more profound, enduring, and interconnected learning than traditional methods. This is supported by perceptions from both students and instructors.

Average grades (scale 1 to 7) were:

- 4th semester (38 students): 5.0 (eight formative in-class assessments + two written multiple-choice evaluations with legal case analysis)
- 6th semester (34 students): 5.3 (same evaluation model)
- 9th semester (19 students): 6.0

Student Perspectives

Qualitative data revealed:

- Increased engagement, linking theoretical learning with practical case analysis improved understanding.
- Researching jurisprudence and doctrine, constructing legal arguments, and developing case theories fostered analytical thinking and knowledge retention.

Assessment criteria included:

1. Relevance and quality of pre-class research.
2. Accuracy and depth in applying legal content during class.
3. Clarity and persuasiveness of oral presentations and legal reasoning during discussions.

Survey highlights:

- 70% clearly understood the flipped classroom structure and appreciated its active, participatory format. Sample quotes:

- "It's a different way of learning that lets us engage through research and group work." "I retain more when I solve cases and apply what I've studied immediately."
- 30% noted they assumed a teaching role through case presentations.
- 80% accurately described the methodology's three stages.
- 20% provided more detailed sequences including multiple research and reflection phases.
- 100% found the methodology useful, emphasizing its relevance, promotion of systematic thinking, and motivation. Quotes: "It helped me understand the subject matter more easily and thoroughly." "Feedback was immediate and helped eliminate fear of speaking up."
- 5% expressed negative experiences, citing difficulty grasping content or anxiety related to continuous assessment.

Teacher Perspectives

Faculty viewed the flipped classroom as an innovative approach shifting focus from teacher-centered delivery to student-centered engagement. Benefits emphasized include:

- Promotion of independent research, oral communication, and teamwork.
- Enhancement of critical thinking, legal analysis, and argumentation skills.
- Encouragement of student ownership of learning.

While traditional lectures remain valuable for foundational concepts, faculty agreed that combining them with active methodologies like the flipped classroom leads to superior learning outcomes.

On the Theoretical Framework

Active teaching and learning methodologies are grounded in social constructivism, focusing on the student and learning process. These approaches promote discipline-specific and cross-disciplinary competencies by framing learning as constructive rather than receptive (Bernal & Martínez, 2009).

Active learning places students as central agents; learning is inherently social, often more influenced by peer interaction than lectures. Meaningful learning occurs through real, feasible, and complex activities that enable knowledge transfer and development of higher-order thinking, fostering learning communities that transcend traditional temporal and spatial boundaries (Larmer & Mergendoller, 2010).

Authentic assessment involves real-world tasks allowing continuous monitoring and feedback.

Participatory Methodologies Related to Flipped Classroom

- Project-Based Learning (PBL): Develops skills through projects addressing real-world problems, promoting integrative understanding, empathy, critical analysis, synthesis, and hypothesis formulation (Larmer & Mergendoller, 2010).

- Research-Based Learning: Encourages collaborative evidence gathering to solve complex questions (Sotomayor, 2023).
- Problem-Based Learning (PBL): Develops knowledge, skills, and attitudes for solving real problems, emphasizing autonomy, cooperative dialogue, critical thinking, and continuous assessment (Pazos-Yerovi & Aguilar-Gordón, 2024).
- Collaborative Learning: Emphasizes teamwork, leadership, critical thinking, communication, decision-making, conflict resolution, and coordination (Johnson & Johnson, 2014; Juárez, Mendo, & Rasskin, 2019). Group roles, tasks, and evaluation criteria are clearly defined.

The flipped classroom integrates these approaches, requiring students to engage with content before class at their own pace, reserving class time for practical application (Martínez-Olvera, Esquivel-Gámez, & Martínez, 2015).

This methodology improves class time efficiency by focusing on applied tasks based on prior independent study. Students revisit material before class; instructors personalize sessions by guiding discussion and problem-solving (Sánchez-Pacheco, 2019).

Gamification, incorporating game mechanics, fosters motivation, collaboration, and competition (Swartz et al., 2008; González, 2019).

Evaluation is formative, focusing on learning over grades, promoting higher-order cognitive skills such as critical thinking, analysis, synthesis, and reflection. Students apply concepts to cases, formulate hypotheses, and propose solutions. Formative assessment samples work at different stages to monitor progress aligned with criteria (Canta & Quesada, 2021; Tecnológico de Monterrey, 2022).

Conclusions and Suggestions for Future Research

This study demonstrates a significant improvement in the quality of student learning in Criminal Law courses using the flipped classroom methodology versus traditional lecture-based instruction. Improvements appear in conceptual understanding and students' ability to analyze and apply legal knowledge critically. These findings are supported by student and instructor perceptions and by semester grades (ranging 5 to 6 out of 7).

Student engagement, stimulated by pre-class preparation, group case resolution, and guided discussion, transformed the classroom into a collaborative and intellectually challenging space, contrasting with traditional rote memorization models. Results reinforce theoretical frameworks supporting meaningful learning.

Students reported higher motivation and commitment, appreciating the flipped classroom as dynamic, demanding, and professionally relevant. This highlights the need to rethink legal education pedagogies by adopting methodologies that transcend traditional models and develop competencies beyond content recall.

The initial hypothesis is confirmed: active and participatory methodologies, such as flipped classrooms combined with other active learning strategies, foster deeper and longer-lasting learning, greater student knowledge ownership, participation, and outcome-oriented evaluation.

Recommendations include gradual integration of active methodologies into the Law curriculum to connect theory with practice better. Faculty development should focus on training in active learning, flipped classroom design, formative assessment, and engagement techniques.

Future work should refine evaluation of the student research phase and develop systematic tools for monitoring and supporting group discussions, improving the methodology's overall effectiveness and assessment.

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Psychology, Soft Skills, and Student Well-being

Social Representations of the Effect of Open Office Spaces on the Development of Soft Skills

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Introduction

The organization of work and workplace environments is increasingly facing the need to adapt to new paradigms of productivity and collaboration. One of the most notable changes in this regard has been the implementation of open office spaces, a design that encourages direct interaction and removes physical barriers between employees. This model, which has gained popularity in many organizations, raises important questions about its impact on the social and professional dimensions of workers' experiences. In this context, soft skills—such as effective communication, teamwork, and critical thinking—are essential in today's work environments, where the ability to adapt and collaborate efficiently with others is critical to organizational success. Despite its prevalence, the impact of open-plan offices on the development and expression of these soft skills remains a subject of debate. While some argue that such spaces enhance collaboration and communication, others suggest that they may hinder employee concentration and time management. Against this backdrop, the central research question of this study is: What are the social representations associated with the open office model, and how do they influence the soft skills of administrative workers? The objective of this study is to explore employees' perceptions of working in open office environments and to evaluate how this type of setting influences their communication, teamwork, critical thinking, and time management skills. To achieve this, the study employs the word cloud technique, specifically using the software *NVivo*, as a methodological tool to visualize the most recurrent terms associated with these soft skills. This chapter reflects on how physical workspace design shapes work dynamics and the development of interpersonal competencies within teams, while also addressing the implications of open office layouts for employee well-being and productivity. These insights are relevant for both organizational theory and practical workplace management.

Soft Skills

From a systems perspective, organizations are becoming increasingly complex due to the growing number of variables being introduced as objects of study in the repertoire of causes and effects shaping social dynamics, as well as the emergence of new approaches that respond to previously unrecognized problems. This complexity requires a rethinking of the skills needed to foster functional work environments, moving beyond traditional technical and academic

knowledge. In this context, the development of soft skills becomes essential—understood as well-researched abilities and aptitudes that are just as relevant as any current trend in organizational research. This is due to the fact that human complexity is irreducible and nonlinear (Poláková *et al.*, 2023). When the concept of "skill," defined as the aptitude to effectively perform a task, is combined with the qualifier "soft," it takes on a broader meaning —referring to the ability to manage emotions and values across diverse contexts (Coronado-Maldonado & Benítez-Márquez, 2023). In the business world, it is increasingly common for recruitment and selection processes to shift their focus away from academic credentials and work experience, placing greater emphasis on the evaluation of soft skill development (Bone *et al.*, 2025). Employers are more likely to select candidates based on the degree to which their competencies align with the job profile, since it is now crucial not only to perform assigned tasks, but also to establish effective professional relationships with colleagues and supervisors (Tushar & Sooraksa, 2023).

In terms of their importance, several authors underscore key soft skills: Coronado-Maldonado and Benítez-Márquez (2023) emphasize emotional intelligence, as it is necessary for interpreting and regulating both one's own emotions and those of others; Rikala *et al.* (2024) identify effective communication and teamwork as essential for enabling interaction not only between humans but also with artificial intelligence; Veríssimo et al. (2024) highlight problem-solving and critical thinking as vital for responding to challenges and making decisions in dynamic work environments; and Pantaruk *et al.* (2025) argue that managers should possess at least five core competencies: knowledge orientation, leadership, communication skills, ethical principles, and the ability to build and strengthen teams. Today's challenges in filling job vacancies are not only due to a shortage of technical profiles, but also to the increasing demand for human-centered skills, which are essential in the context of the Fourth Industrial Revolution. Among these, the ability to collaborate effectively, think critically and analytically, solve complex problems, and demonstrate adaptability, responsibility, and resilience stands out. These competencies are not merely isolated personal traits; they are shaped by organizational expectations that reflect shared social representations of what is considered desirable in a modern work environment (Poláková *et al.*, 2023).

Built Environment

The built environment is not only the physical condition in which human activity takes place, but also a variable that influences work dynamics, human interactions, and even the development of soft skills. The concept of the built environment is inherently interdisciplinary, encompassing architecture, environmental psychology, and organizational sciences at a minimum —though disciplines such as medicine and nanotechnology may also contribute to its study (Mengmeng *et al.*, 2024). This environment refers to the planned, designed, and constructed physical space created by humans for both functional and symbolic purposes, in contrast to the natural environment. According to Lefebvre, as cited by Simone and Blazejewski (2023), every built space is the result of social relations, as it does not merely contain human activity —it actively shapes it. Thus, the design of a work environment can either inhibit or promote certain behaviors. Built spaces are created based on aesthetic and/or logistical criteria, but they also generate models of power (leadership) and communication. From an organizational perspective, no spatial design is ever neutral, as it establishes the conditions under which hierarchies are defined,

effectively shaping power relations by determining who can see, be seen, approach, or participate in a given activity (Srivastava *et al.,* 2024). In this way, space structures workplace interactions, shaping organizational dynamics. Since it mediates the employee's lived experience, space can affect emotional well-being, productivity, and social behavior (Appel-Meulenbroek *et al.,* 2022). Moreover, the field of neuroarchitecture investigates how built environments influence cognitive and brain processes, highlighting variables such as natural lighting, furniture layout, ventilation, and the use of color. This reinforces the idea that space should be seen as an active agent within the organization: it influences motivation, regulates emotional states, and enables —or constrains— opportunities for learning and social connection (Ghamari *et al.*, 2021). In sum, the built environment can be regarded as a strategic tool for promoting desirable behaviors, fostering collective identity, and supporting the development of soft skills, particularly those involving interaction and critical thinking. This suggests that open-plan offices should not be evaluated solely through efficiency metrics, but also by their capacity to activate complex relational processes within equally complex human systems.

Social Representations

Within the organizational framework —where structures, symbols, beliefs, and practices (including rites and rituals) converge— social representations, both as a theory and a methodological strategy, are essential for understanding how individuals interpret their work environment, the relationships established within it, and the meanings they assign to its shaping phenomena. These representations are not merely individual opinions; they are collective constructions that circulate and become consolidated within the historical and cultural context of a given social group (Jodelet, 2008). Serge Moscovici introduced the concept of social representations within the field of social psychology to explain how groups in society construct shared meanings around complex or unfamiliar phenomena, before they become formally recognized or institutionalized. This theoretical framework centers on the formation and circulation of everyday knowledge, or common sense, emphasizing how collectively held beliefs enable individuals to interpret their reality, communicate effectively, and engage in socially coherent behavior (Farsari, 2018). Social representations act as symbolic mediators between scientific knowledge and everyday understanding, facilitating the appropriation of complex concepts by diverse social groups through culturally shared images, metaphors, and narratives. As De Rosa (2024) highlights, this dynamic occurs particularly through multi-channel communication processes, which shape and disseminate socially constructed meanings on crucial societal issues. Social representations, even in organizational settings, manifest through shared beliefs that guide behavior and shape group dynamics. Although not fixed, these representations evolve through language, collective experience, and contextual influences. As Farah (2011) explains, social representations are dynamic constructs, continuously redefined as individuals and groups interact with their environments. They reveal the underlying meaning frameworks that support policies, structures, and interactional forms. For this reason, their identification and analysis are useful for recognizing phenomena such as resistance to change, individual and collective cognitive biases, and dominant discourses. Beckera *et al.* (2021) emphasizes the articulating role of social representations in the processes of identity construction, belonging, and differentiation within institutions. Thus, social representations constitute an unavoidable dimension for understanding phenomena such as organizational

climate, institutional culture, and the development of soft skills, as they often implicitly determine what is considered appropriate, valued, or desirable within an organization. In collaborative organizational contexts, social representations not only function as shared cognitive structures but also as symbolic frameworks that regulate group membership. Through these representations, actors collectively construct an identity that —while not formally imposed— becomes a tacit condition for participation and integration. This identity process, sustained by shared narratives, enables the identification of meanings that bind the group together, opening possibilities for strategic intervention in managing collaboration and shaping organizational culture (Martikainen *et al.,* 2024). Recognizing social representations in organizational contexts allows for mapping shared meanings, thereby enabling strategic intervention. In contexts of increasing social complexity, addressing subjectivity is not optional —it is part of designing more inclusive and adaptive systems, capable of responding to the challenges of human work (Sammut *et al.,* 2015); in other words, organizations must acknowledge the impact of environmental influences.

This study follows a qualitative design with descriptive scope, supported by basic quantitative elements, and grounded in the hermeneutic approach. Data collection was carried out through an online survey using Google Forms, which included open-ended questions aimed at exploring the perceptions and opinions of 42 employees working in the administrative departments (e.g., purchasing, planning, human resources) of a corporate office. All participants operated within an open-plan office environment and represented a range of age groups. To analyze the responses, the word cloud technique was employed. This method enabled the identification and visualization of the most frequently mentioned terms, allowing for the mapping of recurring themes in participants' narratives. Word clouds serve as a visual tool that highlights key concepts and facilitates the interpretation of shared representations related to open office dynamics. Specifically, they provided insight into how employees perceive the influence of the open workspace on communication, teamwork, and other aspects of organizational life.

Through the responses to the open-ended questions, the main perceptions and opinions of employees were identified regarding how the open office model influences their work and workplace dynamics.

Figure 1. What does working in an open office mean to you?

Note. Created by the authors with *NVivo* software

In the word cloud (Figure 1), concepts such as "comfort", "trust", "shared space", "collaboration" and "teamwork" prevail, indicating a positive perception centered on collaboration, trust, and well-being. Terms like "fast communication", "accessibility" and "no hierarchies" are also present, suggesting that the open space is valued for enabling fluid communication and breaking down hierarchical structures. However, there are also elements that indicate tensions, such as "no privacy", "distraction" and "concentration" which may lead to exposure and difficulties in maintaining focus.

Figure 2. How do you think the open office space influences communication within the organization?

Note. Created by the authors with *NVivo* software

The analysis of Figure 2 shows that the open office space is perceived as a facilitator of organizational communication. Terms such as "fast communication", "no barriers", "flow", "collaboration" and "teamwork" prevail, indicating that fluid, direct interaction without physical obstacles is highly valued. Expressions like "approach easily", "improved communication", "constructive benefits" and "effective resolution" also appear, reinforcing the positive perception of communication efficiency in this type of environment. On the other hand, terms such as "limited privacy" and "annoying distractions" are also present, suggesting that the openness of the space can lead to interruptions and reduced concentration, which can negatively affect tasks requiring greater focus or confidentiality.

Figure 3. In what way does the open office space affect your creativity (positively or negatively)?

Note. Created by the authors with *NVivo* software

Figure 3 suggests that open office spaces have a dual impact on creativity. On one hand, concepts such as "collective collaboration", "group idea generation", "collective ideas" and "positive impact" prevail, reflecting a positive view of open environments as spaces conducive to creative exchange and joint idea generation. Terms like "ease of interaction", "dynamic collaboration" and "immediate feedback" reinforce this perspective, referring to the agility of group interaction and an atmosphere that supports the collective construction of solutions. At the same time, words like "annoying interruptions", "interruptive noise", "limited privacy" and "difficulty concentrating" also stand out, suggesting potential challenges for those who require greater focus or private spaces to develop their creativity individually. This tension highlights that, while open spaces enhance collaborative creativity, they may hinder introspective or reflective creative processes.

Figure 4. Do you think working in open office spaces facilitates teamwork?

Note. Created by the authors with *NVivo* software

The analysis of this word cloud (Figure 4) indicates that the open space is perceived as an environment that facilitates teamwork, mainly due to its ability to promote constant communication and interaction. Words such as "easy interaction", "effective collaboration", "fast communication" and "teamwork" reflect that the physical proximity and accessibility of the open environment allow questions to be resolved quickly, information to be distributed efficiently, and bonds between colleagues to be strengthened. Similarly, terms like "relational trust", "quick questions" and "easy accessibility" reinforce the perception of a collaborative, dynamic, and supportive atmosphere. However, the expression "frequent interruptions" also appears, suggesting that this type of space can lead to recurring disruptions that, at times, hinder concentration and the flow of collective work —particularly when deeper focus or discretion is required.

Figure 5. How does working in an open office space influence leadership and authority relationships in your area?

Note. Created by the authors with *NVivo* software

Figure 5 shows that open office spaces influence the perception of leadership by making leaders more accessible and closer to their teams. Terms such as "accessible leadership", "positive leadership", "direct communication" and "increased trust" stand out as potentially favorable themes. Expressions like "closer relationship", "trust subordinates" and "trusting environment" further reinforce the idea of mutual trust. Meanwhile, terms such as "micromanagement", "role confusion" and "less clear hierarchies" highlight possible tensions associated with a less clearly defined organizational structure.

Figure 6. How do you perceive that the open office affects your time management, either positively or negatively?

Note. Created by the authors with *NVivo* software

Figure 6 highlights terms such as "easy access", "instant communication", "quick responses" and "availability for collaboration", which suggest that this type of environment allows for quick resolution of doubts, immediate information exchange, and constant interaction. On the other hand, expressions like "constant interruptions", "easy distraction", "limited focus" and "complex time management" stand out, revealing the challenges faced by those who require greater concentration or a more structured environment to manage their time effectively.

Figure 7. In what way do you think the open office space supports or hinders critical and analytical thinking?

Note. Created by the authors with *NVivo* software

The concepts displayed in Figure 7 indicate that the open space is perceived as an environment that facilitates idea exchange and stimulates collective analysis. Expressions such as "diversity of perspectives", "idea sharing", "access to team opinions" and "analysis stimulation" suggest an organizational context where frequent interaction and exposure to different viewpoints enrich critical thinking and support the construction of shared knowledge. The presence of terms like "joint learning" and "collective construction" reinforces the notion of a setting that encourages active participation and collaborative learning. However, terms like "frequent distractions", "concentration difficulty" and "limited reflection" reveal that in situations requiring introspection or deep analysis, open space conditions may be less suitable. Thus, while networked thinking and group cognitive agility are enhanced, the individual concentration required for complex or cognitively demanding tasks may be somewhat compromised.

Conclusions

Based on the information provided, several key conclusions can be drawn regarding the social representations of open office spaces in relation to the development of soft skills within organizations. Social representations —collective constructions about shared phenomena— offer insight into how individuals interpret their environment and how this environment shapes their interactions and behaviors within the workplace. In the case of open office spaces, these representations reflect both the advantages and potential challenges for developing soft skills such as communication, teamwork, leadership, critical thinking, and time management. On one hand, open office spaces are perceived as environments that facilitate communication and collaboration. Immediate access to colleagues and leaders promotes interaction, supporting the development of skills such as effective communication and teamwork. These settings allow for rapid idea exchange, and foster transparency and trust —elements that are essential for building healthy workplace relationships and strengthening certain leadership styles. However, social representations also highlight several challenges stemming from the lack of privacy and frequent distractions in open spaces. Constant noise, interruptions, and difficulty concentrating are factors that hinder critical thinking and individual productivity. This has a negative impact on the development of skills related to complex problem-solving and idea generation. Employees who require a quieter environment for high-concentration tasks, such as analytical thinking, may struggle to manage their time and priorities in such a dynamic setting. Social representations of

open office spaces also underscore the built environment as a key factor in shaping organizational culture and supporting soft skill development. This type of spatial configuration not only affects visible and direct interactions among employees, but also influences their emotional well-being and team motivation. Employees must learn to cope with distractions and remain focused on their tasks, which demand a combination of self-management, and resilience skills. The word cloud-based representations offer a nuanced view: the open office model is associated with fluid interactions, immediate accessibility, and the collective construction of ideas —factors that energize teamwork and strengthen trust among colleagues. At the same time, the recurring presence of concepts such as frequent interruptions, difficulty concentrating, and complex time management reveals that the same environment can hinder deep reflection and individual analytical thinking. As a result, soft skills —such as adaptability, attention self-regulation, leadership, and relationship management— emerge as critical competencies for leveraging the collaborative benefits while minimizing the impact of distraction. Understanding how employees represent and experience these spaces is essential for designing more inclusive and functional open-plan offices that enhance collective creativity without sacrificing individual focus, thereby fostering the comprehensive development of skills at all organizational levels.

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Comprehensive assessment of neurolinguistic competencies with triangular fuzzy numbers in Business Administration students

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Introduction

Several notable contributions can be identified in the origins of Neuro-Linguistic Programming, dating back to the 1970s, when Richard Bandler and John Grinder developed a systematic method for emulating human excellence in various aspects of everyday life. Over time, other experts have expanded and refined this specific area by introducing innovative models and techniques that have been adopted in multiple fields of knowledge. In particular, Richard Bandler, a computer scientist and therapist, and John Grinder, a linguist, are recognized as the pioneers of NLP. Their research led to the creation of classic works such as "The Structure of Magic (1975)" and "Milton H. Erickson's Patterns of Hypnosis (1976)," which analyze the linguistic and behavioral patterns of successful therapists.

On the other hand, Robert Dilts was a key figure in the early development of Neuro-Linguistic Programming (NLP). He focused on studying and modeling the behavior of influential leaders such as Walt Disney and Martin Luther King Jr. He contributed to the development of concepts such as neurological levels and limiting beliefs (Dilts, 1999).

Other authors, such as Michael Hall and Shelle Rose Charvet, made important contributions to goal programming and language patterns. For example, Hall (2003) proposed the meta-state model, while Charvet (1995) created the "LAB Profile" to identify linguistic preferences in work environments. These authors helped validate NLP as a practical discipline in education, psychotherapy, and coaching.

In the current era, the comprehensive preparation of higher education students requires not only technical knowledge but also the acquisition of key soft skills, such as effective communication, emotional intelligence, and social leadership. However, the assessment of these skills remains a global challenge due to commonly related issues such as relevance, reliability, and the methods employed, as pointed out in a study by (Gilar-Corbí *et al.* 2018).

Soft skills are increasingly valued in occupational and educational settings due to their complementary importance to professional training. However, there are still limitations in assessing these skills in higher education, particularly in terms of the gaps that this method continues to present, which pose a number of challenges at the international level due to the lack of valid and standardized tools to measure them objectively (Succi & Canovi, 2020).

In contrast, measuring soft skills in higher education in Mexico presents a considerable challenge due to their multifaceted nature and the difficulty of assessing them objectively. That is, these competencies, such as effective communication and collaborative work, are fundamental to the comprehensive development of students and their preparation for today's world of work; however, there are still significant gaps in their incorporation into educational processes (OECD 2019).

Consequently, higher education in Mexico faces the challenge of effectively integrating and assessing soft skills. Although curricula recognize their relevance, their practical application and assessment are often insufficient and unsystematic (García, 2024). Specifically, the tools used in Neuro-Linguistic Programming (NLP) offer valuable techniques for improving skills such as Effective Communication and Emotional Management. However, their formal application in education is limited, and there is a lack of documented evidence to support their implementation in this setting (Zhang *et al*; 2023). Furthermore, conventional assessment methods often fail to capture the complexity of these competencies, leading to a gap between teaching and proper assessment (Griffin *et al.*, 2012).

Several studies have examined the impact of Neuro-Linguistic Programming on the academic performance of university students, finding that NLP techniques enhance both cognitive and emotional abilities by improving concentration, self-confidence, interpersonal communication, and academic motivation. According to current studies, the application of Neuro-Linguistic Programming has been shown to be effective in reducing student triggers in several dimensions. Specifically, academic and behavioral. This was demonstrated in research conducted by (Ghanem *et. al;* 2024). Specifically, the study conducted on university management students revealed that participants in NLP workshops experienced significant improvements in both their academic performance by improving their oral expression and task completion (John *et al*; 2025).

Further research supports the applicability of practices in this field of knowledge. For example, Zhang *et al.* (2023**)** investigated the impact of NLP-based interventions on students at academic risk. The study employed a quasi-experimental design and used pre- and post-intervention tools to assess aspects such as academic achievement, emotional intelligence, and critical thinking. The results showed significant improvement in all three areas of intervention, as well as the usefulness of standardized psychological questionnaires as an assessment method.

Although a growing number of scientific articles highlight the application of NLP in organizational settings, a more comprehensive review of the quality of this evidence is lacking. However, there is evidence, as shown by Kotera *et al.* (2019), who conducted a study using the "Preferred Reporting Items for Systematic Reviews and Meta-Analysis" system, showing that NLP can be effective in improving a wide range of work-related psychological outcomes, including self-esteem and work stress.

In another study by Gökdere & Baykal (2022), they used a mixed-methods research approach to analyze the impact of NLP techniques on conflict resolution among administrative nurses. Although not explicitly focused on the university setting, the design of the tools used (such as interpersonal skill scales and qualitative interviews) could be beneficial for students in vocational training. Therefore, the interest of this research focuses on how NLP training can make a difference in terms of supporting the development of interpersonal problem-solving and conflict resolution skills.

In a different context, Lan *et al.* (2024) conducted a review of NLP in education. In particular, they systematically formulated questions, assessments, and error correction. Their contribution was to include data sets as a basis for constructing an adaptive and comprehensive learning method for education.

Other recent research, such as that by Zhang *et al.* (2025), has begun to use Natural Language Processing to automatically create multiple-choice questions from source documents; this could be useful for measuring comprehension gained after participating in a Natural Language Processing program, especially useful in virtual environments and personalized learning platforms.

In addition, the studies reviewed have used a wide variety of resources, from standardized psychological and educational tests to digital platforms that integrate Natural Language Processing (NLP) algorithms. Specifically, the most commonly used tools include pre- and post-test forms, Likert scales to assess soft skills, semi-structured interviews, and automated text analysis.

Finally, Bohra and Shukla (2023) conducted a secondary analysis to determine the impact of Neuro-Linguistic Programming on organizational success. They collected information from previous research conducted through various academic databases. They examined trends and evidence in business settings. They conclude that NLP can improve goal setting, increase motivation, communication skills, and problem-solving abilities. In short, it leads people to perform better.

In terms of interpersonal skills commonly linked to NLP (Neuro-Linguistic Programming), emotional management stands out as the ability to identify and control one's own emotions, according to Goleman (2006). Therefore, through techniques such as anchoring and reframing, NLP helps regulate emotions in times of stress or conflict, according to Knight (2012).

Effective communication is also a fundamental skill, as NLP offers tools to improve active listening, calibration, and empathy (Hutapea *et al.*, 2024). These skills promote more empathetic and efficient interpersonal relationships in the educational environment. Similarly, clarity in goal setting is another skill that is evaluated, as NLP encourages the setting of SMART goals through the alignment of beliefs, values, and behaviors (Dilts, 1999). Therefore, the key skills that are improved through NLP approaches include self-esteem, leadership, cognitive flexibility, and decision-making (Hall, 2003).

Despite the progress made so far, a concerted effort is needed at both the national and international levels to establish standard criteria for assessing soft skills based on methodologies such as Neuro-Linguistic Programming (NLP). The lack of consensus, for example, on the most appropriate tools limits the ability to compare results across different institutions and geographical areas, which hinders the process of continuous improvement of educational programs (OECD, 2019). In addition, the difficulty lies in shifting from a conventional approach focused on technical skills to one that emphasizes the interpersonal skills currently required by the labor market. In short, without appropriate tools and confirmatory methods that incorporate aspects of NLP, the assessment and improvement of these skills lag behind. Recent research highlights confirmatory procedures for assessment tools that aim to address these challenges. However, they still need to be expanded to make their application more widespread and efficient (Griffin *et al;* 2012).

In summary, the assessment of soft skills in higher education in Mexico remains a challenge due to the lack of standardized methods and the limited use of natural language processing (NLP) tools. It is crucial to strengthen these aspects to improve comprehensive training and increase job opportunities for graduates, thus responding to the demands of the globalized world.

This study aims to examine how Neuro-Linguistic Programming (NLP) can support the development of interpersonal skills—specifically communication, goal clarity, and emotional management—among Administration students at the Universidad Michoacana. Using fuzzy triangular numbers and Mamdani-type fuzzy control, the analysis was conducted through MATLAB and the Shiny app for interactive data collection. Given the limitations of traditional qualitative methods, fuzzy logic offers a more realistic way to capture the subjectivity of psychological variables, enabling more adaptive evaluations and informed pedagogical recommendations.

This study used a quantitative approach supported by fuzzy computing to analyze the impact of Neuro-Linguistic Programming (NLP) on the development of soft skills among students in the Bachelor of Business Administration program, which offered a specific perspective through a non-random sample of students from the Faculty of Accounting and Administrative Sciences at the Universidad Michoacana de San Nicolás de Hidalgo. Thus, competencies such as Effective Communication Level, Clarity in Goal Setting, and Emotional Management were evaluated among 46 eighth-semester students.

On the other hand, information was collected through an organized questionnaire that used a Likert scale adjusted to a fuzzy triangular scale. This scale included linguistic levels that reflected different degrees of individual competence and also the Overall Competence Level by category (from "Insufficient" to "Excellent"). The data was analyzed in MATLAB using a Mamdani-type fuzzy inference system, which integrated the linguistic assessments and produced an Overall Neurolinguistic Performance Assessment. In addition, the Shiny tool in R was used to create an interactive web application without the need for HTML. This application facilitated the creation of a fuzzy questionnaire to control the flow of responses within that environment and obtain the corresponding graphs of the assessments. Finally, membership functions were designed using fuzzy triangular numbers, and fuzzy rules were established based on logical combinations between the input variables. The centroid method was used for defuzzification in order to interpret the results on a continuous scale of competence. Using the Mamdani fuzzy inference system, data from 46 eighth-semester Administration students were analyzed to assess three soft skills: Effective Communication, Goal Clarity, and Emotional Management. Individual results were expressed as triangular fuzzy numbers, and overall General Neurolinguistic Performance (GNP) was calculated through fuzzy logic. Defuzzified centroid values showed averages of 6.95 for Communication, 6.45 for Goal Clarity, and 6.62 for Emotional Management, placing students in the "Developed" category. The average GNP score was 6.67. While most students showed acceptable levels, the data also revealed room for improvement, particularly in Goal Clarity and Emotional Management.

Figures and tables summarized fuzzy values and classifications. The Mamdani model enabled more accurate and nuanced analysis of these subjective skills—an approach not possible with traditional evaluation methods (Zadeh, 1975; Mendel, 2017).

Table 1. *Neurolinguistic Performance Table*

Competence	Centroid average	Language range
Level of Effective Communication	6.95	Developed
Emotional Management	6.62	Developed
Clarity in Goal Setting	6.45	Developed
Global Neurolinguistic Performance	6.67	

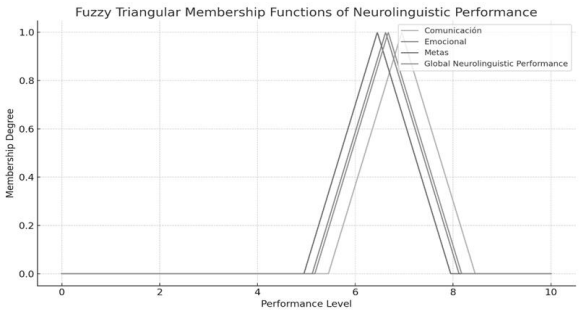

Figure 1. Fuzzy Triangular Membership Functions of Neurolinguistic Performance

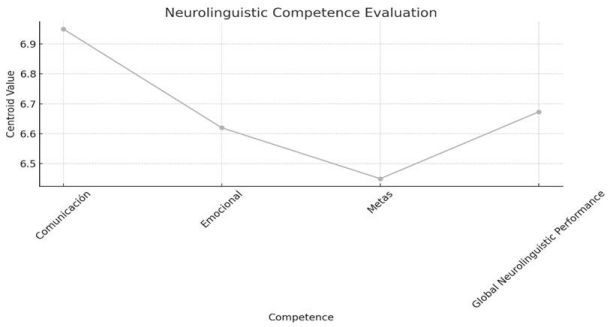

Figure 2. Neurolinguistic Competence Evaluation

Conclusions

The application of Mamdani's fuzzy model to assess soft skills in NLP shows that students reached a "Developed" level of General Neurolinguistic Performance, with average scores of 6.95 in Effective Communication, 6.45 in Goal Clarity, and 6.62 in Emotional Management. These results highlight strengths in communication and suggest the need to further foster social skills in education. The findings align with previous studies (e.g., John et al., 2025; Zhang et al., 2023), which reported academic and emotional improvements after NLP-based interventions. The positive outcomes suggest that cognitive restructuring, visualization, and goal-setting strategies in NLP may have measurable effects when assessed using fuzzy logic.

Mamdani's model, supported by Zadeh (1975) and Mendel (2017), proves effective for quantifying soft skills by translating qualitative data into fuzzy values. This addresses the lack of robust assessment tools in higher education (Griffin et al., 2012). The use of platforms like MATLAB and Shiny ensures reproducibility, though the small sample size (46 students) and narrow scope limit generalizability. More trials are needed to strengthen the evidence. Practically, the study supports integrating subjective and computational assessments to better evaluate soft skills, offering more adaptive insights for curriculum development. Future research should expand the sample, conduct longitudinal studies, and compare NLP with other soft skills development approaches (e.g., Bohra & Shukla, 2023), while aligning assessment with curriculum planning for continuous skill development.

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Rumination and emotional regulation strategies in Business and Management students

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Introduction

University education presents a wide range of academic and personal challenges that can affect students' development (Froment et al., 2024). These challenges often lead to high levels of pressure and mental exhaustion, linked to prolonged stress, which may ultimately result in academic failure (Fernández et al., 2024). Within this context, the concept of Rumination emerges, defined as a repetitive focus on negative thoughts and emotions associated with past experiences, which can generate an emotional burden that undermines academic performance (Vega et al., 2024). In competitive and demanding academic environments, the education of future business and management professionals can be hindered by ruminative tendencies, which impair their ability to concentrate and acquire new knowledge (Flett et al., 2024).

According to Vega et al. (2024) and Zuo et al. (2024), rumination can negatively affect students in several areas, including academic performance, mental health, interpersonal relationships, and emotional distress. This, in turn, can lead to emotional exhaustion, lower motivation, and reduced academic engagement (Li et al., 2023). For instance, among Mexican youth, it was found that ruminative thoughts were associated with self-reproach, as they reported experiencing constant fatigue-related thoughts and concerns about their inability to concentrate on their studies. Moreover, it was observed that students who were employed reported lower levels of rumination (Vega et al., 2024). Thus, rumination can affect both students' emotional well-being and their ability to cope effectively with academic demands (Yamasaki et al., 2024).

In addition, it is undeniable that emotional regulation plays a crucial role in situations that disrupt young people's daily lives. Emotional regulation refers to the ability to appropriately manage and modify one's emotions. This skill is essential, as it allows individuals to cope with stress and academic demands from a more positive perspective (Fernández et al., 2024). Furthermore, it enables individuals to manage and respond to their emotions in a timely manner, involving emotional regulation across different contexts, which is key to both emotional well-being and academic performance (Rojas et al., 2024). Emotional regulation is fundamental for psychological and social well-being, as it helps individuals maintain healthy relationships and make appropriate decisions based on their emotional states (Dominguez et al., 2021).

Within the academic context, poor emotional regulation has been identified as a risk factor associated with symptoms of anxiety and stress among university students (Riemer, 2024). For instance, Hoyos and Borrajo (2023) found that among a sample of Colombian and Spanish participants, women demonstrated greater emotional regulation abilities. It is possible that effectively managing emotions not only helps prevent the negative impact of rumination but also fosters an emotional climate that promotes engagement, a critical element for academic success.

Undoubtedly, there is a pressing need to advance research in this area to deepen the understanding of mental health and well-being among students enrolled in Business and Management programs. Overlooking these factors may have significant consequences for students' academic trajectories, including higher dropout rates and decreased academic performance and achievement. In light of the above, the main objective of this research was to analyze the statistical relationship between rumination and emotional regulation strategies among Business and Management students at a university in Lima, Peru. A total of 312 adults enrolled in university programs in Business and Management participated in the study. Participants' ages ranged from 18 to 40 years (M = 26.52, SD = 5.85). Of the total sample, 152 were men (48.7%) and 160 were women (51.3%). Additionally, 22.4% reported being exclusively dedicated to their studies, while 77.6% indicated that they both work and study simultaneously. Regarding the modality of studies, 88 students attended in-person classes (28.2%), 187 were enrolled in a blended (hybrid) learning format (59.9%), and 37 were studying through fully online, remote learning (11.9%).

To assess rumination, an adapted scale based on the proposal by Hervás (2008) was used. Hervás validated the Spanish version of the Ruminative Responses Scale (RRS) originally developed by Nolen-Hoeksema and Morrow (1991). The scale used in the present study measured individuals' predisposition to repeatedly focus on negative thoughts related to past experiences. It consisted of 10 items distributed across two dimensions: (1) Brooding and (2) Reflection. For the emotional regulation variable, an adapted version of the Emotion Regulation Questionnaire (ERQ) by Gross and John was employed, based on its adaptation to the Peruvian context by Gargurevich and Matos (2010). This instrument includes two emotional regulation strategies: (1) Cognitive Reappraisal, considered an adaptive strategy, and (2) Expressive Suppression, which involves inhibiting emotional expression. A pilot study was conducted to confirm the factorial structure and high reliability of both scales for use in the present research. The surveys were distributed through virtual platforms, and all participants provided informed, voluntary, and anonymous consent to participate in the study. The data were processed using SPSS version 27. Initially, data normality was assessed, and based on the results, non-parametric statistical tests were applied for the analyses.

Table 1. *Correlation between the study variables*

	Emotion Regulation			
	Cognitive Reappraisal		Expressive Suppression	
	r_s	r_s^2	r_s	r_s^2
Rumination	0.262*	0.069	0.204*	0.042

** $p < 0.05$*

r_s: Spearman correlation

r_s^2: coefficient of determination

A positive, significant, and moderate relationship was found between rumination and cognitive reappraisal (table 1). However, the relationship with expressive suppression was small; in this latter case, the findings suggest that higher levels of rumination may also be associated with a slight tendency to avoid expressing emotions across different contexts. Furthermore, the

coefficients of determination indicate that 6.9% and 4.2% of the variance were explained, respectively. These results reflect the complexity of emotional regulation processes among individuals with a tendency to ruminate.

Table 2. *Differences by age*

	18 to 30 years (n=250)	31 to 40 years (n=62)	U	p
	Mdn	Mdn		
Rumination	36.00	28.00	3473.5	0.000
Cognitive Reappraisal	30.00	29.00	7341.0	0.519
Expressive Suppression	19.00	17.00	6947.0	0.205

n: number of participants
Mdn: median
U: Mann-Whitney U test
p: p-value

No age-related differences were observed in the use of either emotional regulation strategy. However, it was found that young adults aged 18 to 30 scored higher in rumination compared to participants aged 31 to 40 (table 2).

Table 3. *Differences by sex*

	Men (n=152)	Women (n=160)	U	p
	Mdn	Mdn		
Rumination	31.00	36.00	6638.00	0.000
Cognitive Reappraisal	30.00	29.00	10552.5	0.043
Expressive Suppression	20.00	17.00	8096.00	0.000

n: number of participants
Mdn: median
U: Mann-Whitney U test
p: p-value

As shown in table 3, there are significant differences between men and women in terms of rumination, with women reporting higher levels of ruminative thoughts. In contrast, men scored higher in cognitive reappraisal and expressive suppression.

Table 4. *Differences by employment status*

	Students only (n=70) Mdn	Work and study (n=160) Mdn	U	p
Rumination	37.00	34.00	5746.0	0.000
Cognitive Reappraisal	30.00	29.00	8378.0	0.890
Expressive Suppression	18.00	19.00	6560.0	0.004

n: number of participants
Mdn: median
U: Mann-Whitney U test
p: p-value

According to employment status, participants who exclusively study reported higher levels of rumination (table 4). Additionally, participants who work and study showed higher scores in expressive suppression. Both results were statistically significant.

Table 5. *Differences by study modality*

	In-person (n=88) Mdn	Blended (n=187) Mdn	Online (37) Mdn	H	p
Rumination	37.00	34.00	31.00	34.593	0.000
Cognitive Reappraisal	31.00	30.00	28.00	1.921	0.383
Expressive Suppression	20.00	17.00	19.00	0.834	0.659

n: number of participants
Mdn: median
H: Kruskal-Wallis H test
p: p-value

As shown in table 5, students enrolled in the in-person modality obtained higher rumination scores compared to their peers in blended and online modalities. This difference was statistically significant.

Conclusions

The results suggest that as ruminative thoughts increase, Business and Management students tend to use both emotional regulation strategies. At first glance, this finding may seem contradictory, as Cognitive Reappraisal is generally considered an adaptive strategy that allows individuals to change or modify the meaning and relevance of certain events. However, it's possible that individuals with high levels of Rumination attempt to cognitively reinterpret their experiences but aren't entirely successful in doing so.

These findings suggest that, within a ruminative context, emotional regulation efforts aren't always effective; they may result in outward Expressive Suppression without altering one's internal perception. This could negatively impact students' academic performance, professional development, and decision-making abilities. Furthermore, although the coefficients of determination were low and the explanatory power is limited, these results underscore the complexity of relationships among psychological variables, which are influenced by multiple factors. Age-related findings suggest that younger participants are more vulnerable to repetitive and self-critical thoughts, which can negatively impact their academic performance and psychological well-being. Given the strong association between rumination and various psychoeducational variables, it would be prudent to incorporate rumination assessment during the early semesters of university studies, considering its critical relevance to young people's mental health.

Additionally, higher rumination scores were observed among women, students exclusively dedicated to studying, and those enrolled in in-person programs. Therefore, it would be important to consider implementing targeted interventions for women to promote their psychological well-being. Likewise, the lack of complementary activities may be exacerbating rumination among those who exclusively focus on studying. Finally, it is essential to assess whether in-person learning has become a potential vulnerability factor due to the social and academic pressures experienced by young people after the pandemic, especially since most students currently prefer to attend in-person classes. Moreover, men obtained higher scores than women in both cognitive reappraisal and expressive suppression. Higher scores in both dimensions were also observed among students enrolled in in-person programs. In conclusion, the results confirm that the psychological variables studied are interrelated, and that students tend to use both emotional regulation strategies, each of which has only a minor effect on rumination. This highlights the need for further research on these dynamics within this specific student population.

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Urban Environment, Architecture, and Digital Fabrication Design

Hodological strategies for the regenerative activation of urban pre-hispanic archaeological monuments (MAPUs) in intermediate cities: The case of Huaca Chacupe, Chiclayo

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Introduction

In recent decades, intermediate Latin American cities have faced a series of structural challenges that include informal urban expansion, increasing spatial fragmentation, territorial exclusion, and a weak articulation between planning systems and the heritage values embedded in their territories (Zarlenga & Cortés, 2021; Badilla *et al.*, 2022). Within these contexts, Urban Pre-Hispanic Archaeological Monuments (MAPUs) represented a strategic opportunity to redefine the relationship between space, memory, and sustainability. However, these sites were relegated to the status of urban voids, lacking both functional and symbolic integration into neighborhood fabric, which favored their progressive deterioration and disconnection from the citizenry (Bassols i Gardella *et al.*, 2025).

In cities like Chiclayo, capital of the Lambayeque region, this phenomenon was exacerbated: 364 Pre-Hispanic Archaeological Monuments (MAPs) were registered by the Ministry of Culture of Peru, of which only one, Huaca Chacupe, is fully embedded within the urban fabric. These cultural assets are distributed in a fragmented manner, lacking landscape treatment, adequate accessibility, or community activation strategies. This situation generated an urgent need to construct intervention models that would integrate heritage as active cultural infrastructure. Consequently, their potential was recognized to function as nodes of neighborhood cohesion, platforms for intercultural education, axes for alternative mobility, and key components in sustainable urban regeneration processes (González, 2020; Carrasco Aparicio *et al.*, 2022).

Recent experiences in Latin America demonstrate that marginalized archaeological sites have the potential to be transformed into active spaces through an articulation of participatory processes, emerging spatial technologies, and regenerative planning strategies. Among the key methodologies are hodological analysis—which enables the reconstruction of historical flows and symbolic routes—fractal geometry—which is useful for interpreting spatial complexity—and collaborative mapping. These tools have facilitated the reinterpretation of the relationship between heritage and territory from a multiscalar perspective (Chen, 2021; Rossitti *et al.*, 2023; Rosado-González *et al.*, 2023).

Recent scientific literature in heritage urbanism and urban regeneration revealed that the bond between heritage and citizenship was strengthened when processes were led by local actors

through tactical strategies that were low-cost, highly adaptable, and employed accessible visualization tools and collaborative technologies. These experiences have been documented in Cuenca, Medellín, Quito, and Santa Marta, where archaeological heritage ceased to be a static object and became a multiscalar territorial resource, transversal to cultural, environmental, and mobility policies (UNESCO & WHITRAP, 2021; Hadj Kilani & Dhaher, 2024).

Aligned with these approaches, the present study incorporated the perspective of heritage from below, promoting a participatory, situated, and context-sensitive approach to territorial dynamics (Badilla *et al.*, 2022). The work was also framed within the principles of SDG 11, which establishes the need to ensure equitable access to urban cultural heritage, promote inclusive cities, and reduce spatial inequalities. In this sense, heritage was understood as infrastructure for community resilience, a symbolic and functional node within urban acupuncture networks (Cariello *et al.*, 2021).

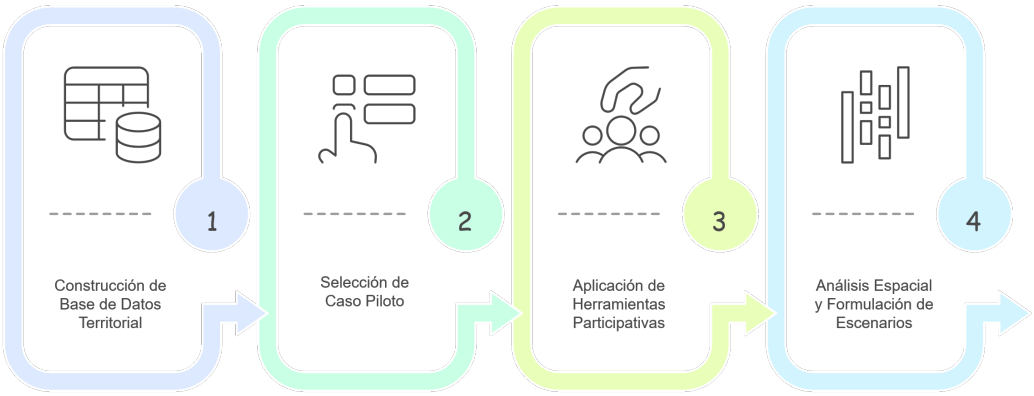
This chapter focused on the case of Huaca Chacupe, also known as Huaca César Vallejo, a monument located in the district of La Victoria. Despite its historical and spatial significance, this MAPU was found to be degraded, isolated from the neighborhood fabric, and excluded from institutional heritage enhancement agendas. Its selection responded to the interest in validating an integrative approach that employed participatory methodologies, spatial modeling, and environmental sustainability criteria. The study aimed to contribute to the construction of replicable tools for other intermediate cities in the country and across Latin America, positioning MAPUs as catalysts for regenerative processes and territorial justice.

Territorial Diagnosis and Regenerative Activation Strategy

This research was conducted under a qualitative, exploratory-applied approach, aimed at understanding and projecting regenerative activation strategies for Urban Pre-Hispanic Archaeological Monuments (MAPUs) in intermediate cities. The specific case of Huaca Chacupe was addressed through an interdisciplinary methodological perspective, combining tools from spatial analysis, social cartography, and participatory urban planning. Field and desk work were organized into four complementary phases, articulated sequentially to ensure methodological coherence and analytical depth.

The first phase involved the development of a territorial database based on the Geographic Information System for the Defense of Archaeological Heritage (SIGDA) of the Ministry of Culture of Peru. The 364 MAPs recorded in the metropolitan area of Chiclayo were identified and georeferenced using GIS software (QGIS 3.22). The variables considered included location, surface area, accessibility level, current use, presence of territorial conflicts, proximity to urban facilities, degree of visibility, and road connectivity. This processing allowed for the creation of density maps, functional overlays, and heritage connectivity analysis, following methodological guidelines proposed by Rossitti et al. (2023) and Sarihan (2021). Thematic layers were also generated to prioritize intervention areas and compare them with qualitative field data. To validate the quality of geospatial information, cross-checking techniques were used, including high-resolution satellite images and on-site verification at critical points.

Figure 1. Study methodology for the regenerative activation of MAPUs.



The second phase focused on selecting the pilot case. A hierarchized multicriteria analysis was carried out, combining weights assigned to objective criteria (population density, educational coverage, distance to healthcare facilities) and subjective criteria (community perception, real estate pressure). Huaca Chacupe was prioritized and its selection validated through semi-structured interviews with officials from the Ministry of Culture, municipal representatives, teachers, and neighborhood organizations, following ethical participation protocols. The combination of technical criteria and local demands reinforced the legitimacy of the case selection, in line with participatory cultural governance strategies described by Rosado-González et al. (2023) and Zarlenga & Cortés (2021). This phase also incorporated participatory weighting matrices that allowed for the contrast between technical prioritization and the symbolic values assigned by the community.

In the third phase, participatory tools for neighborhood diagnosis were applied. Three community workshops were held between April and May 2025, with the participation of residents, students, teachers, and local business owners. The techniques used included social cartography, interpretive walks, semi-structured interviews, and scenario prioritization. The data were systematized through thematic coding and axial analysis, incorporating participatory qualitative analysis methodologies as suggested by Bassols i Gardella et al. (2025) and Rosado-González et al. (2023). This phase made it possible to identify affective representations of the site, patterns of symbolic appropriation, and perceived exclusion factors, which were incorporated into the design of low-impact, reversible urban intervention proposals.

The fourth phase consisted of spatial analysis and the formulation of projective scenarios. A fractal analysis (box-counting) was applied to identify fragmentation patterns of the urban fabric, following the methodology of Chen (2021). Additionally, a visibility analysis (viewshed) and pedestrian connectivity analysis using spatial graphs were conducted to identify intervention nodes and potential neighborhood integration routes. These data were cross-referenced with qualitative information to formulate three intervention scenarios: minimal, intermediate, and

comprehensive. Each scenario was evaluated according to technical feasibility, environmental sustainability, and social legitimacy, using Delphi techniques adapted to the local context.

The comprehensive scenario, validated by participants, included the development of an eco-educational neighborhood corridor connected to the huaca, featuring landscape treatment, multifunctional zones, lightweight cultural equipment, interpretive signage, and symbolic appropriation programs. Finally, an evaluation matrix with social, environmental, and functional indicators was designed, based on methodological proposals by Hardoy et al. (2019) and Cariello et al. (2021). This matrix was conceived as a monitoring and shared management tool for mid-term impact tracking. Participatory monitoring mechanisms with neighborhood actors were established to ensure the institutional and community sustainability of the intervention model.

The results of the research revealed a structurally critical landscape regarding the condition of Pre-Hispanic Archaeological Monuments (MAPs) in the city of Chiclayo. The spatial analysis—based on the overlay of Geographic Information System layers for the Defense of Archaeological Heritage (SIGDA) and fieldwork data—confirmed that approximately 74% of the 364 registered MAPs exhibited signs of abandonment, alteration by informal uses, or functional disconnection from the immediate urban environment. This situation aligns with recent studies highlighting the structural lag of urban archaeological heritage in the face of rapid urbanization processes (UNESCO & WHITRAP, 2021; Zarlenga & Cortés, 2021).

The case of Huaca Chacupe, selected as the pilot site for its location within a consolidated urban fabric, presented multiple conditions of physical degradation. Observations included significant solid waste accumulation, obstructed access points, makeshift perimeter walls, low vegetation cover, and limited visibility from surrounding areas. The visibility (viewshed) analysis showed that the monument was only perceptible within a 45-meter radius, obstructed by built elements that hindered its spatial legibility, as emphasized in studies on tangible heritage visibility (Sarihan, 2021; Morales et al., 2023).

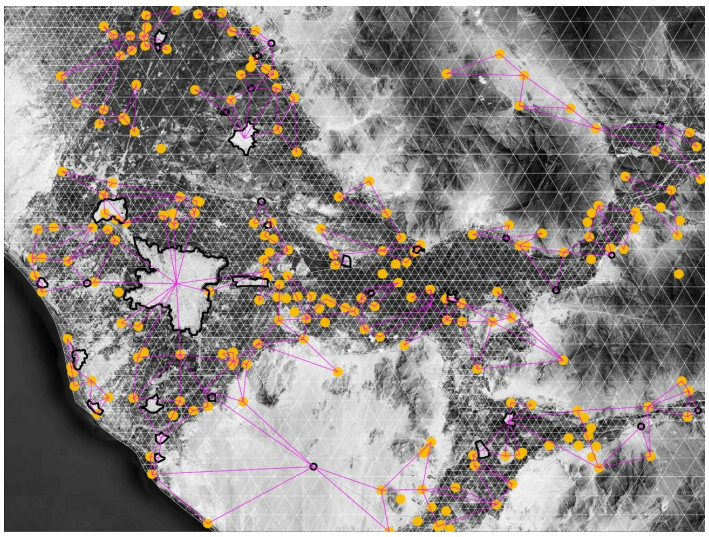


Figure 2. Triangulation of pre-Hispanic archaeological monuments in the Lambayeque Region

Figure 3. Triangulation of urban huacas in the three districts of Chiclayo, José Leonardo Ortiz and La Victoria. Balarezo et al. 2022

During participatory workshops with residents, shopkeepers, students, and teachers, a marked disconnection emerged between the site's symbolic value and its everyday use. While 89% of participants recognized the existence of the huaca, only 31% had visited or passed by the site in the previous month. Affective maps created during participatory sessions revealed perceptions linked to abandonment, insecurity, and lack of infrastructure. However, narratives also emerged regarding neighborhood memory, childhood play, and proposals to reclaim the space through cultural initiatives such as community libraries or heritage interpretation centers, as reported by Bassols i Gardella et al. (2025) and Rosado-González et al. (2023).

The fractal analysis applied to the surrounding urban morphology revealed high spatial fragmentation, with a prevalence of residual micro-plots and underutilized urban voids. This configuration was interpreted as an opportunity to design neighborhood integration corridors by leveraging existing secondary routes, proximity to schools, and the local pedestrian network. Following the frameworks of Chen (2021) and Rossitti et al. (2023), three urban intervention scenarios were formulated: minimal (spot accessibility improvements), intermediate (landscape recovery and basic amenities), and integral (complete transformation of the site into a neighborhood eco-educational hub).

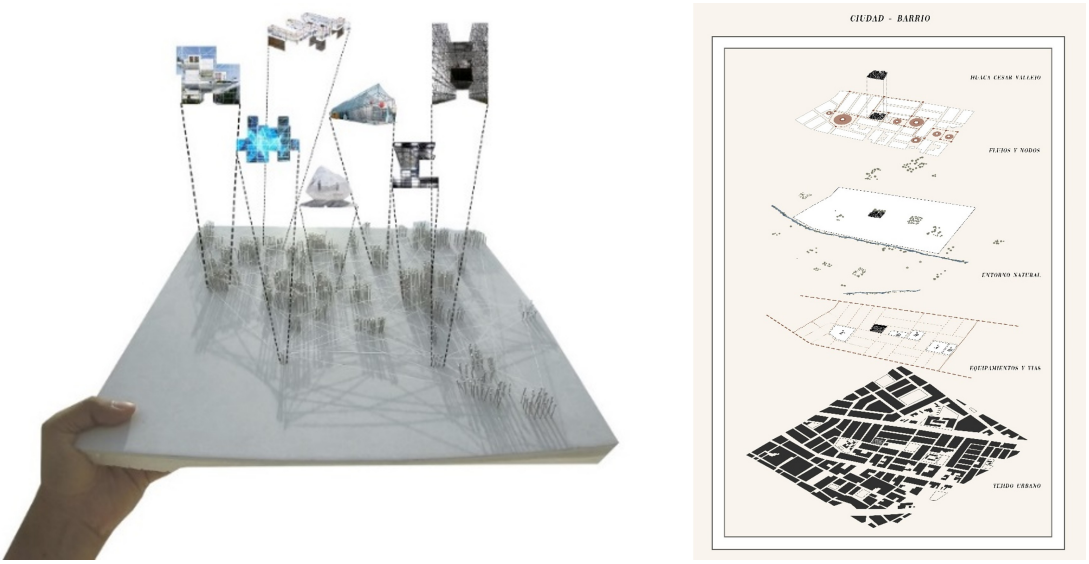


Figure 4. Model of project strategies in Chiclayo - Project readings of the urban fabric where the Huaca Chacupe is located in La Victoria, Chiclayo. Carrasco et al. 2022.

The integral scenario—validated through collective consensus—envisioned landscape recovery of the huaca, implementation of low-impact urban furniture, multifunctional spaces for civic engagement, interpretative signage, and cultural activation programs. Spatial projections for the integral scenario estimated a 23% increase in green coverage within a 400-meter radius and a 38% improvement in pedestrian connectivity to essential services. Additionally, a significant reduction in nighttime insecurity perception was modeled, aligning with studies linking urban visibility and spatial perception (Sánchez Martínez & Aguilar, 2020; Morales et al., 2023).

Finally, a participatory monitoring matrix was developed, encompassing five key dimensions: accessibility, visibility, social use, symbolic appropriation, and environmental perception. This matrix—validated with community actors and local technicians—was conceived as a collaborative monitoring tool to facilitate social oversight, ongoing evaluation, and institutional sustainability of the MAPU activation process. Its design drew from previous participatory evaluation methodologies applied to similar urban interventions in Latin America (Hardoy et al., 2019; Cariello et al., 2021).

The findings derived from the study of Huaca Chacupe allowed for a contrast with various contemporary approaches to urban heritage, spatial regeneration, and citizen participation in intermediate Latin American cities. First, the patterns of territorial exclusion detected—both physical and symbolic—revealed a structural disconnection between archaeological sites and contemporary urban dynamics, as thoroughly documented by Sarihan (2021) in her analysis of visibility and heritage planning.

The use of tools such as fractal analysis and viewshed analysis made it possible to identify material conditions of invisibilization and urban fragmentation, in line with the methodological proposals of Chen (2021) and Kilani & Dhaher (2024). These methodologies helped expose the existence of "blind zones" in the urban fabric, where heritage is relegated to physical and cognitive marginality. Thus, it was reaffirmed that territorial fragmentation is not only a morphological issue but also a manifestation of symbolic exclusion, as previously suggested by Cariello et al. (2021).

The review of documented cases in intermediate cities such as Cuenca, Santa Marta, and Medellín—where urban regeneration was driven by participatory heritage-based processes—reinforces the hypothesis that neighborhood memory and local practices are decisive in the re-signification of these spaces (UNESCO & WHITRAP, 2021; Rosado-González et al., 2023). These examples demonstrate how heritage can shift from being a protected and distant asset to becoming an active cultural infrastructure when processes are led or co-produced by communities.

Likewise, the affective cartographies and collaborative mapping techniques used in this study have been supported by research such as that of Rossitti et al. (2023) and Bassols i Gardella et al. (2025), who highlight the epistemic value of situated knowledge and unconventional territorial representations. These tools contributed to capturing the emotional and symbolic dimensions of territory, which are usually omitted by conventional technical planning.

From a methodological perspective, scenario planning proved suitable for integrating the inherent uncertainties of urban processes with a participatory, forward-looking approach. This approach has been advocated by Zarlenga & Cortés (2021), who argue that heritage environments require reversible and adaptive interventions to avoid processes of exclusionary tourism or cultural gentrification.

The concept of urban heritage resilience also emerged during the diagnostic and participatory formulation process, recognizing communities' capacity to reinterpret and reactivate the values assigned to heritage. This perspective is supported by González (2020) and Hardoy et al. (2019), who argue that urban resilience cannot be separated from the recognition of historical, identity-based, and functional connections with the territory.

Furthermore, the project model based on tactical urbanism allowed for a progressive and contextual logic of operation, using minimal resources while generating significant symbolic impact—particularly in contexts with institutional or budgetary constraints. As noted by Cariello et al. (2021), such low-cost interventions are replicable, context-sensitive, and effective in fostering civic appropriation of heritage spaces.

In sum, the articulation between spatial analysis, community participation, and context-sensitive methodologies reaffirmed the need to address heritage through an integrated, multi-scalar, and situated lens. The experience around Huaca Chacupe shows that MAPUs can be reconfigured as strategic nodes in regenerative urban networks, where memory, sustainability, and citizenship interact dynamically and territorially.

Conclusions

The results of this study confirmed the strategic value of Pre-Hispanic Urban Archaeological Monuments (MAPUs) as active cultural infrastructure within intermediate cities of Latin America. Through the case analysis of Huaca Chacupe, it was demonstrated that these spaces, when addressed through participatory, multi-scalar, and technically rigorous methodologies, can transition from urban voids to functional nodes of territorial articulation, social cohesion, and symbolic regeneration.

The methodological approach integrated spatial analysis tools (such as fractal and visibility analysis), affective cartographies, and structured citizen participation techniques, enabling a complex reading of the urban environment. This methodological combination facilitated a sensitive territorial understanding based on both quantitative and qualitative data, validating claims made by Chen (2021), Cariello et al. (2021), and Rosado-González et al. (2023) regarding the potential of hybrid tools in heritage contexts.

The benefits derived from the proposed model were multiple: projected improvements were observed in pedestrian connectivity, perceived safety, vegetation coverage, and symbolic appropriation. These findings support the hypothesis that MAPUs can serve as catalysts for sustainable urban transformation, especially when integrated with policies on active mobility, public space, and heritage education. This regenerative capacity is enhanced when communities are involved in all stages of the process, as suggested by Bassols i Gardella et al. (2025) and Hardoy et al. (2019).

However, the research also revealed persistent institutional obstacles. Regulatory fragmentation, weak coordination among levels of government, and a lack of targeted funding for urban heritage enhancement represent structural barriers that limit the sustainability of such interventions. This void aligns with the issues identified by Zarlenga & Cortés (2021), who advocate for more integrative, horizontal, and adaptive models of cultural governance.

In response, it is proposed that the urban development plans of intermediate cities structurally incorporate the activation of MAPUs through operational tools such as participatory monitoring matrices, scenario planning, and the design of eco-educational corridors. These strategies, being flexible and adaptable, facilitate the development of public policies with greater territorial sensitivity and cross-cutting heritage perspectives.

It is also recommended to update legal frameworks to recognize the dual nature of these spaces—as protected heritage and as community-use infrastructure. For this, it is crucial to include MAPUs in public investment catalogs and to design mechanisms that incentivize citizen co-management and institutional co-responsibility.

Finally, the study underscores the importance of continuing longitudinal research to assess the socio-spatial impacts of these strategies, as well as fostering exchange networks among intermediate cities in Latin America facing similar challenges. In this framework, MAPUs can be consolidated as articulators between memory, citizenship, and sustainability, strengthening processes of spatial justice, urban identity, and community resilience.

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From Lines to Structures: A Process of Digital Fabrication

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This text arises from the course on Design "Rapid Prototyping" of the Catholic University of Temuco. We gratefully acknowledge the Design program at Universidad Católica de Temuco for the financial support provided for the implementation of this course. Special thanks are extended to Professor Daniela Gaete Fontirroig for her trust in the Design students and for involving them as developers in her project.

Introduction

Large span structures are architectural and engineering systems characterized by their ability to cover expansive areas without intermediate supports. The evolution of large span construction reflects a continuous interplay between structural innovation, material development, and architectural expression. Advances in reinforced concrete, steel, and tensile materials enabled engineers and architects such as Pier Luigi Nervi (Nervi, 1966), Buckminster Fuller (Fuller, 1983), and Frei Otto (Glaeser, 1972) to explore new structural forms. Their work focused on achieving large spans with minimal material use through shape optimization, the development of grid and space frame structures, and the exploration of surface geometries of various curvature classes. These innovations also extended to bar and node systems, contributing to a broader understanding of lightweight and efficient structural assemblies. A common issue in structural systems lies in the solution of the node, the element that connects components of varying geometries and materials. Nodes must provide both degrees of freedom to accommodate geometric complexity and rigidity to resist structural loads. Although bar and node structures are not new, as demonstrated by the pioneering work of Anthony Michel in material optimization (Sarkisian *et al.*, 2012), Emilio Pérez Piñero's foldable bar structures and domes (Peña *et al.*, 2023; Castañón & Ramos, 2023), and Buckminster Fuller's geodesic systems (Calladine, 1978), digital fabrication technologies such as additive manufacturing (FDM) and photopolymerization-based processes have introduced new avenues for their material realization.

Moreover, the integration of generative programming (Abdelmohsen & Massoud, 2021; Agirbas, 2018; Alalouch, 2018) enables the design of structurally coherent and formally complex components under a unified computational logic. This intersection of digital fabrication (Bao, Yan & Xie, 2022) and generative design (Cudzik & Radziszewski, 2019) reactivates the pedagogical potential of nodal structures in architectural and design education. This triad comprising bar and node structural systems for spanning large distances, generative design via node-based programming capable of resolving all junctions where structural members share a common origin or endpoint, and digital fabrication that enables the production of diverse geometries within each manufacturing series bar and node assemblies represent a revisitable design strategy. This framework offers a fertile ground for fostering creativity among undergraduate design students and supports the development of novel spatial configurations.

Within this design challenge, the Rapid Prototyping course, offered in the sixth semester of the Design program in the Catholic University of Temuco, has undertaken two approaches aimed at exploring a range of spatial and formal solutions as an initial exploratory engagement with bar-and-node structural systems.

Thirty-one students from the Design program, all of whom had successfully completed the prerequisite courses in the representation track, participated in the activity. As a result, they possessed a foundational knowledge of both 2D and 3D software essential for the development of the project.

The aim of this pedagogical experiment was to introduce students to nodal structural systems through a hands-on and computational exploration of bar-and-node assemblies (Garcia-Alvarado *et al.*, 2022; Jenny *et al.*, 2022). Two complementary methodological strategies were employed:

Top-Down Approach: Students engaged with known geometries, such as Platonic solids and other polyhedra. They identified edges and intersection points to generate custom nodes using parametric design tools.

Bottom-Up Approach: Students generated freeform spatial lines based on intuitive sketches. These were computationally interpreted through generative scripts, allowing connections to be translated into structural nodes.

For each of these approaches, a node-based script (Livesu *et al.*, 2017; Tedeschi, & Lombardi, 2018) was developed in Grasshopper 3D and subsequently reconstructed by the students under the supervision of the instructor. Prior to this, a general introduction to the Grasshopper 3D visual programming environment was provided, covering the interface, the logic of the graphical language, and its operational principles. It is important to note that this was the students' first exposure to this type of graphical programming, which inherently demands a deeper understanding of geometric generation. Figure 1 displays the resulting node diagram from the initial script developed by Professor Maximiliano Milla. In this example, input to the software requires lines with explicitly defined angles between them in order to generate specific solids predetermined by the instructor. These include a pentagonal-based pyramid, a hypercube, a square-based pyramid, and other regular geometric configurations.

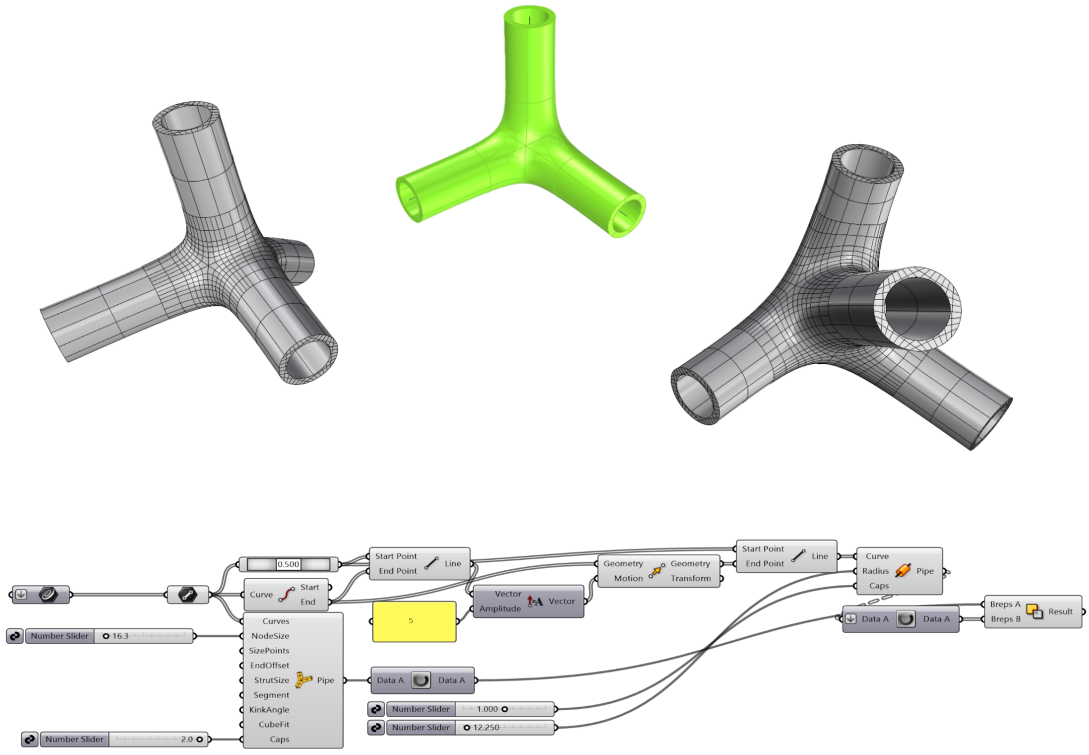


Figure 1. Node-based programming script developed by designer and Professor Maximiliano Milla requires highly precise input data to enable accurate three-dimensional geometric generation.

In the second phase, the class engaged in an open-ended exploration. As shown in Figure 2, Professor Luis García guided students through the Grasshopper 3D online forums, analyzing search results related to structural nodes, joints, and parametric connections. Multiple examples were reviewed and downloaded until the class selected a viable candidate for further development. The instructor executed the chosen script—originally authored by another user—by installing the necessary plugins and collaboratively examining its structure. The programming was then extended to meet the objectives of the exercise: generating manufacturable nodes compatible with a predefined dowel radius, thus allowing for physical prototyping and testing.

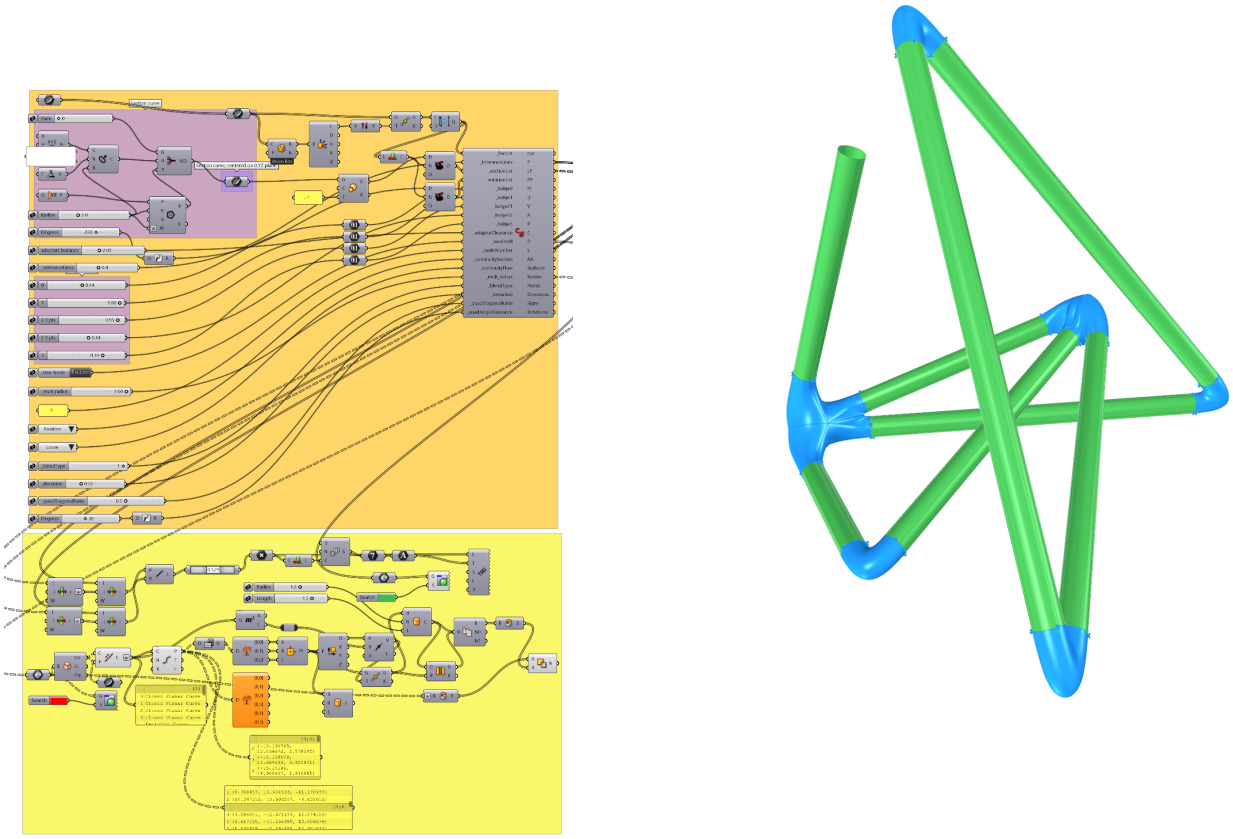


Figure 2. In orange box the node based programming script downloaded from Grasshopper 3D repository, originally developed by Laurent Delrieu. The yellow box displays the second phase of the parametric programming developed by Professor Luis García.

In both methods, standard 10 mm dowels were used as bars, while the nodes were produced via FDM 3D printing using PLA filament. This provided a consistent structural language and allowed for the exploration of node customization in response to varying geometrical constraints.

Results of Tools and Workflow Implementation

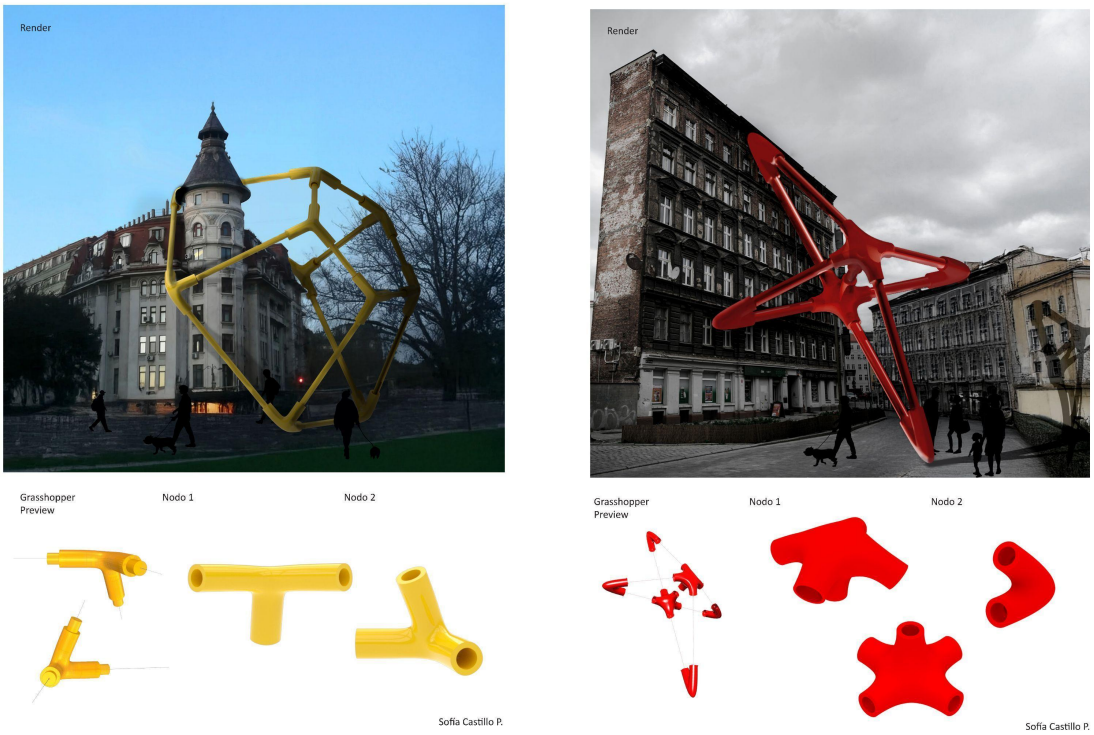
Over the course of a four-week intensive workshop, students were trained in parametric and generative design software (Rhinoceros and Grasshopper), as well as digital fabrication techniques and visualization strategies. Each student produced:

Two physical structural prototype, platonic solid and free form

An annotated panel explaining their process containing:

A digital rendering visualizing speculative or practical applications of the structure. Figure 3 & Figure 4.

Nodes resume defined in grasshoppers logics. Bottom of Figure 3 & Figure 4.



Figures 3 and 4. Imagery conceptualized by student Sofía Castillo.

The workshop concluded with a public exhibition in the main atrium of the Design School at San Juan Pablo II campus, making the outcomes accessible to the broader university community. In Figure 5, 6 & 7 the general final exhibition for the faculty community.

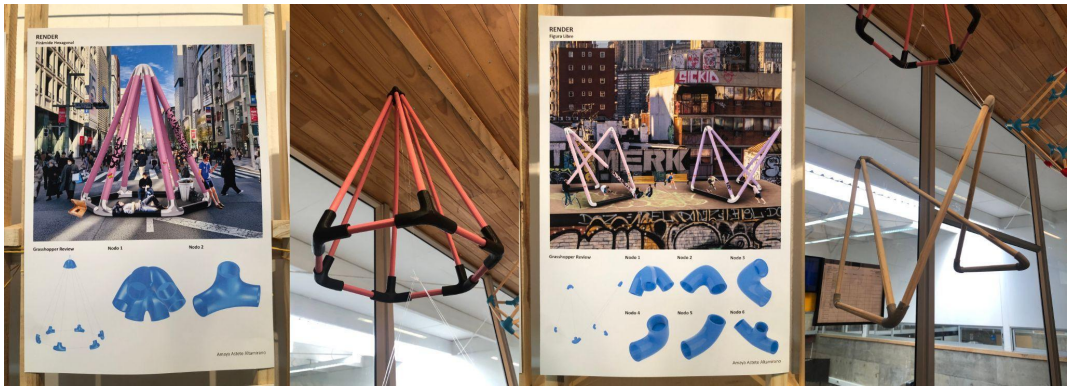


Figure 5. Image of the installation created by student Amaya Astete. From left to right, it shows the conceptual imagery and the fabricated pyramid, followed by the conceptual imagery and the fabricated freeform figure.

Figure 6. Faculty of Information Sciences, headquarters of the chair of content and media analysis.

Figure 7. Faculty of Information Sciences, headquarters of the chair of content and media analysis.

The project revealed students' active understanding of computational design in relation to the materialization of structural systems. Key outcomes included:

The exercise fostered a comprehensive understanding of the material behavior of PLA and its technical limitations within layer based fabrication processes. It strengthened the connection between digital modeling and physical realization, reinforcing design to fabrication workflows. Students developed customized nodes using visual programming, enabling structurally unique yet logically repeatable configurations. The process also encouraged interdisciplinary dialogue, integrating geometric reasoning, creative interpretation, and fabrication knowledge into a cohesive design methodology. The public exhibition amplified the pedagogical value of the

process, sparking interest in replicating or adapting the methodology for other academic and exhibition contexts.

Additionally, two student pairs continued the work by addressing a request from the Director of the Visual Arts program at the university. Professor and artist Daniela Gaete Fontirroig commissioned the development and prototyping of nodes for the solid proposed by Dürer in his *Melencolia I* (1514). One pair determined the node shapes based on information from the unfolded solid, while the pair composed of Victor and Llanquiman derived the forms directly by subtracting from the three-dimensional solid. Figures 8, 9, and 10 depict the exhibition organized by the Professor during her artistic residency at Exabrupto, Moia, Barcelona. Titulada *Incubar Paisaje* (2025).

Figure 8. General view of the art exhibition held by Professor Daniela Gaete Fontirroig (2025).

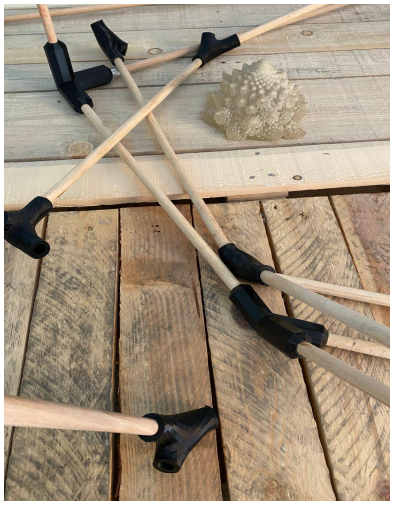


Figure 9. Detailed image of the nodes exhibited in the art show curated by Professor Daniela Gaete Fontirroig (2025).

Figure 10. Detailed image of the nodes exhibited in the art show curated by Professor Daniela Gaete Fontirroig (2025).

Conclusion and Future Research

This educational experience demonstrates how computational design, digital fabrication, and geometric logic can be intertwined in a pedagogical setting. By focusing on the resolution of the structural node, students not only addressed a core technical challenge in architectural design, but also engaged in a process that fostered creativity, customization, and material experimentation. The integration of FDM 3D printing with generative scripting provided a scalable and replicable method for exploring complex spatial systems, positioning the node as both a technical component and a creative catalyst in the design process.

This approach introduces a process that leverages node-based programming to revise and extend the theoretical foundations of large-span structural systems. It enhances the flexibility of connector design while increasing the speed and efficiency of 3D modeling through software-driven logic. In essence, by combining basic geometric inputs within Euclidean space with computational programming and additive manufacturing techniques, these prototypes enable the realization of free-form structural systems at scale.

As future work, this research highlights the potential for scaling up by introducing post-processing techniques for the nodes such as casting in ferrous materials, which would enable the fabrication of larger structures capable of supporting real world loads. This progression also opens the possibility of integrating digital processes such as finite element analysis and deformation simulations to optimize the final structural form.

We are also pleased for the opportunity where students were able to engage in direct collaboration with the discipline of visual arts, thereby validating the knowledge acquired in the course and expanding the scope and impact of their learning.

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Business Innovation, Economy, and Productive Sectors

Entrepreneurial Innovation in the Age of Artificial Intelligence: New Routes to Competitive Productivity for Latin America

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This text arises within the framework of a project by the Corporación Universitaria de Asturias: "Strategies for strengthening SMEs with a focus on circular economy in the Atlántico department."

Introduction

In recent decades, Artificial Intelligence (AI) has changed the ways entrepreneurial ventures design and execute their strategies, marking an evolution towards more dynamic, adaptive, and data-driven models (Brynjolfsson & McAfee, 2017). This process occurs in a context of accelerated digital transformation, where entrepreneurs must respond to complex and competitive markets, using technologies such as machine learning, natural language processing, and predictive analytics to develop value propositions adjusted to contemporary demands (Davenport & Ronanki, 2018).

The early adoption of AI allows entrepreneurial ventures to automate processes, manage information more efficiently, and design user-focused solutions. Iansiti and Lakhani (2020) point out that organizations integrating AI from their inception tend to consolidate as digitally intensive businesses. This integration affects organizational culture and redefines labor dynamics. Data-driven personalization improves customer experience, fosters user loyalty, and strengthens competitive positioning (Rust, 2020), while facilitating strategic decisions based on simulations and multivariate analysis (Shrestha *et al.*, 2019).

AI has become accessible to small and medium-sized enterprises thanks to tools like bots, recommendation systems, and analytics platforms. This phenomenon creates an environment where innovation is more widely distributed (Mikalef *et al.,* 2019). Operationally, automation frees up resources for creative tasks, and adaptive systems allow for timely responses to market changes (Bughin et al., 2018). The convergence of AI with technologies like IoT, cloud computing, and augmented reality expands scalability options (Lee & Trimi, 2018).

The impact also extends to the economic and social environment. Models such as algorithmic e-commerce or on-demand services reconfigure employment, production, and regulation (Floridi *et al.,* 2018). AI transforms management logic towards more adaptive and agile models (Jarrahi, 2018), while business value is redefined based on experience, knowledge, and collaborative networks (Porter & Heppelmann, 2015). This transformation is especially relevant for ventures in early stages, where experimentation is constant (Blank, 2013).

In Latin America, entrepreneurial ventures face digital divides and structural limitations, but also find opportunities associated with diverse contexts, emerging talents, and transforming markets

(Cano-Kollmann *et al.*, 2016). Recent research strengthens this view. Gindert and Müller (2024) show that AI improves the quality and diversity of ideas in innovation teams. Holzner *et al.* (2025) conclude that those who collaborate with AI outperform those who work in isolation, although they warn about a possible loss of creative diversity due to excessive reliance on automated suggestions. Park, Kim, and Lee (2025) demonstrate that LLMs enrich entrepreneurial education, although they may affect argumentative thinking. Winkler et al. (2023) suggest reviewing pedagogical frameworks given the ethical challenges posed by AI. Alshater et al. (2025) highlight the impact of AI on startup creation, automation, and service personalization. Kusetogullari et al. (2025) identify five key research areas: digitalization, AI-assisted education, sustainable innovation, algorithmic business models and data-driven trends, and point out gaps in regulation and governance.

Mariani and Dwivedi (2024) warn that AI redefines product design, intellectual property, and companies' internal capabilities. Tran and Murphy (2023) indicate that AI facilitates low-cost content creation, democratizing access to innovation. In Latin America, Álvarez-Maldonado et al. (2024) document that AI reduces entry barriers, automates decisions, and lowers costs. In turn, programs promoted by Adigital, BID Lab, and Pro Mujer articulate training, financing, and technological ethics in boosting regional entrepreneurial ventures.

Despite these advancements, gaps persist regarding macroeconomic impact, long-term sustainability, and regulatory frameworks. Research in English focuses on technical capabilities, while in the Spanish-speaking world, rigorous evaluations of the real scope of these transformations are lacking. The need for longitudinal, comparative, and interdisciplinary studies is constant to more broadly understand the effects of AI on entrepreneurship. This chapter aims to analyze how technological innovation, driven by artificial intelligence, is transforming business models and opening new routes to competitiveness for contemporary entrepreneurial ventures (Álvarez-Maldonado *et al.*, 2024). The analytical focus is on optimization, personalization, anticipation, and decision-making processes enabled by AI, addressing both its technical and organizational implications, based on current theoretical frameworks and recent empirical evidence.

The research was conducted with a qualitative approach, focused on understanding how entrepreneurial ventures in Latin America integrate artificial intelligence into their operations. Ten cases were studied, selected for their sectoral diversity and level of technological adoption, including areas such as health, education, agro-industry, and financial services. Data collection was primarily carried out through semi-structured interviews with founders and innovation leaders. These interviews explored the motivations behind the implementation of AI, the stages of integration, the types of resources mobilized, and the transformations observed in the respective business models. Each interview was conducted virtually, with the consent of the participants, and lasted between 45 and 60 minutes. The conversations were audio-recorded, fully transcribed, and subsequently subjected to thematic analysis to identify recurrent patterns, differences across sectors, and emergent insights regarding the role of AI in entrepreneurial adaptation and strategic development. The use of semi-structured interviews allowed for a balance between consistency in core questions and openness to participant-driven elaboration, enriching the depth and contextuality of the findings.

The case study is constructed by combining academic knowledge with refracted reality (Lippmann, 2003) broadcast by the media. It is observed that the contents of blockchain technologies have more presence in the media than other technologies, such as AI, Big Data, and Cloud computing, among others. On the other hand, the results show that the information published in the media about blockchain is aimed at disseminating and generating debates about socio-technical and sustainable societal transitions. The news analysed does not delve into specific technical aspects related to platforms, protocols, software/hardware, technical specifications, etc.

Internal Transformations from AI Implementation

The research identified multiple internal transformations that emerged from the implementation of artificial intelligence tools in the ten selected Latin American ventures. Each exhibited unique dynamics depending on the sector, the timing of technological adoption, and the strategic objectives pursued by their management teams. This demonstrates that the process of AI integration does not conform to a uniform model but rather expresses itself in a situated manner, articulating technical capabilities, organizational decisions, and specific operational contexts.

Analytical and Sectoral Applications of AI

At the same time, artificial intelligence solutions were applied to tasks requiring more complex analytical capabilities. For example, a company dedicated to interpreting medical images used automatic classification algorithms, developed from a supervised learning model with local data. This accelerated preliminary diagnosis times without displacing the role of the medical professional, but rather acting as a supporting tool that organized and prioritized clinical review. This was perceived by the health team as an improvement in service quality and technical work efficiency. In another experience, an educational platform employed recommendation systems based on users' learning history to offer personalized content paths, adjusted to their pace of progress, common errors, and individual achievements. This generated a distinct interaction dynamic between the platform and its users, who perceived greater support and content adaptation, reflected in an increased course completion rate and a sustained increase in time spent on the platform. The development team attributed this phenomenon not only to content personalization but also to the system's ability to offer immediate feedback and alternative suggestions for recurring errors.

Logistics Optimization and Consumer Behavior Projection

In terms of logistics and mobility, a company in this sector implemented prediction models that integrated real-time information on traffic, weather conditions, and historical delivery patterns. This allowed for optimizing routes, reducing travel times, and improving resource allocation, especially during peak demand periods. This generated positive impacts on operational planning, customer perception of the service, and the stability of commercial relationships with large distributors, who valued the system's precision and adaptability as an added value compared to competitors without similar tools. In parallel, companies in sectors such as fashion, e-commerce, and agro-industry integrated artificial intelligence solutions to anticipate trends, segment audiences, adjust inventories, and project consumer behavior scenarios. This enabled

new ways of understanding the environment and facilitated data-driven decision-making based on possible scenarios rather than intuition or past experiences. Several interviewees pointed to this as a significant change in organizational culture, shifting the weight from individual experience to systems that provided systematic indicators, although this also generated resistance in some teams who felt displaced or challenged by automated decisions.

Changes in Organizational Decision-Making

Regarding the second analytical axis, which corresponds to changes in organizational decision-making, it was observed that the incorporation of artificial intelligence was accompanied by a transformation in management tools, evaluation criteria, and response times to different environmental situations. Intelligent systems offered not only processed information but also dynamic visualizations that facilitated joint understanding across areas, allowed for scenario simulation, and anticipated possible consequences of certain decisions. In several cases, this helped reduce uncertainty and better align tactical actions with strategic objectives, although this implied a deep review of internal information flows and the roles assigned to different hierarchical levels. The availability of real-time data demanded faster responses, less dependent on successive approvals, and more open to experimentation and continuous adjustment, which was sometimes perceived as additional pressure by intermediate teams, accustomed to more stable dynamics and longer decision cycles.

Performance Automation and Managerial Digital Competencies

In at least four cases, automated performance evaluation systems were implemented that incorporated variables such as productivity, goal achievement, response times, and perceived quality by users. This allowed for the construction of more objective metrics but also generated internal debates within organizations regarding valuation criteria, error margins, and the role that human supervision should play vis-à-vis the results offered by algorithms, especially in contexts where labor relations were sensitive or when the team's room for maneuver was conditioned by structural factors, such as lack of resources or technological limitations.

Reconfiguration of External and Institutional Relationships

The third axis of analysis focused on the transformations that AI generated in the relationship with external stakeholders, especially clients, suppliers, and public institutions, since the introduction of these technologies modified both the perception and the daily interaction with the services offered by the ventures. In several cases, improvements were observed in product personalization, response speed, and the adaptation of services to changing public needs, which led to an increase in loyalty levels, frequency of use, and positive feedback expressed on digital platforms. However, tensions also arose related to algorithm transparency, personal data protection, and excessive expectations that some users placed on automated systems, especially when these were presented as infallible solutions or mechanisms capable of replacing human attention in all cases.

AI, Technological Governance, and Trust Frameworks

In terms of links with suppliers, the implementation of predictive models and data analysis systems allowed for improved logistics coordination, adjusted delivery times, and established more flexible agreements based on demand projections and future scenarios. This was valued as an improvement in efficiency and mutual trust, although it also implied a renegotiation of acceptable error margins and a review of contracts to incorporate clauses recognizing the use of automated tools in planning and monitoring processes. In the case of relationships with public institutions, experiences were documented where AI systems facilitated report generation, evidence systematization, and compliance with quality standards required to obtain certifications or access public funds. This positioned entrepreneurial ventures as more reliable and technologically prepared actors, opening new possibilities for articulation with financing bodies, regulatory entities, or innovation support programs. In this sense, some ventures initiated processes of reviewing their terms and conditions, designing best practice manuals, or incorporating technology ethics committees to ensure that the implementation of artificial intelligence was aligned with principles of transparency, accountability, and respect for user rights, recognizing that trust is a strategic value that can be strengthened or weakened depending on how the use of these technologies is communicated, regulated, and contextualized within the offered service experience.

Conclusions

The findings show that artificial intelligence allows entrepreneurial ventures to automate tasks, make data-driven decisions, and design user-oriented proposals. This capability drives more agile, adaptable, and sustainable business models. The studied experiences demonstrate that AI adoption is viable even in companies with limited resources, facilitating innovation and growth processes. The analysis reflects that the incorporation of artificial intelligence modifies organizational structures by fostering a culture focused on continuous learning, strategic thinking, and the responsible use of emerging technologies.

In the Latin American context, challenges related to technological infrastructure and digital equity exist, although opportunities also arise to adapt solutions to local realities and generate impact. The study helps understand how AI can be integrated into entrepreneurial ecosystems as a technical, organizational, and formative resource. It highlights the need to strengthen alliances among public, private, and academic sectors to facilitate technological adoption, promote digital competencies, and support entrepreneurial ventures in their consolidation process.

This research is limited by the size and geographic scope of the sample, as it focuses on a small number of cases within selected countries in Latin America. Future studies could expand the comparative perspective across regions, explore longitudinal impacts of AI integration, and analyze the role of gender, education, or policy frameworks in shaping adoption dynamics. Deeper investigation into ethical implications and user experience design in AI-driven ventures also presents a relevant path for continued inquiry.

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Data-Driven Strategic Decisions: Decision Trees in Business

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Introduction

The rise of open data, digital transformation processes, and innovation in current contexts requires adaptive strategies for information analysis and decision-making. This is particularly relevant in environments where technological trends, open data, and advanced analytics enable companies to make informed decisions based on a sound understanding of information and data analysis, in pursuit of the most effective solutions to business situations, regardless of their purpose, product, or service offering. (García *et al.*, 2022) highlight the importance of data usage, stating that it becomes a differentiating factor and a key element in the business environment. In this regard, data mining and Business Intelligence (BI) tools are fundamental components in the decision-making process.

Within data mining, decision trees are highly relevant due to their ability to simplify complex data through visual representation, which allows for easier comprehension. (Han *et al*, 2011) emphasize that decision trees, in addition to enabling the classification and prediction of outcomes, facilitate the identification of key patterns and relationships within datasets. This is particularly useful in scenarios were anticipating trends and making data-driven decisions are necessary to sustain business growth and continuity.

The structure of decision trees, through their various components, can be applied in real-life contexts, considering both their applicability and relevance to specific use cases. This study aims to integrate theoretical foundations and practical applications through the simulation of real-world scenarios, making it possible to demonstrate the strategic value of decision trees as a predictive analysis tool in various sectoral contexts.

Theoretical Framework

Nowadays, due to the high volumes of information, access to open data, data stored in corporate databases, and the collection of data from social networks, it is essential for organizations to adopt tools that enable efficient data analysis to make informed decisions. For this reason, Business Intelligence (BI) requires a strategic approach to data analysis and interpretation. It is precisely in this context that decision trees stand out, given their capacity to simplify complex problems in a straightforward and comprehensible manner.

The hierarchical visualization of decision trees—comprising a root node, internal nodes, branches, and terminal leaves—enables the logical breakdown of each process in an easily understandable manner. According to (IBM, n.d.), this type of structure facilitates a clear

understanding for those within the organisation who interpret the decision tree, ensuring confidence in the results and strengthening the decision-making process. It allows for the analysis of both qualitative and quantitative data, with applications across various industries. As noted by (TecScience, 2021), decision trees employ the "If-Then" strategy for decision-making, which helps map the pathway data follows to conclude, contributing significantly to the transparency of the analysis.

Moreover, their capacity to integrate with advanced technologies, such as machine learning algorithms and visualisation tools, enables real-time data analysis and the ability to respond to market changes. This is particularly relevant in scenarios such as inventory management and demand forecasting, where decision trees facilitate resource optimization and the reduction of operational costs. (IBM, n.d.). The structure of a decision tree and its components is presented below: it begins with the root, includes key nodes, and branches that detail the subdivisions considered within each node.

Given that decision trees are visual tools that allow data to be divided into categories to predict outcomes, it is relevant to highlight that their applicability depends on the nature of the data. Below are the types of trees, each accompanied by an example of their application in business contexts. The types of decision trees are Classification Trees, Regression Trees, Entropy - Based Trees and Stochastic Trees.

A mixed-methods approach was employed, integrating documentary review with the analysis of practical case studies. Theoretical concepts were addressed from the perspectives of data mining, Business Intelligence, and predictive analytics. Based on this, the main types of decision trees were classified and exemplified: classification trees, regression trees, entropy-based trees, and stochastic trees. The practical component was developed through representative case studies in key sectors, including banking, e-commerce, healthcare, hospitality, and logistics.

Document selection criteria: peer-reviewed sources from indexed databases (e.g., IEEE Xplore, ScienceDirect), publication years 2014–2025, relevance to decision trees in Business Intelligence or predictive analytics, and availability in English or Spanish; exclusions included non-peer-reviewed materials, duplicated studies, and sources without methodological transparency.

Case study selection criteria: sectoral relevance (banking, e-commerce, healthcare, hospitality, logistics), clear definition of decision variable and outcome metric, feasibility of variable simulation aligned with CART structures, and replicability of the scenario; cases were prioritized when they illustrated distinct tree types (classification, regression, entropy-based, stochastic).

Literature Review

The literature review conducted for this research focuses on the most relevant contributions from the last five years in the field of decision trees applied to Business Intelligence and Predictive Analytics. Both Spanish and English sources were included, ensuring a comprehensive and multicultural perspective. The selection prioritized peer-reviewed books and scientific publications from recognized publishers such as Springer, as well as reputable academic repositories. Table 1 summarizes the key works, their context of application, the type of decision

tree or methodological approach used, and their main contributions, along with reliable DOIs or official URLs.

Table 1. Recent and reliable literature (last five years). Source. Own creation arising from the analysis of the most relevant texts found.

Authors (Year)	Languaje	Source	Context Aplication	Type of Tree Approach	Link/ISBN
Pérez-Márquez, M. (2020)	Spanish	Book	Business Intelligence and data analytics	General BI includes technical and practical aspects (including trees)	Marcial Pons (ISBN 9788426727213)
Fakir, M., Baslam, M., & Ayachi, R. (Eds.). (2021)	English	Book (Springer)	CBI 2021 Proceedings	Studies applying predictive techniques such as trees in BI	DOI: 10.1007/978-3-030-76508-8
Sanjurjo González et al. (2021)	Spanish	Book Chapter (Dialnet)	Explainable AI and decision trees	Improved interpretable decision tree algorithm (DTC)	Dialnet

Practical Cases

Classification Trees

Classification trees If the technology of an e-commerce store seeks to improve its discount strategy by personalizing offers according to customer characteristics, it may currently apply discounts indiscriminately, which results in a loss of revenue by offering discounts to customers who would have purchased without any incentive. To address this situation, a classification tree is constructed that predicts whether a customer is likely to use a discount coupon, thereby allowing offers to be applied only where conversion is maximized without affecting profitability.

The objective of the model is to predict whether a customer will use a discount coupon based on their purchasing profile. To this end, it is necessary to consider the variables used, the structure of the classification tree, and the key nodes that define it.

Variables used: 1) Monthly Purchase Frequency, which can be: Low (1–2), Medium (3–5), and High (>5). 2) Average Purchase Amount, based on the following scale: Low (< COP 500,000), Medium (COP 500,000 – COP 2,000,000), and High (> COP 2,000,000). 3) Time Since Last

Purchase, which includes Less than 15 days, 15–30 days, and more than 30 days. 4) Coupon Usage History: Yes / No. 5) Preferred Product Category: Electronics, Fashion, Home.

Regarding the structure of the classification tree, the root node is Coupon Usage History. If the customer has previously used coupons, Monthly Purchase Frequency is evaluated; if the customer has not used coupons before, Time Since Last Purchase is evaluated.

Among the key nodes, the following are considered: 1) Monthly Purchase Frequency Node (if the customer has used coupons), which may be: High (>5 purchases/month): 90% probability of using the coupon, Medium (3–5 purchases/month): 75% probability of using the coupon, or Low (1–2 purchases/month): 50% probability of using the coupon. 2) Time Since Last Purchase Node (if the customer has not used coupons before), which may be: Less than 15 days: 60% probability of using the coupon, between 15–30 days: 40% probability of using the coupon, or more than 30 days: 20% probability of using the coupon. 3)

The Average Purchase Amount Node refers to the decision point in the tree that evaluates the typical spending level of a customer. It includes the following parameters: High (> COP 2,000,000): 80% probability of using the coupon, Medium (COP 500,000 – COP 2,000,000): 65% probability of using the coupon, and Low (< COP 500,000): 30% probability of using the coupon.

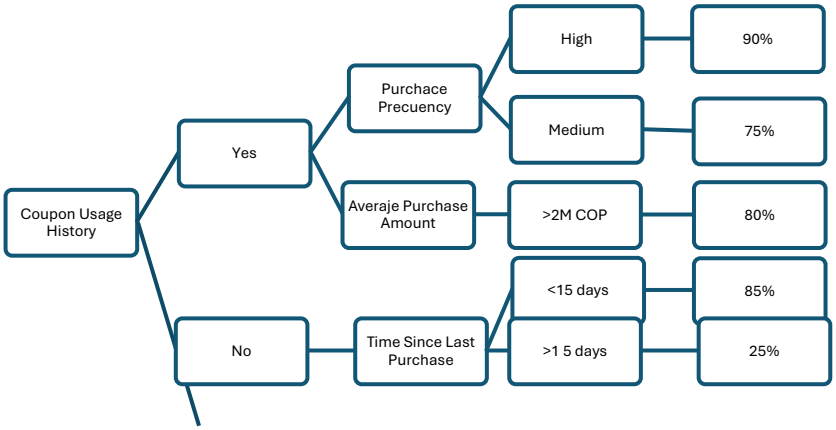

Figure 1. Decision Tree Diagram. Source: Own Creation

The "results and application" section presents the practical Implications and outcomes derived from applying this model. In the case the model enables coupons to be sent to customers with a higher probability of conversion, thereby avoiding unnecessary discounts to consumers who would have purchased the Item anyway.

Regression Trees

One example is predicting the cancellation rate of hotel reservations. Context: A luxury hotel in a tourist city seeks to anticipate the reservation cancellation rate to adjust its overbooking policy and avoid revenue losses. Model Objective: To predict the probability that a reservation will be cancelled based on factors related to customer behaviour and the reservation itself. Variables

Used: 1) Time between the Reservation and the Arrival Date: Less than 7 days, 7–30 days, more than 30 days. 2) Number of Nights Reserved: 1–2 nights, 3–5 nights, more than 5 nights. 3) Payment Method: Credit Card, Bank Transfer, Pay at Hotel. 4) Customer Origin: Domestic, International.

For the structure of the Regression Tree, the root of the tree is the Time between the Reservation and the Arrival Date under the following parameters: If the reservation was made with less than 7 days' notice, the Payment Method is evaluated. If the reservation was made 7–30 days in advance, the Number of Nights Reserved is evaluated. If the reservation was made more than 30 days in advance, the Customer Origin is evaluated.

The key nodes with their respective branches are Payment Method Node (if the reservation is in less than 7 days), which may be: Pay at Hotel (85% probability of cancellation, Bank Transfer (60% probability of cancellation, and Credit Card (35% probability of cancellation. Number of Nights Reserved Node (if the reservation is between 7 and 30 days), which includes: 1–2 nights: 70% probability of cancellation, 3–5 nights: 50% probability of cancellation, and more than 5 nights: 20% probability of cancellation. The Customer Origin Node (if the reservation is made more than 30 days in advance) is divided into two categories: International Customer, with a 45% probability of cancellation, and Domestic Customer, with a 20% probability of cancellation.

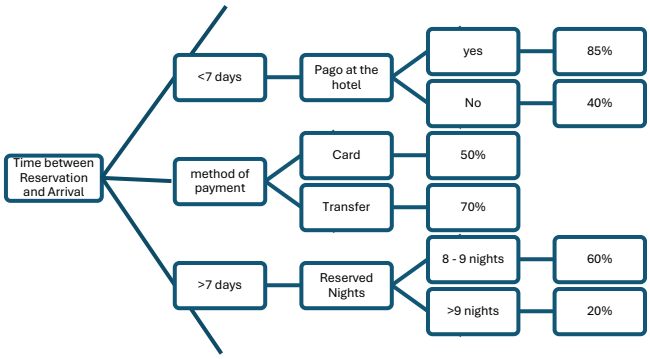

Figure 2. Decision Tree Diagram. Source. Own Creation

The "Results and Application" Section outlines the practical outcomes and strategic Implications derived from applying this model. In this case, the model allows the hotel to anticipate cancellations and apply strategies such as advance charges or promotions for reservations with lower risk.

Decision Trees Based on Entropy

This technique is employed to partition data efficiently by identifying the purity of divisions at each level of the tree. Entropy measures uncertainty or disorder within a dataset. This type of tree enables the analysis of complex and multivariate datasets, requiring a clear identification of the variables that contribute to good classification. However, it presents challenges such as overfitting, which demands proper pruning and the definition of appropriate variables and their ranges.

A practical case involves a fashion marketplace aiming to reduce the cart abandonment rate on its platform. Currently, 70% of shopping carts do not result in completed purchases, leading to a loss of revenue.

The objective of the model is to determine the probability that a user will abandon their cart based on their behaviour on the platform.

For this case, the variables used are: 1) Number of Items in the Cart: 1–2, 3–5, More than 5. 2) Session Time in the Store: Less than 3 minutes, 3–10 minutes, more than 10 minutes. 3) Selected Payment Method: Yes / No. 4) Device Type: Mobile, PC.

In the structure of the Entropy-Based Tree, the root of the tree is the Selected Payment Method, which can be: if the user has selected a payment method, the Number of Items in the Cart is evaluated; if the user has not selected a payment method, the Session Time in the Store is evaluated.

The key nodes with their respective options are the following: Node 1) Number of Items in the Cart (if the user has selected a payment method): More than five items: 20% probability of abandonment, between 3–5 items: 40% probability of abandonment, and between 1–2 items: 60% probability of abandonment.

Node 2) Session Time in the Store (if the user has not selected a payment method), which is subdivided into: Less than 3 minutes: 85% probability of abandonment, 3–10 minutes: 50% probability of abandonment, and more than 10 minutes: 30% probability of abandonment.

Node 3) Device Type, which may be: Mobile: 75% probability of abandonment and PC: 45% probability of abandonment.

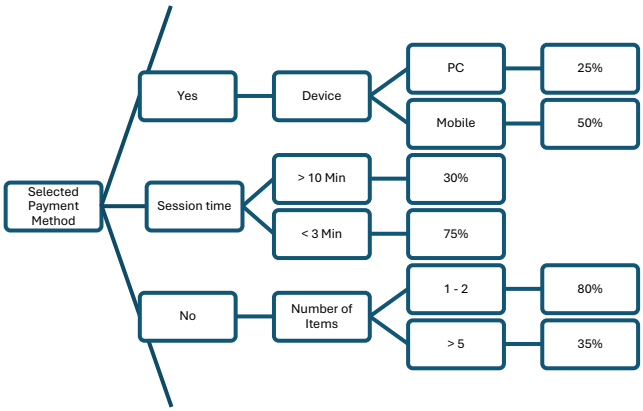

Figure 3. Decision Tree Diagram. Source. Own Creation

The "Results and Application" Sections present the main practical outcomes and strategic actions derived from Implementing this model. In this case, generating automatic reminders and promotions for customers with a high probability of cart abandonment during the purchasing process Is Identified as a viable strategy.

Stochastic Trees

This type of tree constitutes an advanced variant of decision trees that allows for the incorporation of randomness in the construction of the model. These types of trees randomly select a subset of features to choose the splitting criterion, making them an excellent tool in data analysis, especially within the field of Business Intelligence. A clear example of their applicability arises when a fast-food restaurant seeks to predict delivery delays and anticipate when an order will be late, along with the percentage of delay, considering traffic and weather variables. The objective is to predict the probability of delivery delays associated with external factors.

The variables used are: 1) Weather Conditions: Sunny, Rain, Storm. 2) Day of the Week: Weekday, Weekend. 3) Number of Orders in the Kitchen: Low (0–10), Medium (11–30), High (>30). 4). Delivery Distance: Near (<2 km), Medium (2–5 km), Far (>5 km). In the structure of the stochastic tree, the root node is Weather Conditions, which is subdivided as follows: if the weather is stormy, the Delivery Distance is evaluated; otherwise, if the weather is rainy or sunny, the Number of Orders in the Kitchen is evaluated.

The key nodes are Delivery Distance Node (if the weather is stormy), which considers: Far (>5 km): 90% probability of delay, Medium (2–5 km): 70% probability of delay, and Near (<2 km): 50% probability of delay. Number of Orders in the Kitchen Node (if the weather is rainy or sunny) includes High (>30 orders): the Day of the Week is evaluated, Medium (11–30 orders): 40% probability of delay, and Low (0–10 orders): 10% probability of delay. Finally, the Day of the Week Node (if the kitchen load is high) is divided into: Weekend: 80% probability of delay and Weekday: 60% probability of delay.

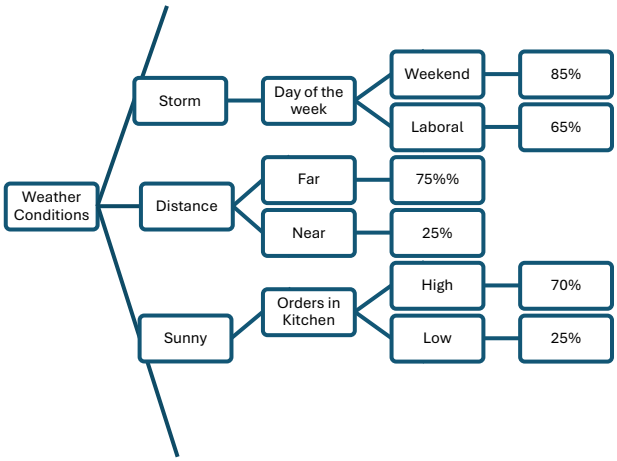

Figure 4. Decision Tree Diagram. Source. Own Creation

The "Results and Application" section outlines the key practical outcomes and strategic measures derived from this model. In this case, the restaurant adjusts estimated delivery times and offers compensation to customers who are at a higher risk of delay. Decision trees have proven to be practical tools in various business contexts. Considering the nature of the data and the analysis objective, it is possible to select the most appropriate type of decision tree for each

case. Table 1 provides a practical guide for choosing the decision tree that best fits the company's needs.

Table 2. Comparative Guideline for Selecting a Decision Tree. Source. Own adaptation, based on the definitions of decision trees proposed by Pérez Márquez (2014) on Data Mining

Type of Decision Tree	When to Use It	Example in Bussines Intelligence
Classification Tree	To segment data into categories	Categorising customers, detecting fraud, or classifying products.
Regression Tree	To predict numerical values	Predicting values such as prices, sales, or time.
Entropy-Based Tree	To improve data segmentation and maximise information gain	To conduct extreme classification, such as identifying customers highly likely to cancel a membership or subscription.
Stochastic Tree	To model uncertainty and make decisions under risk	Applicable in uncertain environments where risk determination is needed, such as predicting delivery delays influenced by internal or external factors.

In the cases presented—coupon usage, payment methods, booking cancellations, and delay prediction—it becomes evident that by considering the applicability of decision trees, it is possible to use them effectively in business environments. Their structured format and the identification of key elements in each case allow for their practical implementation, provided that clear analysis objectives, contextual understanding, and data analysis potential are in place.

The results confirm that decision trees are valuable for interpreting business data, identifying key variables, and generating actionable rules. Their use in various sectors has improved resource optimization, customer segmentation, and operational efficiency. Although based on simulated data, the findings were validated through pruning, cross-validation, and depth control. Future work should validate with real data, test ensemble methods, and integrate models into real-time dashboards for decision-making.

Conclusions

The analysis confirms that decision trees are an effective tool for structuring, interpreting, and optimizing data-driven business decision-making processes. Their visual representation facilitates the identification of key variables, supports predictive modeling, and enables clear communication of complex results to various stakeholders, thus strengthening strategic planning.

The comparison showed that each three types excel at specific tasks: classification for categorical predictions, regression for continuous values, entropy-based for maximizing information gain, and stochastic for managing uncertainty. Selecting the appropriate model improves accuracy and efficiency

The evaluation revealed that decision trees offer clear advantages, such as interpretability, adaptability to diverse data sets, and integration with advanced analytics tools. However, their limitations include susceptibility to overfitting and reduced performance with highly imbalanced data. Their applicability is maximized when aligned with an organization's data maturity, industry-specific requirements, and strategic objectives, ensuring short-term operational benefits and long-term scalability.

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Supply chain of bovine cattle in Colombia after the pandemic: new realities based on systems thinking

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Introduction

Bovine livestock farming has historically been a cornerstone of Colombia's rural economy, significantly contributing to the agricultural gross domestic product (GDP) and the livelihood of millions across various regions of the country (Alzubi et al., 2023; Houshyar et al., 2024). However, the COVID-19 pandemic, declared in March 2020, drastically disrupted global supply chains, directly and indirectly impacting all stages of the cattle supply chain—from primary production to distribution and final consumption (Hashem et al., 2020; Malik et al., 2024). In Colombia, these disruptions revealed deep structural vulnerabilities, such as dependence on imported inputs, limited logistical infrastructure, informality in commercialization, and technological gaps among producers. Immediate effects included restrictions on labor mobility, interruptions in the supply of strategic inputs such as feed, vaccines, and veterinary medicines, and difficulties in accessing credit and complying with sanitary vaccination cycles (Burkart et al., 2020).

From an economic standpoint, the pandemic exposed the fragility of profitability in the livestock sector, worsened by exchange rate volatility, the rising cost of imported inputs, and a decline in consumers' purchasing power. The latter led to a notable reduction in beef consumption in favor of more affordable protein sources like chicken and eggs (Burkart et al., 2020). However, new opportunities also emerged, such as increased market interest in traceable, safe, and sustainable products, along with renewed momentum toward the modernization and digitization of processes. In particular, shifts in consumption patterns spurred growth in local and alternative distribution channels. According to a Nielsen study cited by Burkart et al. (2020), purchases at public markets increased by 23% during the pandemic, reflecting a transformation in Colombian consumer preferences. This trend underscores the need to adapt marketing strategies, promote short distribution circuits, and leverage digital tools such as e-commerce.

In this scenario of transformation and uncertainty, systems thinking emerges as a suitable methodological approach to understanding the multiple interactions among actors, processes, and external factors shaping the cattle supply chain. This approach allows for the analysis not only of linear causal relationships but also of feedback loops, non-linear dynamics, and cumulative effects that impact the system's resilience (Tonnang et al., 2023). Thus, viewing the chain from a systemic perspective facilitates the identification of critical intervention points and the formulation of integrated strategies that contribute to its long-term sustainability.

This chapter analyzes the new realities facing the bovine cattle supply chain in Colombia in the post-pandemic stage, using systems thinking as a conceptual framework to identify vulnerabilities, improvement opportunities, and strategic implications. It is grounded in the guidelines established by the Sustainable Bovine Livestock Public Policy 2022–2050, aiming to propose action paths that strengthen adaptive capacity, operational efficiency, and the environmental, economic, and social sustainability of the sector.

Based on the developed analysis, this chapter seeks to generate impacts at three levels. First, it contributes to the academic field by integrating systems thinking into the discussion on livestock sustainability in post-pandemic contexts—a perspective still underexplored in Latin America. Second, it provides practical inputs for public policy makers by identifying critical points and strategies aligned with the Sustainable Bovine Livestock Policy 2022–2050. Finally, the chapter aims to serve as a guide for actors in the productive sector by proposing concrete actions aimed at improving the resilience, efficiency, and sustainability of the cattle supply chain in Colombia in the face of future crises, changing market demands, and increasing environmental pressures.

Post-Pandemic Perspectives in Colombia for the Bovine Cattle Supply Chain

The COVID-19 pandemic brought about an unprecedented global disruption in agri-food systems, especially in countries like Colombia, where bovine livestock plays strategic economic, social, and ecological roles. While the initial impact was shaped by logistical restrictions, income loss, and decreased consumption, the post-pandemic phase has revealed a window of opportunity to rethink the cattle supply chain through a transition toward sustainable, resilient, and territorially integrated systems. In this context, the reference document Sustainable Bovine Livestock Policy 2022–2050 (Government of Colombia, 2022) provides a strategic roadmap for transforming the livestock sector, aligned with the Sustainable Development Goals (SDGs) and the goal of carbon neutrality by 2050.

One of the main lessons from the pandemic was the exposure of structural bottlenecks in supply chains. The Colombian livestock sector—responsible for 48.7% of the livestock GDP and 1.4% of the national GDP—showed high vulnerability to transport disruptions, the closure of commercial channels, and constraints in the industrial processing of meat and dairy products. Additionally, there is a strong concentration in formal processing, which has exposed the predominance of the informal market, particularly in the dairy subsector, where more than 53% of milk bypasses industrial channels (Sustainable Bovine Livestock Policy, 2022). In the post-pandemic stage, there is growing recognition of the need to transition toward a more efficient, resilient, and sustainable value chain. This transition entails improvements in primary productivity, system modernization, and integration into differentiated markets based on attributes such as traceability, animal welfare, and environmental sustainability. Incorporating quality and safety standards in processed products (meat and milk), along with adequate value addition, is essential to position national production in increasingly demanding international markets.

One of the most relevant pillars of the Sustainable Bovine Livestock Policy 2022–2050 is its territorial sustainability approach. In a global context of increasing climate pressure, Colombia has identified the livestock sector as responsible for 44.4% of greenhouse gas (GHG) emissions from the entire agricultural sector, mainly due to enteric fermentation and manure management. This situation positions the cattle supply chain as a key actor in meeting the international commitments established in the Nationally Determined Contribution (NDC), which sets a target to reduce agricultural sector emissions by 51% by 2030. In the post-pandemic context, it is crucial to implement low-carbon livestock production models that are climate-adapted, landscape-based, and ecosystem-efficient. In this regard, transitioning to silvopastoral systems, agroforestry arrangements, and ecological restoration practices not only improves meat and milk productivity but also significantly reduces the ecological footprint of the system. As the policy suggests, environmental sustainability cannot be understood in isolation but rather as part of a dynamic system in which biodiversity, water, soil, and rural landscapes interact with productive activity.

The social impact of the pandemic left deep marks in rural areas, especially among small and medium-scale livestock farmers with limited access to technical assistance, credit, or digital tools. Although livestock generates over 810,000 direct jobs (6% of national employment), its structure remains fragmented and characterized by low levels of associativity: 82% of livestock farms in Colombia have fewer than 50 animals (Sustainable Bovine Livestock Policy, 2022). In the post-pandemic phase, there is an urgent need to build a new rural pact in which sustainable livestock farming is also a strategy for equity and well-being. This requires strengthening agricultural extension services, democratizing access to clean technologies, encouraging generational renewal, and empowering the role of women and youth in the value chain. The Sustainable Bovine Livestock Policy emphasizes capacity building through frameworks such as the National Agricultural Innovation System (SNIA) and the implementation of departmental extension plans that integrate sustainability and climate change considerations (Sustainable Bovine Livestock Policy, 2022). Moreover, well-being must be understood in a comprehensive manner—not only as living conditions for producers but also in terms of animal welfare, public health, rural employment formalization, and national food security. In alignment with the SDGs, the policy advocates for livestock farming that contributes to poverty reduction, responsible production, and more sustainable communities (Sustainable Bovine Livestock Policy, 2022).

The post-pandemic era has made it clear that without solid and adaptive governance, it is impossible to manage the complexity of the agri-food system. Accordingly, the policy recognizes the need to consolidate a coherent institutional framework, with clearly defined roles and territorial capacities for monitoring, traceability, and sanitary control. It highlights the strengthening of the Sustainable Livestock Roundtable of Colombia (MGS-Col) as a multi-stakeholder platform that brings together over 40 public, private, and academic institutions. Additionally, progress has been made in environmental certification seals (such as the SAC Seal), the creation of livestock sustainability observatories, and interoperable information systems that support evidence-based decision-making (Sustainable Bovine Livestock Policy, 2022).

Likewise, innovative financing mechanisms have been promoted, such as the Instrument for Sustainable Productive Transformation (ITPS) and the Comprehensive Program for Productive Reconversion of Livestock Farming (PIRPAG), which combine public resources, private banking,

and international cooperation. These tools have been essential in promoting productive transformation in regions such as Caquetá, Guaviare, and Magdalena Medio, encouraging a livestock sector that is not only more productive but also regenerative.

This research adopts a qualitative-descriptive approach grounded in systems thinking to model the dynamics of the bovine cattle supply chain in Colombia within the post-pandemic context. The primary methodological tool employed is the construction of a Causal Loop Diagram (CLD), which enables the representation of feedback relationships, reinforcing and balancing loops, as well as the cumulative effects that characterize complex systems such as those found in the agricultural sector (Tonnang et al., 2023).

The methodology is structured into three phases. In the first phase, an exhaustive documentary review was conducted on the impacts of the COVID-19 pandemic on Colombia's cattle supply chain, with the main reference being the document Sustainable Bovine Livestock Policy 2022–2050 issued by the Government of Colombia (2022). Based on this review, the main structural, social, economic, technological, and environmental factors influencing the performance of the supply chain were identified.

The second phase involved mapping key stakeholders and processes within the chain, including stages such as primary production, industrial transformation, commercialization, distribution, and final consumption.

In the third phase, the CLD was developed using the tool comodel.io to graphically represent the interactions among the key variables. Reinforcing feedback loops (R) and balancing loops (B) were identified. Each loop was analyzed according to its expected behavior in response to external disturbances, such as a new logistical disruption or a public policy reform. This analysis enabled the identification of bottlenecks, leverage points, and desirable pathways for enhancing the sustainability of the supply chain.

This section presents the CLD, developed based on an analysis of the structural, social, economic, and environmental factors shaping the dynamics of the Colombian cattle system, where five balancing loops and two reinforcing loops were identified.

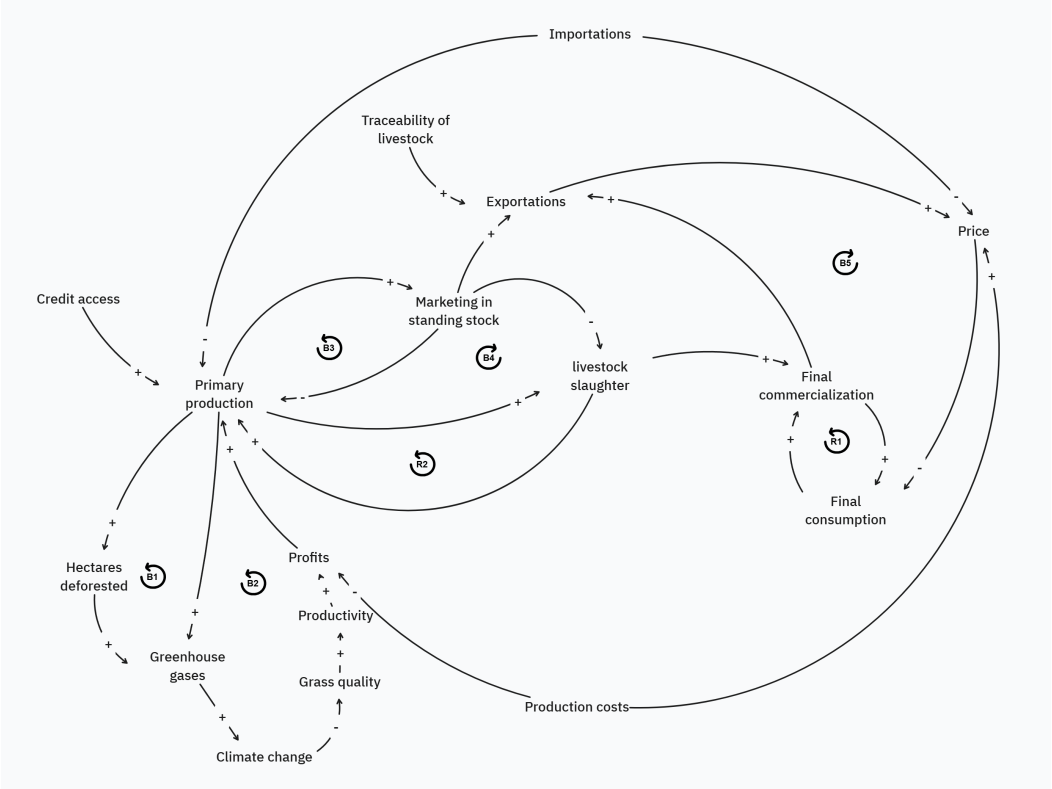

Figure 1. Causal loop diagram of the bovine cattle supply chain in Colombia in the post-pandemic context.

The first loop identified (B1) is a balancing loop, with primary production as its central variable. In this cycle, an increase in primary production is associated with an expansion of deforested land. This direct relationship shows that greater productive expansion often relies on converting forested areas into grazing lands. Consequently, greenhouse gas (GHG) emissions increase due to land-use change and extensive cattle farming practices. These higher emissions contribute to climate change, which in turn degrades pasture quality. The decline in pasture quality negatively affects system productivity, leading to a decrease in profits. As profits fall, investment capacity in primary production declines, ultimately resulting in a deceleration or containment of productive growth—thus closing the loop.

The second loop (B2) is also a balancing loop, again centered around primary production. Here, increased production directly leads to higher GHG emissions. This reflects the fact that greater livestock activity results in more emissions, especially from enteric fermentation and waste management, as noted in the Sustainable Bovine Livestock Policy 2022–2050. The increase in GHG emissions drives climate change, which negatively affects pasture quality (an inverse relationship). The decline in forage quality then reduces system productivity, which lowers profits and diminishes reinvestment capacity in primary production, completing the cycle.

The third loop (B3) establishes a direct relationship between primary production and marketing in standing stock (i.e., live animal trade). The diagram shows that an increase in production leads

to a higher supply of animals available for live sale, mobilizing productive inventory toward the market. The inverse relationship between live marketing and primary production indicates that as more animals are sold, the available stock at the farm level decreases, temporarily reducing productive capacity until the next cycle.

The fourth loop (B4) is a balancing loop, in which primary production positively influences marketing in standing stock. As production increases, more live animals become available for sale. This increase in live animal sales leads to a higher number of livestock slaughtered. The relationship between slaughter and primary production is negative: the more animals are slaughtered, the fewer remain in the production system, which limits the ability to maintain production in subsequent cycles.

The fifth loop (B5) describes how exports affect the internal dynamics of the domestic market. Here, an increase in exports leads to higher prices for livestock products. This positive relationship suggests that allocating a greater share of production to international markets reduces domestic supply, which drives prices upward. The rise in prices negatively affects final consumption—a higher price results in reduced demand. Lower domestic consumption in turn dampens the incentive to export further, thus introducing a self-regulating mechanism that helps stabilize the system.

The first reinforcing loop (R1) illustrates a mutually reinforcing growth dynamic between final marketing and final consumption. According to the diagram, an increase in final consumption leads to greater marketing of livestock products due to higher demand across distribution channels. This is a direct and positive relationship. Greater marketing, in turn, stimulates more consumption—likely through increased product availability, expanded sales channels, or proactive marketing strategies.

The second reinforcing loop (R2) shows a direct relationship between primary production and livestock slaughter. As primary production rises, more animals become available for slaughter. This higher availability encourages increased slaughter activity, which in turn positively influences primary production. The positive feedback relationship of this loop indicates that slaughtering more animals may trigger further production—whether by replenishing stock, maintaining the production flow, or responding to greater market demand.

Conclusions

The COVID-19 pandemic not only exposed the structural vulnerabilities of Colombia's agri-food system but also compelled a profound rethinking of how the bovine cattle supply chain operates. Far from being a temporary disruption, the global health crisis revealed the complexity and fragility of a system where productive, logistical, environmental, and social links are dynamically—and often unstably—interconnected. Under this premise, this study highlights the usefulness of systems thinking as a critical tool for understanding and acting upon the realities of the cattle sector, particularly in transformational post-pandemic contexts.

One of the main contributions of this research was the identification and modeling of the feedback loops embedded within Colombia’s cattle system. Through the construction of the

Causal Loop Diagram (CLD), it was possible to observe how patterns of production, marketing, consumption, slaughter, and environmental sustainability are far from linear relationships. Instead, they operate as interdependent circuits that either reinforce or limit the system's behavior. This perspective is essential to avoid isolated decisions or fragmented public policies that overlook the side effects and cumulative impacts of interventions.

The identified balancing loops reveal self-regulatory mechanisms within the system which, while they help prevent extreme imbalances, can also lead to stagnation or regression if underlying structural causes are not addressed. For example, initial productive expansion may drive economic growth, but it can also lead to deforestation, increased greenhouse gas emissions, and pasture degradation, ultimately resulting in reduced productivity. These dynamics emphasize the importance of recognizing the biophysical limits of the system and adopting sustainability strategies that do not compromise the ecological foundation of livestock production.

Similarly, the reinforcing loops demonstrate how certain components—such as the relationship between final consumption and marketing, or between slaughter and primary production—can trigger virtuous cycles or, in the absence of control, unsustainable pressures. In this regard, the research shows that development opportunities for the sector cannot be separated from institutional strengthening, improvements in traceability, access to clean technologies, and the development of local capacities. Growth must not be an end in itself, but a means to achieve a livestock sector that is fairer, more resilient, and more environmentally respectful. Another key reflection concerns the importance of a territorial approach in achieving a sustainable livestock transition. The Sustainable Bovine Livestock Policy 2022–2050, used as a primary reference, emphasizes that sectoral challenges cannot be addressed uniformly. Productive, social, environmental, and cultural conditions vary significantly across regions, as do intervention priorities and strategies. The post-pandemic context offers an opportunity to rethink livestock governance from the bottom up, recognizing the diversity of actors and regional contexts, and allowing for the creation of localized agreements that reflect their specific needs.

In this sense, it is essential to give visibility to the role of small and medium-scale cattle farmers, who constitute the majority of the country's productive base but face multiple structural barriers to accessing technical assistance, financing, or innovation. Low levels of associativity and high informality limit their bargaining power and ability to access differentiated markets. Therefore, one of the most urgent tasks in the post-pandemic stage is to consolidate a supportive institutional network that promotes organizational strengthening, financial inclusion, training in sustainability, and generational renewal. The future of livestock farming cannot be built without the active participation of those who sustain it today. On the environmental front, the conclusions are unequivocal: it is impossible to talk about sustainability in the cattle supply chain without decisively addressing the climate crisis. The sector is responsible for a significant share of Colombia's agricultural GHG emissions, and its transformation is essential to meet international climate commitments. The promotion of silvopastoral systems, ecological restoration, and sustainable landscape management is not only desirable but also a technical, ethical, and political imperative. Sustainability should not be understood as a complementary attribute of livestock production but as its structural core.

In conclusion, Colombia's bovine cattle supply chain stands at a turning point. The pandemic has served as a catalyst for exposing vulnerabilities but also as a window of opportunity for structural transformation. This study demonstrates that resilience, sustainability, and equity are not isolated goals—they are interdependent dimensions that must be addressed simultaneously and in a coordinated manner. Only then will it be possible to build a livestock sector that not only feeds the country but also protects its biodiversity, strengthens its territories, and dignifies the lives of those who make it possible.

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Analysis of technological capabilities in the automotive industry: a vision for electromobility in Mexico

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Introduction

The global shift to electromobility accelerated after the COVID-19 pandemic, prompting nations to reassess their economic models, technology strategies, and industrial priorities. In this context, electric vehicles (EVs) have emerged as key alternatives to combustion vehicles, responding to environmental, energy, and market demands. This transition reflects broader changes in global production and consumption, fueled by advances in renewable energy, battery systems, and mobility.

Mexico, as a central actor in North America's automotive industry, faces both opportunities and challenges in adapting to this trend. With the automotive industry contributing approximately 4.61% of the national GDP by 2024, and nearly one-fifth of household expenditure allocated to transportation, according to 2025 data from INEGI, electromobility represents both an economic and social turning point. This study analyses the country's transition to electromobility through technological capabilities such as design innovation, advanced manufacturing, and technological absorption, emphasizing Mexico's potential role in global EV value chains through assets like lithium.

Garrido (2022) highlights how nearshoring has positioned Mexico to attract new investments amid the relocation of manufacturing from Asia. Hernández and Benites (2023) note the dual nature of this opportunity, pointing to institutional and policy challenges despite advantages such as proximity to the U.S., the USMCA, and infrastructure like the Transisthmian Train. Similarly, Gereffi (2025) stresses that nearshoring, driven by U.S. geopolitical concerns, requires Mexico to embrace a more strategic, innovation-driven approach.

Automotive Industry in Mexico

As mentioned by Arroyo (2025), Mexico has currently become a competitive country in terms of manufacturing, as it has entered into major trade agreements with other countries. However, the automotive industry that has been developing in the country for more than four decades and that was strengthened after the signing of NAFTA, has focused on being part of a production

chain oriented to the manufacture of vehicles and auto parts. To such a degree that, throughout this time, Mexico has focused on training and preparing engineers capable of responding to the prevailing needs of the automotive industry. However, since President Claudia Sheinbaum Pardo took office, the need for a reconfiguration of the automotive industry has become clear, with a renewed commitment to future demands for substitute products aligned with environmental sustainability. It this sense that the bet on electric vehicles is an option that goes through the path of Mexico's opportunity. Not only the creation of vehicles, but of all the necessary components in its value chain.

This is how Micheli (2025) establishes the incentive for electromobility in Mexico. The country is committed not only to seek ways to encourage the production of electric vehicles, but also to take advantage of the supply chain demand that this industry can trigger, particularly in the need for accumulators, whose main base is lithium. It is in this sense that, as Micheli (2025) mentions, the lithium economy has entered a new era characterized by the dynamism of battery production associated with electromobility and the emergence of strategic alliances with automotive companies with mining and battery companies. This era also marked by geopolitical tensions, especially due to China’s dominance in the global lithium value chain. This is the time in which Mexico will join a dynamic of learning and starting up the industrialization of lithium and will need to generate its economic advantages within the framework of a nationalist legislation on lithium and its insertion in the North American economic space.

Technological Capabilities

The notion of technological capabilities is linked to the idea of technological change, understood as the combined effect of several technologically related activities, such as invention, innovation, development, transfer, and diffusion (Arteaga, 1995). Likewise, if we consider the evolutionary theory of technological change, Nelson and Winter (1982) mention that change is not generated simply by importing equipment with new technology, but requires specialized resources, accumulated and deliberately generated by investment. Thus, Lall (1982), Bell and Pavitt (1995), and Dutrénit (2000) establish resources of a non-tangible nature as technological capabilities. Kim (1997) defines technological capabilities as "the ability to make effective use of technological knowledge to assimilate, use, adapt and change existing technologies; it makes it possible to create new technologies and develop new products and processes in response to the changing economic environment".

A technological capability is defined as "the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt and change existing technologies. It also enables the creation of new technologies and the development of new products and processes in response to a changing economic environment. It denotes operational mastery over knowledge". (Kim, 1997). Accordingly, Bell and Pavitt (1992) define technological capabilities as the set of resources required to generate and manage technical change, including skills, knowledge and experience. Bell and Pavitt's (1992, 1995) classification establish the main technological capabilities on the basis of four technical functions: 1) investment activities, 2) production activities, 3) the development of linkages with firms and institutions, and 4) the production of capital goods.

These resources also serve to generate and manage technical change (Bell and Pavitt, 1992). Given the above, a capability is defined as the set of knowledge and organizational routines of a productive, technological and managerial nature that the firm has accumulated throughout its "evolutionary path" or technological trajectory (Yoguel and Rabetino, 2000). Therefore, it is in the firms where the dynamic learning process through which technological capabilities are acquired takes place. On the other hand, Dutrénit (2000), establishes the need to distinguish between routine technological production capabilities and innovative capabilities; the former are those applied to operate existing technology, and the latter are used to generate and manage technical change. In this regard, Díaz González (2018) mentions that innovation is a fundamental factor for the economic welfare of companies, constituting a novel practice that involves the creation of products, processes or services in the environment.

However, for a better understanding of technological capabilities, it is useful to recover the contributions of Lall (1992), who distinguishes three types of capabilities that are achieved in companies through learning processes: investment, production and linkage (Table 1). This first taxonomy of capabilities is the origin of a series of empirical studies by Lall (1982, 1992), in which he suggests that firms learn and build technological capabilities. In this way, the author generates a theoretical and methodological basis that will serve as a support for subsequent studies.

Table 1. Characteristics of investment, production and linkage capabilities for Mexico

	MEXICO	Observation Status
Investment capabilities	A collaborative project involving academia (IPN, TecNM), government (Secihti), and the productive sector aims to develop mini vehicle technology. With an investment of 25 million pesos, the plan includes building assembly plants nationwide. The initiative supports the energy transition by reducing emissions and enhances urban mobility through space-efficient vehicle design.	Consolidated
Production capacities	Mexico's automotive industry includes 23 light vehicle manufacturers affiliated with AMIA and registered with RAIAVL. As of 2019, 55 economic units were engaged in vehicle and truck manufacturing. Over 40 assembly plants operate across key states like Puebla, Guanajuato, Estado de México, Nuevo León, and Sonora.	Consolidated
Linkage capabilities	Olinia, the Mexican government's project to produce affordable and 100% Mexican electric cars, is part of the "Plan México," which aims to promote electromobility in the country. Olinia's production will be located in Puebla, Mexico. In 2027 Production estimate Start (10,000 units produced)	In consolidation

Source. Own elaboration

There are various classifications of capabilities based on the postulates of Lall (1992), who developed a first taxonomic proposal that serves as a basis for other authors to make concrete proposals on specific industrial sectors. He also concludes that capabilities at the country level are classified into three categories: physical investment, human capital and technological efforts (Table 2).

Table 2. *National Technological Capabilities (NTC)*

Resource Capabilities	Economic Environment Incentives	Institutional Infrastructure
Physical investment (infrastructure, industrial equipment)	Degree of competition in the domestic market	Technical and university education system
Human capital (technical training, engineers, managers)	Trade policies and exchange rate regime	Innovation support institutions (technology centers, incubators)
Technological effort (R&D, engineering, continuous improvement)	Macroeconomic conditions (stability, input prices, etc.)	Legal and institutional frameworks that promote learning and innovation

Source. Own elaboration based on concepts from Lall, 1992.

The ideas proposed by Lall (1992) regarding the success of Asian countries in comparison to the Mexican context. It can be highlighted that one of the things that were done differently is the participation of the State in terms of selective intervention. As we can see at the beginning of this document, this selective selection was developed by the Mexican government by converting the project into a national strategy for 2030.

Data Analysis

Figure 5 shows a historical series of sales of compact and subcompact vehicles, both domestically produced and imported. It can be observed that, following a significant drop from 2019 to 2022, there was a brief recovery. However, throughout the entire period, sales of imported vehicles remained higher than those of domestic ones. One possible explanation for the decline in compact and subcompact sales is the decree on foreign used vehicles published on January 19, 2022. This decree allows the regularization of vehicles that had already entered the country in previous years, aiming to address the issue of so-called "chocolate cars[4]." However, this policy apparently led to an increase in the consumption of alternative options, thereby reducing the demand for new vehicles.

[4] Orozco (2024), it is noted that the colloquial term *"auto chocolate"* bears no relation to the food item. It is associated with informality, illegality, and especially the temporary usefulness of the motor vehicle, which may be removed at any time by Mexican authorities due to its lack of registration in the Public Vehicle Registry (Repuve).

The following figure presents a comparison between the sales of compact and subcompact vehicles with gasoline engines and those with electric engines. Although the consumption levels are disproportionate, the demand for electric vehicles has grown exponentially over the past four years. This suggests a shift in consumer preferences away from traditional vehicles.

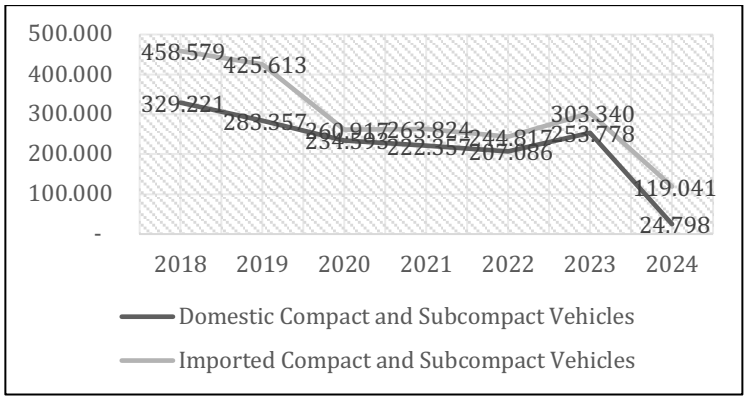

Figure 1. Historical Sales of Imported and Domestic Compact and Subcompact Vehicles in Mexico. Source: Own elaboration with INEGI data

Figure 2 presents a comparison between electric vehicle sales and compact and subcompact gasoline vehicle sales in Mexico, their main competitor. An exponential and increasing trend are observed in the consumption of electric vehicles, along with a significant decline in compact vehicle sales. A point of equilibrium is noted in 2023, where the growth rate for electric vehicles surpasses that of gasoline-powered ones.

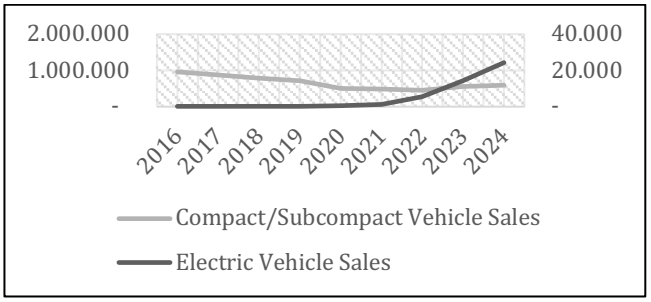

Figure 2. Comparative Historical Sales of Compact-Subcompact and Compact-Subcompact and Electric Vehicles in Mexico. Source: Own Source: Own elaboration with INEGI data

Finally, figure 3 presents a correlation analysis between electric vehicles and compact and subcompact vehicles, showing an inverse relationship between these two data series over the period from 2016 to 2024. Therefore, it can be stated that vehicle consumption in Mexico is undergoing a transition. However, it is important to note that the correlation coefficient, with a value of 0.33, is relatively low, although the sign is in the expected direction.

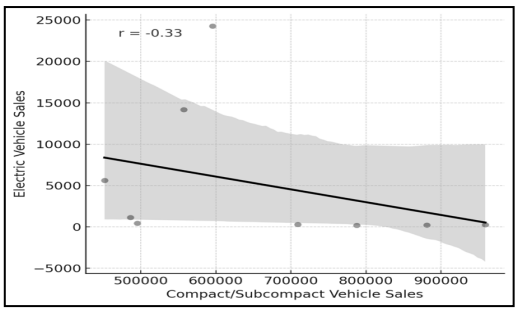

Figure 3. Correlation Analysis of Electric Vehicles and Compact and Sub-Compact Source: Own elaboration with INEGI data

There is a weak linear correlation between sales of compact and semi-compact vehicles and sales of electric vehicles. The graph suggests an incipient structural change in the Mexican automotive market. Although the transition to electric vehicles is not yet dominant, a partial substitution trend is already reflected, with the growth of electric vehicles occurring in a context of falling compact/sub-compacts.

Electric vehicle sales have grown significantly in recent years, especially from 2021 onwards, while light vehicle (gasoline) sales have seen a moderate recovery after the 2020 (pandemic) downturn. In years such as 2023 and 2024, electric vehicle sales increased rapidly, even when light vehicle sales did not grow at the same rate. This indicates that the growth of electrics is weakly dependent on a drop in gasoline vehicles. The sustained increase in electric vehicle adoption suggests a structural transition of the market rather than a simple one-to-one replacement with traditional vehicles. Electric vehicles still represent a small proportion of the total market, but are rapidly gaining ground due to public policies, incentives, environmental awareness, and changes in manufacturer supply. The transportation energy transition is not automatically displacing the gasoline vehicle market but is generating new parallel demand.

Conclusions

Mexico is at a historic juncture that could redefine its position in global value chains through the transition to electromobility. This change not only implies replacing combustion vehicles with electric vehicles, but also a structural transformation in the way of producing, innovating and linking technological, industrial and human capital capabilities. The country has proven to have a solid base in the automotive industry, with more than four decades of experience in manufacturing, exports and engineering education, but faces the challenge of moving from routine technological capabilities to intermediate and advanced innovative capabilities.

The data analyzed show a change in automotive consumption patterns in Mexico. As of 2021, electric vehicle sales have grown significantly, even though total light vehicle sales have not fully recovered pre-pandemic levels. This phenomenon evidences an emerging parallel demand, rather than a simple one-to-one substitution, which requires rethinking public policies, charging infrastructure, investment in lithium batteries, and modernization of the national electric system. In this context, according to Jiménez, Peralta & Valencia, (2025) the Sonora Plan is governed as

a strategic axis of green industrial policy. This development model seeks to articulate the energy transition with technological value chains, taking advantage of resources such as lithium, sun and land. This strategy is key to inserting Mexico into the nearshoring phenomenon, linking foreign investment with national infrastructure, while building local capacities for innovation, production and sustainability. However, significant challenges remain. Institutional fragmentation, lack of evaluation mechanisms and weak linkages between academia, industry and government outside of pilot projects such as OLINIA, limit the country's ability to take full advantage of this window of opportunity. In addition, it is necessary to strengthen investment in research and development (R&D), and to generate effective incentives for attracting key companies in the electromobility supply chain.

In conclusion, if Mexico wishes to consolidate its position as a strategic node in the energy and technology transition, it must adopt a comprehensive strategy based on the development of technological capabilities, institutional strengthening and a long-term industrial vision. Success will depend on its ability to align public policies, productive infrastructure and natural resources with the new dynamics of global trade.

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Society, Armed Conflict, Migration, and Public Health

Parenting and territory: reflections and challenges

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Introduction

Parenting is a phenomenon that can be conceptualized as a set of activities deliberately aimed at the comprehensive development of the individual. However, there are more precise definitions, such as the one by Aguirre (2010), who describes parenting as a set of actions that adults in a culture perform to guide the development of infants toward specific levels and in particular directions. This definition is quite suitable for the development of this text because it emphasizes that parenting actions are not universal, as they are strongly mediated and shaped by the specific cultural context in which they occur (Lansford, 2022). Likewise, it highlights the objective of parenting: to promote child development in multiple areas, from physical and cognitive to socioemotional

In relation to parenting styles, Cardona-Oviedo and Terán-Reales (2017) state that these constitute a way of behaving linked to cultural determinants. This means that families adopt certain patterns that naturally adjust to the particular characteristics of each family, as well as the resources available to them and their interaction dynamics. These patterns, which can be both implicit and explicit, are transmitted generationally and forge, within each culture, a normative framework that guides child development. In this sense, it is relevant to establish a clear distinction between parenting practices that occur in rural contexts and those in more urban environments. These differences, ranging from the physical environment to community interactions and economic opportunities, directly and significantly affect the practices and parenting styles adopted by families (Akurathi, 2022).

For this reason, it is important to consider the specific context when studying the dynamics that shape parenting styles in a specific population, such as the Chocó region, Colombia. In this region, the geographical particularity and Afro-Colombian cultural richness shape the parenting experience, as well as the entire sociopolitical and historical context. The latter has been marked by a complex and prolonged armed conflict in Colombia, which has generated forced displacement, land dispossession, and multiple violations of fundamental human rights, perpetuating cycles of poverty and exclusion (Comisión de la Verdad, 2022). In the specific case of children in the region, upbringing usually takes place within the framework of an extended family (Longo et al., 2024). This means that the responsibility and care of minors do not fall exclusively on biological parents but are actively distributed and shared among grandparents, uncles, aunts, cousins, and other significant community members. This model of collective

upbringing strengthens community ties and transmits a sense of belonging and shared responsibility.

The Colombian Pacific region has historically been one of the territories most affected by structural violence and armed conflict (Comisión de la Verdad, 2022). Its environmental richness, strategic location, and the State's institutional weakness in this territory have made this region a fertile ground for the persistent presence of illegal armed actors, the development of illicit economies, and constant territorial disputes (Salas, 2015). Prolonged and permanent institutional neglect has created a power vacuum that has been filled by various armed groups and criminal gangs operating under logics of social and economic control over communities (Defensoría del Pueblo, 2020). This shows that the conflict in this region has had a deeply rooted ethno-territorial dimension, disproportionately affecting these populations.

However, since Chocó has not been the only department affected by the conflict, and as previously mentioned, there are numerous displacement figures impacted by the armed conflict, the change of territory in the context of parenting has profound implications that resonate with the dynamics of uprooting and exclusion already mentioned. The rupture of the social and cultural fabric inherent in relocation significantly alters the traditional support networks crucial for parenting practices (González, 2004). Caregivers may face social isolation and a decrease in community resources, which could directly impact their ability to offer a stable and affectionate environment for children. Furthermore, the loss of cultural routines linked to the territory of origin can generate a disconnection in daily parenting practices, affecting the identity and well-being of minors (Carbonell et al., 2024).

These implications extend to the child's comprehensive development, which is affected by the transition to another place and adaptation to a new environment. Displaced children may experience stress, anxiety, and emotional difficulties due to the loss of their home, school, and friends (UNICEF, 2016). Likewise, factors such as the need to adapt to new social dynamics and even discrimination or lack of cultural recognition in the new territory can hinder their socioemotional and cognitive development. For parents and caregivers, the pressure to rebuild their lives in an unknown place can generate high levels of distress and parental stress, affecting the quality of interactions and consistency in regulating their children's behavior (Granada & Domínguez, 2012).

While this socio-historical context has high intricacies, it is precisely in this scenario of adversity that parenting practices become particularly interesting, as understanding these complex dynamics is essential to appreciate the resilience and cultural richness of the communities that inhabit Chocó today. For this reason, the present study aims to conduct a case analysis on the parenting experience of a woman who, in search of better parenting contexts for her daughter, moves to Chocó, finding different perspectives on the cultural encounters that can be found.

The methodology of this interview, designed to be part of a case analysis study, focuses on the exhaustive and qualitative exploration of the parenting experience of a single participant, with a case analysis approach (Stake, 1995). This approach allows for a deep and contextualized understanding of her perceptions, challenges, and influences in her role as a mother.

Data Collection: Semi-structured Interview. The main tool for the construction of this case was a semi-structured interview. The semi-structured interview is a qualitative data collection technique that combines a pre-established set of questions with the flexibility to explore emerging topics during the conversation (Hernández-Sampieri & Mendoza, 2018). Specifically, subtopics such as influences on parenting, family history and bonds, impact of armed conflict, influence of territory and culture, institutional support, her daughter's experiences, values in parenting, personal challenges in parenting, and her own childhood memories were explored.

Participant: J is a 31-year-old woman, born in the department of Putumayo, Colombia. She has a degree in business management technology and currently runs a shop in the department of Chocó, in addition to her parenting and childcare duties. J expressly agreed to participate in the study through informed research consent.

Data Analysis: The interview analysis was carried out following the six phases of Braun and Clarke's (2006) thematic analysis, which allowed for systematic immersion and deep interpretation of the data, through the following steps:

1. Familiarization with the Data: This initial phase involved deep immersion in the interview transcript. Initial notes were taken on recurring ideas, impactful phrases, and possible patterns related to parenting practices, the relationship with the territory, family, community, and conflict.
2. Generation of Initial Codes: This process involved identifying interesting and significant characteristics in the text, both at a semantic and latent level.
3. Searching for Themes: This involved grouping the initial codes into broader potential themes and sub-themes, and collecting all relevant coded data extracts within these identified themes.
4. Reviewing Themes: This phase focused on refining the candidate themes. All data extracts collected for each theme were reviewed to ensure they formed a coherent pattern and that there were clear distinctions between themes.
5. Defining and Naming Themes: Consideration was given to how each theme fit into the overall story of the data in relation to the research question.

The Intergenerational Fabric of Parenting: Analysing this theme delves into how J's parenting practices are deeply shaped by her own upbringing and how she was raised. This highlights the active and reflective process of intergenerational learning and adaptation.

Replication, guiding children to overcome difficulties: J openly expresses a strong desire to replicate in her children the empathetic, counselling, and opportunity-giving approach of her father, considering him a role model in how to carry out her parenting work, while consciously distancing herself from her mother's more "strong" behaviour, which she justifies as a consequence of her mother's early orphanhood. This selective adoption of parental traits reveals a deliberate effort to break cycles of upbringing induced by difficulties. This suggests that the intergenerational transmission of parenting is not a passive replication of past patterns, but an active and selective process.

"Because my dad has a style, a way of reaching people, he, he always gives you opportunities, he advises you."

Resilience and Autonomy in a Complex World: In environments marked by violence and complex, unpredictable social dynamics, where there is very little external control, fostering a strong sense of self-awareness and the ability to reflect on one's own actions becomes a mechanism of psychological survival. This practice that J carries out with her children seeks to equip them with internal resources to navigate challenging social landscapes, empowering them to find stability within themselves when external stability is scarce.

Territory as a Shaper of Parenting: In this theme, territory takes on meaning as an active agent in shaping family life, upbringing, security, and development.

Freedom and Nature in Childhood, Recalling Her Own Childhood: J recalls her "free" childhood on a farm, characterized by unlimited nature, surrounded by animals and vegetation, which contrasts sharply with the limited and carefully managed "freedom" she seeks for her children in her current place of residence. In a more urban context with social order disturbances, "freedom" for children becomes a scarce commodity that parents must actively seek and organize in specific, controlled micro-environments. This highlights how the changing territorial landscape, from rural to urban and from conflict-ridden to relatively safer, forces parents to reflect on childhood freedom, underscoring environmental limitations in child development in such environments, and contrasting them with their own upbringings.
It serves as a psychological anchor, representing an idealized state of child development, and implicitly, a reference point against which she evaluates her current environment and her children's experiences. This idealized vision influences her parenting choices, such as seeking natural spaces like the beach for her children. In this phrase by J we can see a clear example of this.

"The freedom of being with animals, with that... We had cows, chickens, and pigs then, and so one is happy."

The Current Reality: Seeking Refuge Within the Conflict:
J's mobility from Putumayo to Chocó are not simple changes of residence, but deliberate and strategic acts and decisions for the well-being of her children. Her decision to move is explicitly linked to "macabre violence", as she herself mentions below, highlighting migration as a critical coping and resilience strategy for families and individuals in conflict-affected regions, where parents actively seek safer territories to safeguard their children's physical and psychological well-being.

"If I was going to sell the little farm to set up my business there.... And in those days, the macabre violence started, and I decided to work around here."

Places of Importance: Home and Beach as Havens:
In the everyday urban environment, which is perceived as more chaotic and insecure, J identifies specific micro-environments such as her home and the beach as strategic spaces for her children's healthy development. The beach is valued for allowing children to "be children," which

is very much associated with the freedom previously addressed in a more natural setting. This demonstrates how parents in challenging urban or displaced contexts must actively seek safe and appropriate spaces for development, rather than relying on the broader, uncertain community environment.

The Diversity of Cultural Landscapes and Community Dynamics: This theme explores J's experiences with cultural diversity, particularly the clash between the indigenous values obtained from her own upbringing and the dominant culture in her current place of residence.

Cultural Clashes: J perceives a significant cultural difference, characterized by excessive noise in her immediate environment and communication she perceives as hostile and aggressive. She contrasts this sharply with her own culture, which she finds more respectful. This cultural clash creates substantial challenges for her family's adaptation, especially for her daughter's school experience.

These highlights how children, particularly those from culturally distinct backgrounds, can internalize and manifest the stress of incompatibility and/or cultural clashes through emotional withdrawal. This emphasizes the critical need for culturally sensitive and inclusive educational environments that recognize and mitigate the psychological burden of cultural difference in children.

Emotional Consequences of Violence and Armed Conflict: This theme examines the impact of armed conflict on J's life, her family, and her parenting practices. It reveals how historical trauma continues to shape both current fears and protection strategies.

Personal Trauma and Fear of Armed Groups: The account is a clear example of what happens when living in a state where atrocities become part of the daily fabric of life. Prolonged exposure to such violence leaves consequences that manifest as chronic fear and anxiety, not only for adults and their family members but also for their children. This underscores the critical need for comprehensive long-term mental health and psychosocial support for survivors in post-conflict settings, as trauma extends far beyond the period of active conflict. A clear example of this is the following sentence:

"My sister was the youngest, and it affected her much, much more than me... Even when I saw the army, I was afraid."

Strategies for Neutrality and Survival in Adversity: In an environment where political affiliation or the perception of it can mean danger and even death, neutrality becomes a form of protection and an effective survival strategy in the context of armed violence. It is not an abstract moral stance but a philosophy of life rooted in the experience of survival, transmitted intergenerationally through parenting as an essential life skill in a context of continuous danger. This propensity for neutrality is evident in this narrative.

"Because one always, always has the fear that they will infiltrate those groups. The greatest fear is that. I always instill in my daughter to be neutral, neither here nor there."

Conclusion

The analysis of J's case, a woman who migrates to Chocó in search of a safer parenting environment for her children, offers an important window into the intricate relationship between parental practices, territory, and the persistent aftermath of armed conflict. The findings underscore the agency and resilience of caregivers in contexts of adversity, as well as the profoundly contextualized nature of parenting.

J's experience allows us to observe how parenting transcends mere biological transmission and is configured as an active and reflective process of intergenerational learning. J's decision to replicate her father's empathetic and counselling approach, while preferring to distance herself from her mother's repertoire, is a clear example of this decision-making capacity. This adaptation is not a replication of patterns but an adaptive strategy that seeks to break cycles influenced by past difficulties, such as her mother's early orphanhood. In contexts where violence and unpredictability are constant, this selectivity becomes a mechanism for fostering autonomy and self-awareness in children, equipping them with internal resources crucial for psychological survival. As Masten (2018) has highlighted, resilience in development is not an exceptional quality but the ordinary ability of individuals to navigate adversity and adapt positively, often by internalizing strategies that provide internal stability in the face of external scarcity. This study corroborates that parenting practices are indeed strongly mediated and shaped by the specific cultural context in which they develop, challenging the notion of universality.

The territory emerges as a fundamental shaper of parenting experiences. The marked difference between J's "free" childhood, immersed in her native Putumayo, and the active search for specific micro-environments such as her home or the beach for her children in urban Chocó, highlights the transformation of childhood freedom based on the geographical and sociopolitical landscape. This dilemma not only emphasizes environmental limitations in child development in conflict contexts but also exposes the profound implications of displacement due to violence. The rupture of the social fabric inherent in relocation alters traditional support networks, generating social isolation and a critical decrease in community resources essential for stable parenting. J's migration from Putumayo to Chocó, driven by "macabre violence," exemplifies mobility as a coping and resilience strategy in the face of conflict. However, this displacement, although strategic, introduces complexities such as cultural clashes and the need to adapt to new social dynamics. From Bronfenbrenner's (1979) ecological model perspective, J's narrative illustrates how caregivers, under stress, can actively shape microsystems (the home, the beach) to mitigate the impact of macrosystems (conflict, receiving culture) and exosystems (institutional weakness), evidencing the reciprocal interdependence between children and their environment.

J's confrontation with cultural diversity in Chocó, marked by her perception of hostility, underscores the challenges faced by displaced families when integrating into new contexts, especially when communication norms and values differ. Her daughter's internalization of this cultural stress, manifested as emotional withdrawal, highlights the urgent need for culturally sensitive and inclusive educational and community environments. This phenomenon aligns with the complexities of acculturation, a process that, according to Sam and Berry (2010), can

generate significant psychological stress when the values of the origin culture conflict with those of the receiving culture.

Finally, the study reveals the profound and lasting emotional consequences of the armed conflict in J's life. The fear and anxiety, which extend from her to her children, underscore the critical need for comprehensive long-term psychosocial support for survivors in post-conflict settings. Prolonged violence, where atrocities become part of the daily fabric, leaves sequelae that require intervention beyond the period of active armed conflict. J's strategy of instilling neutrality in her daughter is not merely an ethical stance but a philosophy of life forged in the experience of survival, as it represents a coping mechanism developed in environments where the perception of political affiliation can imply a threat to integrity, something also observed in studies on trauma and adaptation in populations affected by prolonged conflicts (Thabet & Vostanis, 2015).

In summary, J's case not only deepens the understanding of how armed conflict and displacement shape parenting practices but also highlights parental agency and creativity in the active pursuit of their children's well-being. The territory, in this context, becomes a dynamic space of resistance and re-signification, where family resilience is manifested through the selective preservation of traditions and the innovation of survival strategies in the face of incessant adversity.

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Social Pedagogy and Child Recruitment in the Colombian Armed Conflict

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"This article arises from the Well-being, Clinical and Mental Health research line at Ibero, in collaboration with the University Institution Mayor of Cartagena (Colombia) in the field."

Introduction

Armed Conflict and Childhood in the Colombian Caribbean

The Colombian armed conflict has profoundly affected childhood. Boys and girls have been victims of forced displacement, recruitment, sexual violence, family homicides, and cultural uprooting. According to data from the Unit for Victims, more than 2.5 million minors have been officially recognized as victims of the conflict (Unidad para las Víctimas, 2022; Human Rights Watch, 2021; Save the Children, 2019). These experiences generate psychosocial impacts that affect comprehensive development, self-esteem, affective bonds, and sense of belonging. Therefore, it is necessary to implement trauma-sensitive educational strategies capable of promoting resilience and identity reconstruction (Jiménez, 2017; Machel, 1996; UNICEF, 2016).

In the case of the Colombian Caribbean, this theory is applied to explain the recruitment and manipulation of children based on what Galtung calls the Triangle of Violence, a theoretical model that analyzes the formation and evolution of violence and conflict as a natural and permanent condition of human beings, that is, structural (Galtung, 1985). In this sense, it is not yet possible to speak of a complete post-conflict phase in this subregion. Child recruitment remains a reality, as parallel armed groups have emerged, such as criminal gangs (BACRIM), youth gangs, and micro-trafficking groups (Coalico, 2020; Springer, 2012).

Moreover, families in the subregion belong to vulnerable and rural sectors, where economic and institutional instability hinders children's holistic development. From this wave of violence, armed youth groups emerge, engaging in theft, territorial control, and street fights. These youths abandon schools and extracurricular activities due to lack of interest, as they perceive them as failing to meet their expectations. They also attribute school dropout to social problems, the absence of a sustainable economy, and government neglect of their communities. Galtung refers to this as direct violence, since it is exercised by specific actors and becomes evident through the continuous emergence of local armed groups and the lack of regional security (Perea Mojica, 2015).

The third category completing the triangle is cultural violence, manifested through symbolic and communicative means that, in one way or another, justify destructive actions (Galtung, 1985). Cultural violence is visible in the Montes de María since, although children did not experience the period of violence directly, they reflect its aftermath through family history and the new lifestyles of their parents and relatives. Fear has become one of the legacies of that period, along

with new social roles and parenting patterns. Violence is internalized as the primary mechanism for resolving conflicts—an inheritance from illegal armed groups that perpetuates cycles of abuse and violence (Heckman, 2006; Ortega & Rey, 2007).

Along these lines, Sirvent (2004) argues that poverty should be understood as a trident of multiple poverties: not only economic and social poverty but also: (i) poverty of protection, derived from fear generated by historical violence, which obstructs channels for social participation in reparative processes; (ii) poverty of participation, arising from contextual issues such as weak institutions in addressing violence against communities; and (iii) poverty of understanding, which fosters fatalistic and reductionist thinking that transforms victims into victimizers, holding them responsible for the violence in their territory, thus naturalizing injustice.

Social Pedagogy and Peacebuilding in Childhood

This study analyzes significant experiences in communities of the Colombian Caribbean region where social pedagogy interventions were implemented, highlighting their impact on transforming the living conditions of children affected by conflict. It also establishes clear guidelines for the collective reparation of children in situations of armed conflict. (Del Pozo Serrano, De Lima, & Mercado, 2021).

Social pedagogy is a discipline that emerges from the intersection of education, social work, and psychology, oriented toward promoting human development in vulnerable contexts. It focuses on shaping autonomous and critical individuals through non-formal, community-based, and participatory educational processes (Caride & Meira, 2001). Unlike traditional education, social pedagogy prioritizes lifelong accompaniment and situated educational action, emphasizing care, affectivity, and social justice (Jiménez, 2017; Galtung, 1996; UNICEF, 2016; Betancourt et al., 2013).

In contexts marked by exclusion and violence, this pedagogy becomes an alternative for building active citizenship and fostering social reparation, by providing spaces for expression, recognition, and reconstruction of life's meaning (Cussiánovich, 2006). Childhood is thus recognized as a subject of rights, not as a passive object of assistance, transforming intervention practices into logics of participation and child protagonism (Gómez & Suárez, 2018; UNESCO, 2017; Lederach, 1997).

Resilience, understood as the capacity to overcome adverse situations and construct dignified life projects, is strengthened through affective, protective, and meaningful environments (Manciaux, 2003; Rutter, 2012; Ungar, 2011). Social pedagogy contributes by providing spaces for symbolic expression, artistic activities, and group dynamics that allow for the re-signification of suffering.

Emotional education also emerges as an essential component. Fostering emotional competencies in children enhances self-knowledge, empathy, and behavioral regulation—key elements in preventing new cycles of violence. In the Colombian post-conflict context, social pedagogy becomes a key strategy to build stable and lasting peace from the ground up. This involves not only ceasing armed violence but also transforming the structural conditions of

exclusion, inequality, and silence that have shaped the lives of millions of children (Gómez & Suárez, 2018).

The research was conducted under a qualitative approach with a participatory perspective. Data collection techniques included semi-structured interviews, focus groups, and participant observation. This methodology aimed to understand the data in a non-generalizable, interpretative, and holistic manner, considering the study context and its dynamic reality (Cisterna, 2005). The qualitative research consisted of detailed descriptions of participants' narratives and documentary evidence on the subject, including experiences, attitudes, and beliefs. Consequently, it was based on a descriptive design, seeking to specify the relevant properties of the case under analysis, that is, interpreting various aspects, dimensions, or components of the phenomenon investigated (Hernández Sampieri, Fernández Collado, & Baptista Lucio, 2014).

Participants. The study involved 12 social educators and community leaders engaged in intervention projects in the departments of Bolívar, Atlántico, and Magdalena. These participants work in areas severely affected by the Colombian armed conflict, where they interact daily with victimized populations.

Data collection techniques. Three focus groups and twelve interviews were conducted on the role of social pedagogy in collective reparation processes for children in the Caribbean region, examining their strategies, effects, and monitoring of pedagogical interventions. Guiding questions were of two main types: (i) general or "grand tour" questions, which began with broad prompts to introduce the topic of interest, and (ii) specific questions aimed at deepening the discussion.

Analysis. Three units of analysis, or a priori categories, were explored, each corresponding to one of the specific objectives of the research. The analysis was carried out through thematic coding, identifying emerging categories related to the effects of social pedagogy on inclusion, resilience, and identity reconstruction. An ethical perspective sensitive to the suffering and dignity of the children involved was prioritized.

To analyze the collected data, a systematization process was carried out using the technique of hermeneutic triangulation (Cisterna, 2005). This involved relating and cross-referencing information pertinent to the case study for each unit or category of analysis derived from the sources collected. The analysis formed part of the corpus of research results and responded to different stages: (a) selection of pertinent and relevant information—defining the units of analysis and contributing to the construction of categories and subcategories; (b) triangulation of information from each source (interview participants and focus groups), establishing ascending conclusions and grouping responses by unit based on similarities and differences across the instruments applied.

Categories of Analysis

The findings indicate that social pedagogy has had a positive impact on:

Emotional and social resilience. Children developed skills to express their emotions, build support networks, and reframe traumatic experiences. Emotional and social resilience in childhood is a complex process that entails the capacity of children to confront and overcome adverse situations, while maintaining psychological well-being and strengthening social skills that facilitate integration into their family, school, and community environments (Luthar, Cicchetti, & Becker, 2000).

Identity reconstruction. Through artistic, theatrical, and narrative practices, children were able to recognize their histories, rights, and role within the community. Child participation is defined as an active process in which children and adolescents engage in community life and decision-making processes that affect their rights, well-being, and environment. This concept is grounded in the United Nations Convention on the Rights of the Child (UNICEF, 2020), which acknowledges children's right to be heard and to participate in social, cultural, political, and economic life. Participation fosters not only social skills, leadership, and responsibility, but also strengthens community bonds, promotes solidarity, and cultivates a sense of belonging and social commitment (Hart, 1992).

Child participation. Community activities fostered leadership, solidarity, and co-responsibility in the construction of peaceful environments. Participation not only enhanced children's agency and leadership skills but also reinforced their role as active contributors to social transformation (Hart, 1992; James & Prout, 1990).

Recovery of a sense of belonging. Collective memory practices facilitated the re-signification of territorial ties and strengthened community bonds. The recovery of belonging in communities refers to processes of re-signifying affective, cultural, and territorial connections that reinforce collective identity and enable individuals and groups to rebuild their sense of rootedness in contexts of loss, displacement, or conflict. This process entails reclaiming shared histories, traditions, and collective memories, which serve as the foundation for strengthening the social fabric and promoting community cohesion. From the qualitative analysis, four main categories emerged, structuring the effects and impacts of social pedagogy on children affected by armed conflict. These categories are connected to psychosocial, educational, and community processes that highlight the transformative potential of the interventions. The following sections present these categories and their respective subcategories.

Emotional and Social Resilience

This category encompasses the personal and collective strategies developed by children to overcome adverse experiences, reframe pain, and generate positive emotional resources. Subcategories: i) Emotional expression and catharsis. Artistic workshops and recreational activities encouraged the verbalization of repressed emotions (fear, sadness, anger); ii) Reconstruction of life purpose. Through life narratives and self-affirmation exercises, children began to project personal aspirations and future goals; iii) Meaningful psychosocial support. The

role of the social educator proved fundamental as an affective figure and emotional support, strengthening participants' subjective sense of security; iv) Social educators highlighted how artistic and recreational activities enabled children to safely and creatively explore and express emotions, facilitating processes of emotional catharsis that were both therapeutic and liberating (Betancourt et al., 2013; Cyrulnik, 2003; Masten, 2014; Hart et al., 2011).

Identity Reconstruction and Sense of Belonging

This category demonstrates how social pedagogy facilitates the re-signification of children's identities as dignified subjects with their own histories, culture, and voice, challenging discourses of passive victimization. Subcategories: i) Territorial identity and collective memory. Historical memory activities allowed children to reconnect with their cultural roots and communities of origin; ii) Recognition of rights and self-esteem. Work based on the Convention on the Rights of the Child and empowerment exercises fostered a positive self-image as valuable citizens; iii) Affirmation of diversity. In culturally mixed contexts resulting from displacement, activities promoted respect for differences and interculturality; iv) Social educators emphasized that memory practices reinforced children's cultural identity and community belonging, empowerment activities enhanced self-esteem and rights awareness, and intercultural practices fostered inclusion and social justice (Lansdown, 2010; James & Prout, 2015).

Active Participation and Child Agency

This category refers to children's involvement in decision-making processes and collective initiatives, representing a shift from passivity to action. Subcategories: i) Leadership in community activities. Children organized campaigns, public presentations, and murals with messages of peace and reconciliation; ii) Emerging child leadership. Some children assumed roles as mediators, spokespersons, or facilitators among peers; iii) Shared decision-making. Participatory methodologies included children's voices in the design of activities; iv) Educators described how children progressively engaged in organizing community events, took on leadership roles in peer mediation, and participated in collective decision-making processes. These practices not only strengthened their agency but also promoted democratic participation, responsibility, and mutual respect within their communities (Shier, 2001; Percy-Smith & Thomas, 2010).

Strengthening the Social Fabric and Culture of Peace

This category highlights how interventions generated effects beyond the individual, contributing to the reconstruction of the social environment and intergenerational relationships. Subcategories: i) Intergenerational encounters. Activities fostered spaces for dialogue among children, parents, grandparents, and community leaders to reflect on conflict and peacebuilding; ii) Solidarity and school/community coexistence. Improvements were observed in peer relations, reduction of aggression, and increased collaborative attitudes; iii) Collective impact projects. Initiatives led by children (gardens, murals, ecological campaigns) extended beyond educational programs, producing visible transformations in the community; iv) Educators emphasized that intergenerational dialogue fostered healing and unity, while community projects reinforced solidarity, collaboration, and collective pride. Such initiatives transcended the classroom, visibly

transforming communal spaces and contributing to peacebuilding efforts. In sum, these results demonstrate that intergenerational experiences, solidarity practices, and collective projects not only benefit children's individual development but also strengthen the social fabric and promote a culture of peace in their communities (Bar-On, 2006; Muñoz & Molina, 2010).

Conclusions

The study concludes that social pedagogy holds a high transformative potential in contexts marked by armed conflict. Its implementation in communities of the Colombian Caribbean has contributed to strengthening both individual and collective capacities among children affected by violence**.** The discussion of the findings supports the assertion that social pedagogy not only mitigates the effects of armed conflict on childhood but also fosters the development of critical, resilient, and empowered individuals. By integrating affection, memory, participation, and social justice, this pedagogical approach emerges as a key strategy for rebuilding the social fabric in post-conflict settings. These results demonstrate how social pedagogy, when implemented through a territorial, participatory, and trauma-sensitive approach, advances processes of symbolic reparation, restoration of bonds, and reconstruction of citizenship from childhood. The presence of significant adults, the use of art as a language of transformation, and the promotion of child participation were recurring elements across all the experiences analysed.

Its incorporation into comprehensive victim care policies, as well as into territorially focused educational programs, is therefore recommended. Investing in social pedagogy means investing in sustainable human development, reconciliation, and the construction of lasting peace from childhood.

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Citizenship for peace among students with moral disengagement in Colombia

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This text arises from the project "Peacebuilding and Citizenship Based on the Chair of Peace in Colombia's Educational Institutions" of the Minuto de Dios University Corporation UNIMINUTO.

Introduction

Morality is constructed by a set of values with which a community identifies in the exercise of its social life, configuring itself as elements that regulate the life of the human being, in its individual and collective exercise (Brizuela et al., 2021). This situation turns it into a premise that, when internalized by people, develops self-regulated behavior patterns in them, with which they assertively and proactively establish interaction with other subjects in their social group (Aguilera & Manzano, 2021).

But in some cases, individuals disconnect from morality, engaging in behaviors that violate it, directly and indirectly affecting others in their social environment. From this perspective, moral disconnection leads to situations such as cyberbullying, bullying, theft, and gender-based violence, among other cases that contradict prosocial behavior that favors community life (Bautista et al., 2024). In this sense, social settings are contexts where the presence of moral disconnection can be evidenced, expressed through individual and collective behaviors (Gómez & Correa, 2022). This behavior directly impacts social conflicts and penalized behaviors, which hinder the construction of civic principles that shape the exercise of citizenship for peace, one of the most important categories for Colombia within the framework of its commitment to building peace in its territories.

From this perspective, Ciudad Bolívar, one of the towns in the Bogotá district located in the south of the district, built through the efforts of its inhabitants, many of whom are displaced, has made significant progress in shaping its territory and addressing basic needs in terms of sanitation, public health, and education (Cruz et al., 2024). However, among some of its inhabitants, behaviors are recorded that demonstrate a moral disconnect that affects the development of citizenship for peace in the town (García-Noguera & Verdugo, 2023). From this assessment, as seen in the Management Report of the Comprehensive Plan for Security, Coexistence, Citizenship and Justice (PISCCJ) of Bogotá D.C., issued by the District Secretariat of Security, Coexistence and Justice of Bogotá (2023), in the Ciudad Bolívar locality, a high rate of homicides, micro-trafficking, robbery and extortion is recorded, affecting community life and the public policy actions that the nation and the government are carrying out to improve the living conditions of its inhabitants.

Within this scenario, the Arborizadora Alta School is located, a District Educational Institution, one of the largest public schools in the Ciudad Bolívar area, serving an educational population of 2,561 students, at the preschool, basic and secondary levels in the morning and afternoon

shifts, with a formative bet outlined in the Institutional Educational Project [PEI] (Arborizadora Alta School, 2019), which, through the implementation of a critical significant learning pedagogical approach, seeks to train critical and participatory individuals, committed to their social environment.

This approach tends to be limited by the behaviors of some students, which demonstrate a moral disconnect. In this regard, many children and adolescents at the school continually engage in various maneuvers to avoid assuming their moral responsibility in the face of situations of aggression, destruction of institutional property, theft, bullying, or cyberbullying, among other actions that consistently affect healthy coexistence and the exercise of civic conduct. This situation is further exacerbated when considering that students, when questioned about their behavioral actions, tend to consider them correct, fair, or valid, contradicting the moral minimums established by the institution in its coexistence manual and, on a more global scale, acting against the moral values inherent to Colombian society and international considerations embodied in principles such as the Declaration of Human Rights.

In this context, education for citizenship for peace can be considered a pressing need due to the social conditions present in the area, but its construction and development must be based on research on the moral disengagement experienced by students (García-Noguera & Dueñas, 2024). Based on this consideration, the research sought to design a proposal to promote citizenship for peace among students with moral disengagement at the Arborizadora Alta School in Ciudad Bolívar, Bogotá.

Upon reviewing the background, the study "Students' assessment of school climate, coexistence, and violence in secondary schools in northwestern Mexico" was found, developed by Calderón-González and Vera-Noriega (2022). They sought to understand students' assessments of democratic coexistence in their school, their relationships with their classmates, violence on campus, and the school climate in general. To this end, it was framed within a quantitative, cross-sectional, and correlational approach. It concludes that the model used is a useful tool for predicting situations of violence that occur in the institution. This study is a reference that contributes to this project, providing references for the construction of the previous categories.

Under these same considerations, the study "Moral Disengagement Strategies in Virtual and Face-to-Face Bullying" was developed by Romera et al. (2021). They sought to examine which dimensions of moral disengagement were associated with bullying (face-to-face/virtual) and explore the effects related to sex and age. To this end, it was framed within the quantitative, multiple regression approach. It concludes that the moral disengagement strategies employed have an impact on aggression and bullying among adolescents. This study is a reference that contributes to this project, conceptual references for the construction of the previous categories of the research.

Also, the study "The protective role of empathy and emotional self-efficacy in predicting moral disengagement in adolescents disengaged from illegal armed groups" developed by Gómez & Durán (2020) was reviewed. They sought to analyze the role of empathy and emotional self-

efficacy as predictors of moral disengagement in adolescents disengaged from illegal armed groups. For this purpose, it was framed within the quantitative, multiple regression approach. It concludes that empathy and self-efficacy are factors that protect the moral disengagement of the study participants. This study is a reference that contributes to this project, conceptual references for the construction of the previous categories of the research.

The research reviewed reveals the presence of moral disengagement within the school setting and the consequences it can cause, altering the conditions of coexistence and respect for the moral minimums that regulate interactions between stakeholders in the educational community.

In accordance with the problem and proposed objectives, citizenship for peace is understood as an expression of the exercise of citizenship, which rejects the different expressions of violence in the interaction and resolution of conflicts between individuals and communities, promoting social environments framed in dialogue and respect for human rights (Moreira & Aguirre, 2019). Under this consideration, citizenship for peace can be assumed as a strategy for building peace in environments marked by conflict, rescuing the ethical and moral values that dignify human beings in the exercise of their civic commitment (Restrepo et al., 2020).

Likewise, moral disconnection is assumed to be a behavior associated with a restructuring of moral action in human beings, overlooking acts or feelings associated with actions that violate the scale of moral values established by social groups (Gómez & Correa, 2022). Therefore, moral disconnection is associated with situations of violence and crime that affect the exercise of citizenship in social environments, increasing conflict dynamics in the different dimensions of development of individuals and communities (Gómez & Durán, 2021).

Moral disengagement is a process whereby people, through various mechanisms, reframe their behavior, adopting behaviors that violate norms or values accepted by the social collective. In this sense, it is an action that leads individuals to reject questions, censure, or criticism of their actions because they believe they are not violating an established moral norm. This can lead to conflictual situations that disrupt healthy coexistence and the well-being of individuals.

From this perspective, Gómez & Correa (2022) point out that, "moral disconnection refers to the sociocognitive strategies that people use to restructure their understanding of an immoral, violent, or cruel action and thus avoid moral self-censorship" (p. 275). Therefore, Martínez-González et al. (2020) consider it important to carry out research that demonstrates moral disconnection, the mechanisms through which it is expressed, and its presence in different social settings, to develop intervention proposals that highlight the importance of morality.

Taking into account the problem and objectives to be developed in the research project, it is possible to consider that the paradigm of critical theory is the one that best fits the proposed problem, because it allows the knowledge of the phenomenon within the framework of its natural scenario and to advance actions of change, promoting a transformation in the moral conduct that the students are currently developing (Ortiz, 2015).

This paradigm, developed based on the contributions of the Frankfurt School, seeks to understand and transform reality (Ortiz, 2015). To this end, this process articulates research

proposals in which individuals and communities have a significant role, as actors who directly participate in the various phases of the study. This approach contributes to the development of processes of emancipation and commitment to the transformation of reality (Loza et al., 2020). Likewise, it seeks to overcome the division in the epistemological appreciation of reality from positivist and constructivist perspectives.

In line with the critical theory paradigm, it can be argued that the study of the social and cultural factors that motivate students' moral disengagement is consistent with the social critical approach, as it allows for addressing the research problem with a strong commitment from the researcher to understanding and transforming reality.

For the development of this research, the students at Arborizadora Alta IED School will be considered as the population. A total of 2,630 students are enrolled in the two-day program offered by the school, from transition to eleventh grade. These children and adolescents are critical and participatory, with interests and beliefs associated with the social and cultural situations that permeate their context.

According to the population, for the development of the project, a convenience sample will be considered (Hernández-Sampieri & Mendoza, 2020), made up of 45 students from the ninth, tenth and eleventh grades (15 students from each grade).

In the development of the fieldwork considered in the research initiative, the following information collection techniques will be considered:

Open-ended survey: This is a technique that facilitates the reliable and confidential collection of information, intended to explore participants' knowledge, experiences, or perceptions about a specific topic. A questionnaire is used as an instrument for its development (Hernández et al., 2014).

Focus group interview: This type of interview seeks to gain a deeper understanding of social reality, with the intention of tracing underlying elements based on the interventions and dialogue between participants. Within the project, the focus group interview guide (Hernández et al., 2014) would be used.

Co-creation workshop: This technique encourages exploration, dialogue, and knowledge-building among research participants, with a markedly participatory and prosocial nature. Its application in the project would be developed through the co-creation workshop guide (Hernández et al., 2014).

The validation of the designed instruments was carried out through expert judgment, this validation process being an exercise of critical review of the proposed devices to guarantee their reliability and objectivity in accordance with the interests of the study (Hernández et al., 2014).

The analysis of the collected information will be carried out based on the data records collected through the research techniques used. These will be processed from the categorical analysis (Hernández et al., 2014), starting from the initial categories assumed in the study and

incorporating the emerging categories that may arise. Likewise, the development of the categories is considered according to their operationalization in the subcategories and analysis units that develop them (Hernández-Sampieri & Mendoza, 2020). This information will be subject to axial coding (Hernández-Sampieri & Mendoza, 2020), its descriptive analysis and interpretation according to the theoretical referents assumed in the project.

Mechanisms of moral disconnection

This subcategory was framed within the study's first specific objective, which seeks to "characterize the mechanisms of moral disengagement that are recorded in students' behaviors." To this end, it was developed through an open-ended qualitative survey, which focuses on the massive and reliable collection of primary data (Hernández et al., 2014). Its operationalization used a questionnaire consisting of 12 open-ended questions, 4 for each unit of analysis.

In this regard, it is important to note that the data analysis was conducted by constructing a matrix of axial codes that allowed for grouping the information according to the defined categorical operationalization. The data suggest that students engage in moral disengagement mechanisms such as the use of euphemisms, shifting responsibility, and minimizing consequences. These are strongly linked to the behaviors students display in their interactions in the classroom, at home, and in their neighborhoods.

The information collected reflects the moral disconnection that students have developed, building a behavior that deviates from the minimum ethical axiological principles that can guarantee healthy coexistence (Gómez & Durán, 2021).

Social media

This subcategory was framed within the study's second specific objective, which seeks to "determine the importance of the local social environment in students' moral disengagement mechanisms." To this end, it was developed through a focus group interview, which allows for a deeper understanding of the appropriation of social reality, with the intention of tracing the underlying elements (Hernández et al., 2014). In its operationalization, the instrument used was a focus group interview guide, consisting of 12 open-ended questions, 4 for each unit of analysis.

The data collected demonstrate that the mechanisms of moral disengagement they have developed respond to behavioral patterns fostered by the social environment. It is important to note how the violence experienced and continues in the area is clear, along with other factors that have perpetuated certain conditions of poverty.

As Prieto-Ursúa & San Martín (2024) have pointed out, the importance of the social environment in the development and strengthening of moral disconnection mechanisms is evident, a situation that in the context of students is facilitated by the expressions of violence that exist in the territory.

Citizenship for peace

This subcategory was framed within the study's third specific objective, which seeks to "design an educational proposal that fosters citizenship for peace in students with moral disengagement." To this end, it was developed through a concretization workshop, a technique derived from participatory and social research that encourages processes of exploration, dialogue, and knowledge construction among research participants (Hernández et al., 2014). A concretization workshop guide was used as a tool for its operationalization.

The data collected demonstrate that case studies using problem-based pedagogy can foster the development of critical thinking linked to citizens' civic duty, viewed within the framework of peacebuilding initiatives.

The role that critical thinking can play in the development of citizenship for peace is rescued, using for this purpose strategies of problematic pedagogy that lead students to question their civic duty within the bets for the construction of an environment of dialogue, peace and reconciliation (García, 2012).

Conclusions

In conclusion, the research demonstrated the existence of mechanisms of moral disengagement in students, strongly linked to their social context. This problem, through an educational approach centered on case studies mediated by problem-based pedagogy, encourages the development of critical thinking based on the exercise of citizenship for peace. Finally, it is important to emphasize that addressing this problem requires additional research because it is a multifactorial reality that must articulate actors, histories, and initiatives that energize peacebuilding in accordance with the unique characteristics of the territories.

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Migration from resilience and complexity: towards a new framework

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This text arises from the CONAHCYT BORDER SCIENCE project No. 1327731, "Resilient attitudes and exercise of active citizenship, which was developed by members of Mexican transnational families, of status mixed migration, under conditions of great adversity in the current economic, political and social context in the United States and Mexico."

Introduction

The way in which the challenges posed by the contemporary world are framed within environmental changes, human mobility, challenges to our way of living together, our economy, etc., and how alternatives are identified that are close to solutions that seem never to be definitive, has changed over time as research activity identifies new conceptual frameworks and tools for its analysis. However, it seems that we continue to see only two mutually exclusive paths: one that proposes that our world be sustainable, humane, developing new technologies for the common good, etc., and the other, driven by the economic insatiability inherent to the capitalist world (accumulation and dispossession). If the above is to be taken seriously in research on migration, we are faced with permanent challenges. The subjects of our research (migrants) and their contexts are constantly changing as a result of practices ranging from arbitrary detention in transit or at the destination, to family separation and the violation of the right to migrate, and even loss of life.

The migration phenomenon has been analyzed by experts from various perspectives: reasons for migration, volume and destination of remittances, impact of migrant organizations on their communities of origin, contributions of migrants at the origin and destination, public policies to support the actions of migrant organizations, etc. This is especially true of the migration of Mexicans to the United States, a phenomenon that dates back more than 120 years (Durand, 2016). Zacatecas, Guanajuato, Michoacán, and Nayarit were the states with the highest migration intensity to the United States (CONAPO, 2010).

Everything changed with the arrival of the new administration in the United States in 2025. Border arrests have been reduced to a minimum, but raids in rural areas and cities like Los Angeles, California, Dallas, Texas, and Chicago, Illinois, are a daily occurrence. Deportation and the criminalization of migrants are the central objective of current policy on the matter; the threat is constant.

Given these circumstances, it is necessary to offer a complementary approach to research on the migration phenomenon. The idea is to incorporate additional elements and tools to the frequently employed descriptive approaches, which have had little impact other than reflections in academic forums, but have not transcended the proposals for those tasked with designing

public policies appropriate to the circumstances. Today, returned or deported Mexican migrants in particular face a dilemma: they return, and things have changed in their communities and places of origin. It is not easy to overcome the traumatic situation of being separated from their families, fragmented families, assets they will never be able to recover, etc. Studying the complexity of the circumstances they face and helping them find their "normalcy" should motivate a multidisciplinary perspective that sets aside isolated epistemic positions that only see one side of the phenomenon (a single discipline) and therefore generate partial and fragmented proposals.

Based on the evidence, we propose incorporating two constructs into the methodological strategies used in studies on Mexican migration to the United States: complexity and resilience. We must be clear that transferring concepts from an experimental discipline to a social one has implications, but this does not mean we should stop developing alternatives for better management of the migration phenomenon.

Complexity

In physics, a system is said to be complex (CS) when it is composed of multiple branches disciplines. However, when a phenomenon is said to be complex and composed of several branches disciplines, it refers to the phenomenon having multiple variables that interact with each other in a linear and nonlinear manner, and the response varies depending on the combination of levels of each variable. These branches can be understood as the different pathways or paths through which the variables of the system interact with each other.

The territories from which migration originates are societies that occupy a specific space in the biosphere; they are CS; they are a fragment of reality that includes physical, biological, social, economic, and political aspects (García, 2006). CSs are characterized by totalities in which the functioning of the whole is not equal to the sum of its parts. Thus, migration, viewed as a CS, must be analyzed holistically, leaving aside the unique characteristics of the phenomenon in the history of the phenomenon.

CS have two characteristics: they are open and dynamic. This simultaneity implies that the system maintains communication with its environment, made up of the elements of the universe that lie outside its boundaries, determined by the research interest. The latter establishes what the system is, what its elements are, and which ones make up its environment, that is, all those elements of the universe that, while outside the system, are part of it. Open and dynamic CS subsist in view of the continuous interaction with their environment (Zamora, 2009).

In the context of a migration-related research problem, complexity motivates the creation of indicators that accurately express the relationships resulting from the interaction between variables that affect how the migration process will be managed (origin, transit, destination, return) and the skills needed to manage it. This will enrich our understanding, in this case, of how migrants build resilience from multiple perspectives. More generally, complexity refers to a set of interconnected variables, factors, or components that relate to each other in ways that are not always obvious. It is important to establish that the range of interactions grows geometrically

and therefore requires judgment when choosing dimensions, variables, and scales of expression for these variables, as well as identifying how the response (or responses) will be assessed in a given context. The study of culture, societies, migration and ecosystems, among other topics, requires the convergence of various disciplines and the reformulation of epistemic visions that are far removed from a single discipline.

Resilience

The word "*Resiliencies*" is a Spanish version of the English word "resilience." This concept is taken from physics and is similar to "elasticity," the ability of materials to recover their original size and shape after being compressed. From a psychological and social perspective, resilience means a combination of factors that allow human beings to confront and overcome life's problems and adversities and build upon them (Suárez Ojeda, 2001). The concept began to be used in the field of Evolutionary Psychology, as a attempt to explain why some children, faced with a life of stress, were able to overcome adversity and be transformed by it, becoming healthy individuals (Menvielle, 1994).

Vanistendael (2003) proposed five dimensions of resilience: informal networks (having friends, participating in community activities); meaning in life; transcendence (ability to discover meaning and coherence in life); positive self-esteem (self-worth, confidence in one's abilities); aptitudes and skills (developing competencies and confidence); and sense of humor (ability to play, laugh, enjoy, and have fun). Vanistendael (2003) revealed that the concept of resilience is based on three protective factors that promote it: personal factors, relational-affective factors and institutional-community factors (Munist et al., 1998). Others proposed that resilience should be addressed from a more procedural perspective, since it is not a factor that influences its determination, but rather a person-context interaction (Melillo & Suárez Ojeda, 2001).

Green and Conrad (2002) propose that resilience factors are internal and external in nature; internal: personal psychological resources that allow one to overcome adversity; external: those that are not within the person, involving the family, school, community, social and cultural systems. Rivera and Andrade (2006) propose that these resources have at least five dimensions (Figure 1): Affective, Cognitive, Instrumental, Social and Material resources.

Figure 1. *External and internal resources and dimensions (Rivera and Andrade (2006).*

Migration, complexity, resilience

Mexico has one of the most complex migration contexts in the world, characterized by high levels of emigration and an increasing presence of returnees, forcibly deported people, people in transit, immigrants, asylum seekers, refugees, and internally displaced persons (Sánchez-Montijano & Roberto, 2022). The above quotation provides a brief outline that reinforces the idea of paving the way for studies on complexity and its relationship with resilience in migrants. To this end, they propose addressing several key aspects: Protective Factors; Diversity of Experiences; Integration Policies; and Personal and Community Resilience. Hence the consideration of viewing the migration process as a complex system, which should set the new standard for research, from a perspective that moves away, as noted, from a unit disciplinary view, and toward a multi- and interdisciplinary one.

The methodological procedure was determined by the nature of the phenomenon of interest (migration). Seeking to gain a deeper understanding of the migrant family (unit of analysis), an instrument (Ethnic survey) was designed that included the following analytical dimensions: General aspects, Social networks, Material well-being, Subjective well-being, Information and rights claims, Religion, Employment, Access to healthcare, Security and insecurity, Education, Emotional states. Each dimension comprised between three and five items. The setting was the cities of Los Angeles, Anaheim and Sacramento in the state of California, typically receiving Mexican migrants. Fourteen ethnic surveys were conducted; no attempt was made to determine the significance of each dimension. Fieldwork was carried out during the months of July and August 2024. As the context was already one of insecurity and fear, work was only carried out in the urban area.

Main findings

Seventy-five percent of the respondents were women and 25% men. This is explained by the fact that these were household interviews; the age range for the group was 22 to 56 years old. The highest frequency was 44 years old. The length of stay in the United States is constant (87.5%), only 12.5% come and go (circular migration). Ninety-four percent reported having moved to a place where there were already relatives; 75% responded that they had been in the country for decades. The household status in 63% of cases is that members were born in Mexico and others in the United States. Thirty seven percent reported having members born in Mexico. Thirty-seven percent reported irregular immigration status. In terms of material well-being, 68% had moved in with a family member (parents, grandparents), 68% reported having bought a house through credit, 12.5% acquired it in cash. Fifty percent own their own car, 6.3% own their own motorcycle, and the rest share a car with others. In terms of subjective well-being, 88.5% believe their achievements are the result of their own efforts; 69% assert that their achievements make them happy, but there are still unfinished tasks.

However, 56% consider their life better than it was 10 years ago. Their achievements center on owning their own home (or paying for it) and educating their children. 62.5% reported they did not have Social Security; 12.5% had Medicare, and 12.5% had Medicaid. Regarding education, 50% had completed secondary or high school, 25% had a bachelor's degree, and 6.3% had a

master's degree. 62.5% professed Catholicism as their religion, 31% did not respond, and the rest were Christian. Their religion provides support and guidance, but (49%) did not respond. Fifty-seven percent reported permanent employment, 18.8% temporary employment, and the remainder did not respond; they work primarily in services (50%) and industry (37.5%). 37.5% consider their salary better today than it was at the beginning. Regarding social relations, 44% respond being married to another person from the same town or a different one but from Mexico, only 6.3% are married to someone from another country. The ties are mainly limited to the family; the reason is that this is where they are listened to and given advice and information; they find the greatest acceptance at home and in the Church; 32% feel aggression from Anglo-Saxons and Asians; 38% say they have not experienced aggression. They are afraid of being separated from their children and being deported (44%). They only socialize with acquaintances and try not to leave home due to self-imposed limitations. They feel that nothing can be changed and that the reduction in their rights is due to their immigration conditions.

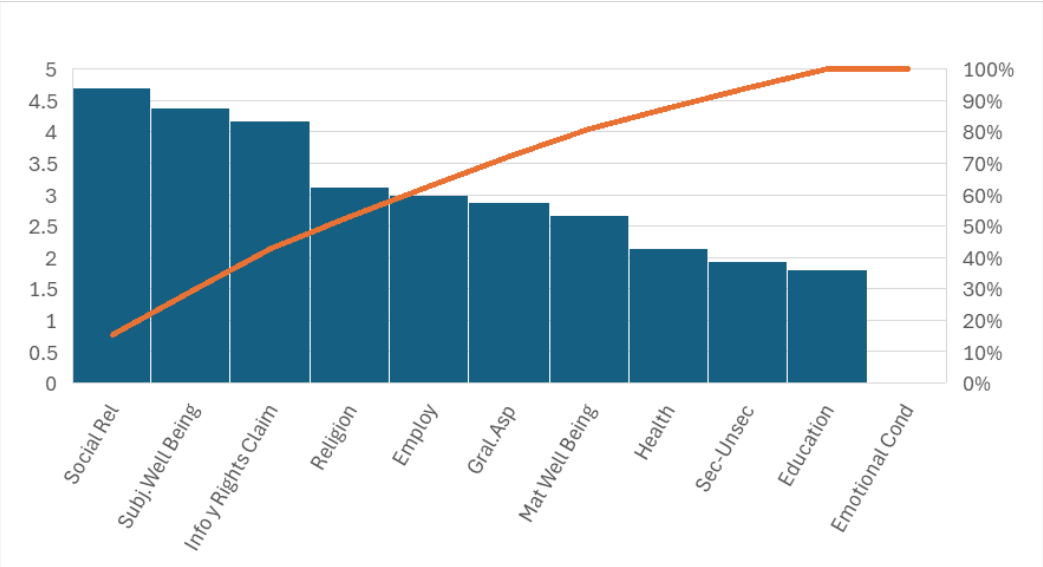

Figure 2. Pareto analysis analitic dimensions.

Using non-conventional analysis, the Pareto graph of the whole allows us to visualize the three most important dimensions: Social Relations, Subjective Well-being, and Information and Claiming Rights. Emotional condition had an imperceptible response (Figure 2). The following is an individual analysis, after weighing the responses (Figure 3).

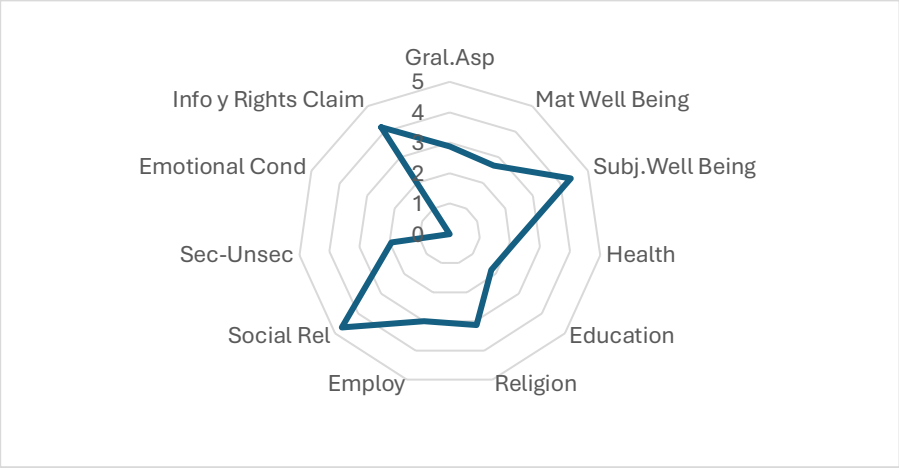

Figure 3. Survey 1. Male, 45 years, 37 en US.

From the perspective of complexity (multivariate analysis and cluster analysis), Figure 4 shows families and their circumstances expressed with all dimensions.

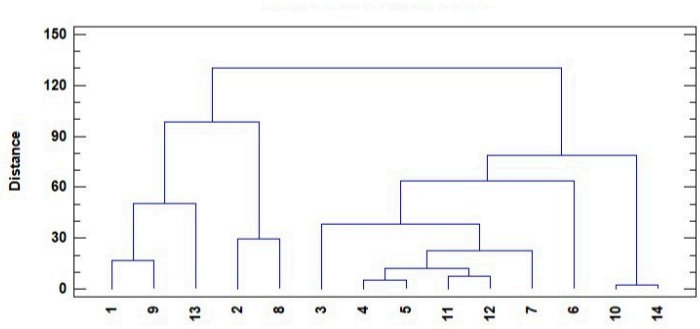

Figure 4. Dendogram Method Ward, Euclidean Distance.

Describing each dimension or case, even in a non-significant sample, can be difficult and confusing when it comes to policy design. So, might studying resilience in migrants from a complex perspective offer any advantages over traditional approaches? Let's take a look.

In Figure 4, a group of families (1,2,8,9,13) are characterized by the fact that subjective well-being is more important than material well-being, they give more importance to their children's education, social and family relationships are very important, religion is important, and they are concerned about security/insecurity. Meanwhile, the group of families (3,4,5,6,7,10,11,12,14) give little more importance to subjective well-being than material well-being, they do not have access to health systems, their children's education is not important, religion is important, social and family relationships are important, and they are not concerned about security/insecurity. This second analysis integrates all the dimensions considered simultaneously.

Based on experience, it is proposed that the resilience of migrants should be studied from an integral perspective:

Promote a multivariate perspective approach: This allows us to view resilience and complexity as an emerging phenomenon resulting from the interaction between multiple factors of different nature (individual, family, community, origin, destiny, social). The multivariate approach helps to identify how these factors interrelate and affect migrants' resilience.

Dynamic Model Design and Analysis: Use structured and semi-structured surveys with qualitative strategies (in-depth interviews, focus groups, life histories) to build dynamic models and simulations to understand how changes in certain factors (such as migration policies, support networks, economic conditions) can impact migrant resilience over time.

Boosting Interdisciplinarity: Complexity encourages collaboration across disciplines (psychology, sociology, economics, political science, etc.) to address resilience from multiple angles and gain a more comprehensive understanding.

Adaptability and Flexibility: The complex perspective highlights the importance of adaptability and flexibility in migrants' responses to challenges. This can guide the development of interventions and policies that are more adaptive and able to respond to migrants changing needs.

Networks and Connectivity: Analyse social networks and their vulnerability as understanding migrant support from a complexity perspective can reveal patterns and dynamics that are crucial for resilience. This includes how these networks are formed, maintained, and evolve in response to different challenges.

Multilevel Resilience: Complexity allows for the study of resilience at different levels (individual, family, community, and transnational) and how these levels interact with each other.

Innovation in Methodologies: The complexity perspective can inspire the use of innovative methodologies, such as social network analysis, complex systems theory and big data to study resilience more effectively.

It is estimated that these suggestions, which aim to move beyond traditional approaches, can provide a richer and more nuanced understanding of resilience in migrants, allowing for the development of more effective strategies and public policies to support their well-being and adaptation.

Conclusions

The complexity perspective helps highlight the importance of adaptability and the capacity to respond to changes and challenges. This is crucial for understanding how migrants can develop resilience strategies in changing and unpredictable contexts. It offers a robust and flexible framework for studying resilience in migrants, allowing for a deeper and more holistic understanding of this phenomenon. What has been stated so far has methodological and

epistemological implications.

Additionally, a complexity-based approach to resilience could help to improve migrant support policies and practices. This would ensure that they are more adaptive and dynamic, and able to address the diversity of migrants' experiences and needs. At the same time, it would place respect for their human rights at the centre of the debate.

Undoubtedly, individual capacities (e.g., health, youth, education, etc.), community support networks, and inclusive policies are essential to helping migrants overcome adversity in their destination context. In light of the changing circumstances faced by migrants, academia needs to adopt a more holistic approach that considers the individual, community and organisational aspects of migration.

This reflection raises the issue of avoiding suffering, stress and separation from people who possess the skills and abilities to harvest fruit and vegetables, maintain equipment and machinery, provide services ranging from surveillance and cleaning to elderly care, and enter scientific fields of study. We must reformulate our research strategies and aspire to obtain results that shed light on those responsible for formulating immigration policies that guarantee a dignified life for Mexican workers across the border.

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Analysis of social determinants of health: a case study of informal workers in the city of Cartagena de Indias, Colombia

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This text originates within the framework of a project: "to evaluate the quality of life and social determinants of informal workers in the city of Cartagena – Colombia "de la Universidad Americana de Europa Unade and Institución Universitaria Mayor de Cartagena

Introduction

Informality is a phenomenon that has been present in the economies of developed and developing countries for decades. Countless studies have revealed the importance of informality in the world's economies, given the existence of surplus labor and few jobs, which generates unemployment that, in turn, leads to the existence of informality (Rodríguez Lozano & amp; Calderón Díaz, 2015).

Consequently, there are many mitigating factors that are part of the quality of life of those who work in the informal economy; one of them, and perhaps the most important, are the social determinants of health (DSS), (Tamayo et al., 2018); en el mismo sentido, The World Health Organization defines the social determinants of health (SDH) as "the circumstances in which individuals are born, develop, work, live and reach old age, with all the aspects that surround daily life, this includes economics."

The social determinants of people without formal employment deserve to be studied; the number of people without formal employment worldwide is large, and Colombia is no exception. Because of the type of work they do, they lack social protection and access to quality health services established for workers, which translates into health problems, stress, and other health issues rooted in their informal status.

This study aims to provide a deeper understanding of the social determinants of health and their role in the lives of informal workers in Cartagena de Indias, Colombia. This research is intended as a foundational study for designing and implementing effective public policies that promote health equity and improved working conditions, as well as strategies for preventing risks associated with informality. Understanding how social, economic, and environmental factors influence their health is essential (García-Pérez et al., 2024) and understand the magnitude of these determinants.

Quality of life theory

This theory addresses the physical, psychological, and social aspects that influence people's well-being. This theory of quality of life (QoL) has been widely used in sociology, public health, and the social sciences in general, and has been instrumental in understanding how emotional, social, material, and psychological factors contribute to people's well-being (Galán, 2012).

There is no universally accepted definition when it comes to quality of life, (Ramos, 2017). Quality of life is closely related, on the one hand, to the ability to make decisions, happiness, stress, depression, expectations and key aspects of life and, on the other hand, to employment, economic security, health, education, recreation, housing, natural environment, decent work and relationships with others, which are intrinsic to life CV (Noriega et al., 2018).

Social determinants and quality of life of informal workers in Latin America

The social determinants and quality of life of informal workers is a highly controversial topic, Vélez et al. (2016), They claim that dignified working conditions are not guaranteed in informal employment or work, and that this type of work highlights the implicit inequalities.

For his part, Perelman (2014), It establishes that in vulnerable populations there is a great challenge in defining health as a right from the moment the individual is born with equal guarantees (Campos, 2016). Reflection on health is positive, contrary to some studies from an economic perspective and under the absence of disease, (Gutiérrez, 2015). The lack of health insurance highlights the need for humanitarian support for this population segment (Tinoco, 2018). The landscape of informality in Latin America is repetitive in all countries; international recommendations must be taken into account (CEPAL, Naciones Unidas, 2020). Various authors state that informality is more a matter of survival than choice, more of obligation due to a lack of options; it is easy to access informal work, so when people have no other options, they resort to informality (Schteingart, 2018).

For this quantitative study, the total estimated population (N) was 400,000 informal workers. Using a 95% confidence level ($z = 1.96$) and a margin of error of 0.5 ($e = 0.5$), an initial sample size (n) of 382 participants was determined.

However, to strengthen the robustness of the data, it was decided to collect 450 surveys. The instrument: SF-12 v2 (Short Form Health Survey), validated through international studies, applied to each particular and common way of earning a living in Cartagena:

Motorcycle workers, manicurists and pedicurists, ride-hailing drivers, taxi drivers, recyclers, rappers, dancers, waiters, domestic workers, delivery drivers (Rappi and others), neighborhood store assistants, street vendors of: ice cream, fruits and vegetables, pork, coffee and herbal teas, candy vendors, makeup artists, air conditioning repair technicians, kitchen assistants, etc.

The social determinants of health are directly related to quality of life worldwide. Today, after an

in-depth analysis of these determinants, a country can establish the level of quality of life of its inhabitants, which will be useful for decision-making.

The questionnaire used assesses health-related quality of life, covering both physical and mental aspects. Version 2 optimizes measurement across diverse populations.

Table 1. SF-12 instrument v. Source: own elaboration.

Health survey of informal workers in Cartagena - SF-.12 V questionnaire (survey for academic purposes)	The questions relate to health. For each of the following questions, please mark with an "X" the box that best corresponds to your answer.
1	Overall, how would you describe your health? 1 Excellent 2 Very good 3 Good 4 Fair 5 Poor
2	The following questions refer to activities or things you might do on a typical day. Does your current health limit your ability to do these activities or things? If so, how much? Moderate exertion, such as moving a table, vacuuming, bowling, or walking for more than 1 hour (1) Yes, it limits me a lot. (2) Yes, it limits me a little. (3) No, it doesn't limit me at all.
3	Go up several floors by stairs (1) Yes, it limits me a lot. (2) Yes, it limits me a little. (3) No, it doesn't limit me at all.
4	During the past 4 weeks, how often have you had any of the following problems at work or in your daily activities because of your physical health? ¿Did he do less than he would have liked to do? (1) Always (2) Almost always (3) Sometimes (4) Only occasionally (5) Never
5	Did you have to stop doing some tasks at your job or in your daily activities? (1) Always (2) Almost always (3) Sometimes (4) Only occasionally (5) Never

6 During the past 4 weeks, how often have you experienced any of the following problems at work or in your daily activities because of an emotional issue (such as feeling sad, depressed, or nervous)?
Did you accomplish less than you would have liked because of an emotional issue?
(1) Always
(2) Almost always
(3) Sometimes
(4) Only occasionally
(5) Never

7 Did you do your work or daily activities less carefully than usual, due to some emotional problem?
(1) Always
(2) Almost always
(3) Sometimes
(4) Only occasionally
(5) Never

8 How often have you had problems performing your job or other activities because of your health?
(1) Always
(2) Almost always
(3) Sometimes
(4) Only occasionally
(5) Never

9 During the past 4 weeks, to what extent has pain interfered with your usual work (including work outside the home and household chores)?
Did you feel calm and peaceful?
(1) Always
(2) Almost always
(3) Sometimes
(4) Only occasionally
(5) Never

10 Did he have a lot of energy?
(1) Always
(2) Almost always
(3) Sometimes
(4) Only occasionally
(5) Never

11 Did you feel discouraged and depressed?
(1) Always
(2) Almost always
(3) Sometimes
(4) Only occasionally
(5) Never

12	During the past 4 weeks, how often have physical health or emotional problems made it difficult for you to participate in social activities (such as visiting friends or family)? (1) Always (2) Almost always (3) Sometimes (4) Only occasionally (5) Never

he following table contains the instrument's questions grouped by dimensions as follows:

Table 2. Dimensions SF-12 v2. Source: Self-made.

Social determinants of helth: dimensions SF-12 v2		
DSS Dimension	Conceptual relationship whith the SF-12 v2	Questions: Q
Working conditions	It reflects how physical or emotional limitations affect work performance or daily activities.	4, 5, 6, 7, 8
State of health and beauty (body image and physical-mental well-being)	It assesses self-perception of overall health, vitality, and emotional balance.	1, 10, 11
Access to and quality of health services	It is expressed indirectly in the perception of pain, its management, and the ability to maintain functionality.	9
Social environment and support networks	Evaluate how physical or emotional health limits social interaction, visits, or personal relationships.	12
Material conditions of life	Related to the functional capacity to perform basic activities and the level of energy or fatigue.	2, 3, 10

The analysis considered the dimensions of social determinants of health, including working conditions, material and living conditions, access to and quality of health services, social environment and support networks, and personal health and well-being, in relation to the quality of life of informal workers in the city of Cartagena. The instrument applied to this population segment was sufficient for this purpose. Table 3 shows the responses that comprise the dimension of working conditions; Q corresponds to each item in the question.

Table 3. Results of the working conditions dimension. Source: own elaboration.

Working conditions					
Q	Always	Almost always	Sometimes	Just sometimes	Never
Q4	219	46	87	70	28
Q5	56	189	55	80	70
Q6	53	155	36	109	97
Q7	48	174	50	79	99
Q8	94	117	101	60	78

The results for the working conditions dimension, which is part of quality of life, revealed a latent physical limitation affecting 48.9% of the surveyed informal workers. This is compounded by physical and emotional difficulties that interfere with their ability to perform their informal work. It is evident that working conditions in general are poor, and the aforementioned factors, such as the lack of a workplace that meets minimum requirements for preventing occupational diseases, the effects of very hot temperatures, rain, street noise, and other conditions inherent to street vending and informal work, all contribute to precarious employment.

Table 4. Results of the health and beauty status dimension (body image and physical-mental well-being). Source: Author's own elaboration.

State of health and beauty (body image and physical-mental well-being)					
	Excellent	Very good	Good	Regular	Bad
Q1	15	25	64	248	98
Q10	Always	Almost always	Sometimes	just sometimes	Never
	99	103	124	69	55
Q11	104	125	113	60	48

In this dimension related to health and beauty, 55.1% of respondents rated their health as fair, while 21.8% considered it poor. They also reported fluctuations in energy levels and emotional well-being. Finally, this segment expressed a commitment to maintaining resilience and prioritizing their own well-being. 78.3% of the workers do not exercise, demonstrating poor health habits. Therefore, the survey reveals unhealthy habits that do not prevent work-related illnesses. Furthermore, the emotional demotivation stemming from a lack of purpose in life is reflected in a less than satisfactory level of physical and mental well-being.

Table 5. Results of the Access and quality of health services dimension. Source: Author's own elaboration.

Access to and quality of health services					
	Always	Almost always	Sometimes	just sometimes	Never
Q9	111	124	94	60	61

The results show that 52.3% of respondents have access to healthcare services in the city, while the remainder experience gaps in access, all related to income instability. However, regarding access to and quality of healthcare services, it was observed that 71.9% of informal workers surveyed reported not having their basic needs met. These individuals indicated that they are part of the subsidized healthcare system, meaning their services are not of the same quality as those provided to workers who pay into social security monthly, as it is a free service. They do not receive adequate care or access to medical specialists within reasonable timeframes, instead facing waits of more than 90 days.

Table 6. Results of the Social Environment and Support Networks dimension. Source: Author's own elaboration.

Social environment and support networks					
	Always	Almost always	Sometimes	just sometimes	Never
Q12	166	98	88	47	51

Among the workers surveyed in this dimension, 58.7% reported having close support networks, including friends and colleagues, which provide emotional support. A smaller proportion indicated the opposite. The results for this dimension also highlighted a 69.1% perception of optimism, along with strong bonds of friendship that contribute to feelings of happiness among the respondents.

Table 7. Results of the dimension of material living conditions. Source: Author's own elaboration.

Material conditions of life					
	If it limits me a lot	If it limits me a little	No, it doesn't limit me at all		
Q2	97	276	77		
	If it limits me a lot	If it limits me a little	No, it doesn't limit me at all		
Q3	51	174	225		
	Always	Almost always	Sometimes	just sometimes	Never
Q10	99	103	124	69	55

For this dimension, it is clear that 61.3% consider health limitations; however, 50% state that this does not affect their daily activities and they work every day, compared to 55% who report

occasional difficulties or limitations, and 44.9% who report consistent performance. According to their statements, there is a latent lack of improvement in exercise habits and balanced diet, which is important for maintaining good health at work.

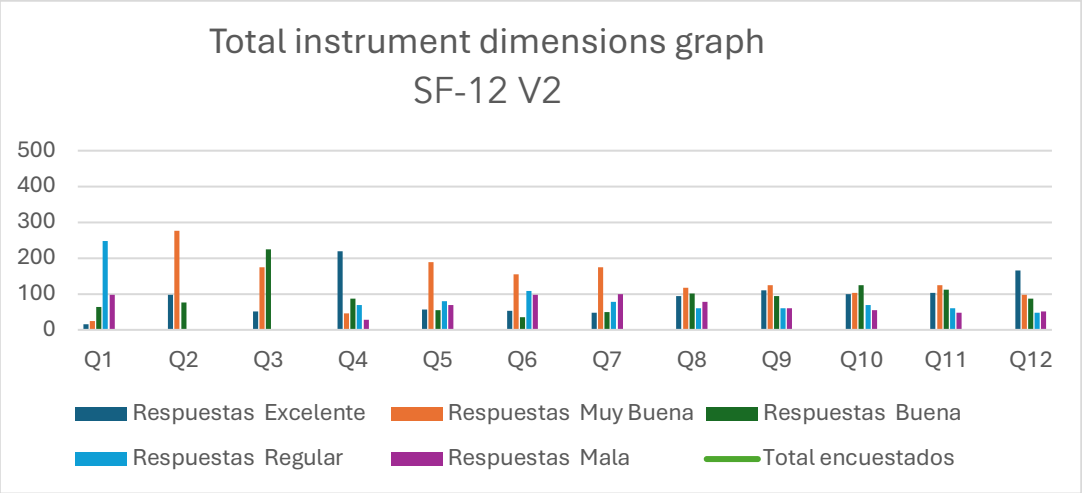

Figure 1. Total dimensions of the SF-12 instrument. Source: own elaboration.

Within the results grouped in the graph, the overall result of the dimensions of the SF-12 SF-12 V2 instrument can be observed.

Within the results grouped in the graph, the overall result of the dimensions of the SF-12 SF-12 V2 instrument can be observed:

1. A percentage greater than 50% of informal workers, even when they report health problems, do not consider these problems serious enough to affect their job performance.
2. Physical and mental energy is emphasized in the daily tasks performed.
3. They encourage the desire to feel good.
4. Adaptation to the life circumstances they have to live through.

Among the results grouped in the graph above, it is necessary to highlight the unfavorable aspects after the application of the instrument:

1. A trend in health status from poor to fair impacts productivity.
2. Emotional problems and social difficulties that influence quality of life
3. Stress due to economic uncertainty, precarious working conditions.
4. Conformity disguised as resilience.

The impact on quality of life suggests greater attention and importance; most face a situation that limits their ability to plan for the future and ensure an adequate quality of life. Therefore, urgent intervention is required from the Colombian state, especially from the tourist city of Cartagena de Indias.

Conclusion

Informal employment, income instability, and economic insecurity generate chronic stress that directly affects physical and emotional health. The lack of formal employment exacerbates vulnerability; therefore, insufficient income and difficulty meeting basic needs such as housing, food, and transportation are key factors that undermine the well-being and quality of life of informal workers. A significant proportion maintain adequate energy levels for their daily tasks, indicating physical resilience and demonstrating psychological strengths, as well as adaptability to daily life despite work limitations. Stress from economic insecurity, fluctuating income, and precarious working conditions were the main causes of the negative impact on their mental health. Consequently, many workers reported symptoms of anxiety, emotional exhaustion, and constant worry about income stability, which directly affects their overall well-being and quality of life.

The results confirmed the initial hypothesis that social determinants such as access to health services, education, working conditions and the social environment are intrinsic to economic factors and have a significant impact on the health of informal workers in the city of Cartagena.

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Art, Literature, Music, and Political-Cultural Studies

A Song of Fire and Ice: The Philosophical Drama of Puccini's *Turandot*

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Introduction

Turandot is Puccini's (1858-1924) last and unfinished opera; a powerful work, surely the densest of all the Maestro's compositions, mysterious and unsettling, defined by the riddles of an inscrutable Chinese princess, beautiful and cruel to any man who dared to court her. *Turandot* is characterized not only by the enigmatic elements that permeate its plot but also by the mystery that surrounds the creation of any operatic proposal, especially when like this one it is distinguished by suffering and death. In these pages we are going to approach this major work with more than respect because, despite the objections of the reluctant critics of Puccini's time, we are sure that this is a score that represents a new compositional milestone, a break with the Romantic past (and also the present post-Romantic), a different outline for a balanced dramatic-musical structure and a step forward in the operatic avant-gardes of the 20th century, a varied and new artistic terrain that paradoxically was incomprehensible to the composer from Lucca.

> Despite its unfinished state *Turandot* is rightly regarded as the summit of Puccini's achievement, bearing witness to a capacity for self-renewal unsurpassed by that of still greater composers (...) The style remains true to the composer's 19th century roots, but it is toughened and amplified by the assimilation of uncompromisingly modern elements, including bitonality and an adventurous use of whole-tone, pentatonic and modal harmony (...) These attributes, combined with Puccini's unfailing ability to communicate directly with an audience, have established *Turandot* as a classic of 20th century opera (Sadie, 1997, pp. 641-642).

After the premieres of the three operas that make up *Il Trittico*, Puccini once again turned his attention to the Orient. His friend Renato Simoni suggested that he stage an adaptation of a work by Carlo Gozzi. With his approval, Simoni collaborated with the librettist and journalist Giuseppe Adami to write the libretto for *Turandot* in Italian. It is worth noting that even before the first performance of this new work, Weber, Danzi, Reissiger, Rechbaum, and Busoni had taken an interest in Gozzi's drama, either by composing for the various theatrical productions of the work or by providing literary support for their own performances. As early as 1917, Busoni had premiered his homonymous opera in Switzerland, developing what he had composed for the playwright thirteen years earlier and also writing the German libretto. The premiere of the *Turandot* would take place at the Teatro alla Scala, on April, 25, 1926, almost a year and a half after the death of its creator. Between 1924 and 1926, Franco Alfano, one of Puccini's pupils, completed the score that the composer had left unfinished in the third act after Liù's death, adding two more scenes to the opera.

Puccini's personality was multifaceted and conflicted, holding both a commitment to technological progress and a fondness for the serenity of rural life. He experienced his most fulfilling years on his farm in Torre del Lago, a remote Italian location that he found delightful, despite the overwhelming presence of the city, devoting himself simultaneously to hunting birds, reading books, and wooing women. His wife tolerated his numerous infidelities as she recognized that falling in love was for him a kind of vital and *creative necessity*: the feminine psyche, which can be considered an *elixir of love*, served as the most intimate source of inspiration for the Maestro. This may be why the majority of his operatic blueprints bear titles of feminine names or adjectives (Honolka *et al.*, 2005, p. 333). The most recent of these was *Turandot*. It is debatable whether this is Puccini's most representative creation; what is clear, however, is that it was the one that most preoccupied him, eliciting a range of emotions: "Penso ora per ora, minuto per minuto a *Turandot*, tutta la mia musica scritta fino ad ora mi pare una burletta e non mi piace più. Sarà buon segno? Io credo di sì" (Puccini, 1928, p. 176). This supposition, nevertheless, was not entirely accurate; the composer was unable to complete his work and to derive pleasure from contemplating a finished project; he would perish at the conclusion of the initial scene of Act III.

Turandot's Premiere and Libretto

At the premiere the renowned soprano Rosa Raisa was entrusted with the role of Princess Turandot, while the Aragonese tenor Miguel Fleta assumed the character of Calaf. The conductor was Arturo Toscanini who, after leading the orchestra to Liù's death, stopped the musicians to address the listeners with the famous words: 'Qui il Maestro finì'. Audiences from all over the world reacted favorably but not the specialist critics who were disappointed by Alfano's conclusion which did not reach the desired level of instrumentation, resulting in a weak *finale* compared to what had already been written. Whether Puccini finished *Turandot* before his death is also a mystery. The fact that it concludes with a Hollywood ending which diverges from the traditional framework of Italian Romantic (and tragic) opera, and not with Liù's suicide, which would have greater dramatic impact, suggests that this was the original conclusion of Puccini's magnum opus.

The libretto for *Turandot* was written by Giuseppe Adami (1878-1946), editor of the magazine *Lettura* and music critic for the newspaper *Il Corriere della Sera*, and Renato Simoni (1875-1952), after *Turandotte* (1762), a drama by Carlo Gozzi and a translation into Italian by the poet and librettist Andrea Maffei of *Turandotte, Prinzessin von China* (1802), by Friedrich Schiller. The script for this production is set in Imperial China. The well-known diegesis concerns Turandot, the daughter of the Emperor Altoum, who refuses to give herself to a man unless he can answer three riddles, otherwise the suitor is condemned to be beheaded. The first act of the play opens with this official announcement by a mandarin of the imperial court: Popolo di Pekino! La legge *è questa… Turandot la Pura sposa sarà de chi, di sangue regio, spieghi i tre enigmi ch'ella proporrà. Ma chi affronta il cimento e vinto resta, porga alla scure, la superba testa.*

This law of terror and blood which the princess has imposed on her realm could not be revoked by anyone, not even by her father, the emperor of China. On the day of the execution of the last unfortunate candidate for her hand in marriage, Timur, the exiled king of the Tatars,

accompanied by his faithful slave Liù, was among the crowd in her presence. There by chance he meets his son Calaf, whom he had thought dead. A violent passion overcomes the young prince when Turandot appears and against all advice he offers to answer the three riddles. His answers are correct, but the inaccessible woman, trapped by a vengeful and cruel hatred, does not keep her promise to give herself to the winner of the test. As a result, and even at the risk of his own life, *il Principe Ignoto* tells Turandot that she must discover his name before sunrise. If she fails, she must be his. For one agonizing night no one may sleep in the town:

> By order of Turandot, *no one shall sleep in Peking. Whoever can give the name of the stranger who has won her challenge shall be rewarded. Whoever dares conceal it will receive death as punishment* (Mayer, 1995, p. 5).

And Liù who has been in love with Calaf since childhood is tortured by the princess, who did not know that Liù would rather die than reveal the prince's name. The sacrifice of the young girl and a passionate kiss from the Tatar would finally break the princess's burning ice.

Puccini's Last Work: Between Music and Philosophy

Who will sing my opera? asked Puccini in 1924. Perhaps he knew then that he would not live long enough to see the completion of his last piece. Many other questions come to mind when we try to reflect on this: What is the real difficulty in performing the main roles here? For a start: Turandot has to be sung by a dramatic soprano with a big and heavy voice, in a Wagnerian style with a royal bearing. The role also requires certain qualities that were demonstrated a few years earlier in Verdi's leading roles such as Violetta in *La Traviata*, or Gilda in *Rigoletto*. The real complexity of Turandot as a role lies in the changes in tessitura between acts II and III. We think that these musical attributes should not be considered or judged from a dramatic or theatrical point of view as we advise you to continue reflecting on other aesthetic matters. However, the most important distinction between Turandot and the Valkyrie Brünnhilde, for instance, remains when we consider the subtleties of the melodic line and the beauty, color, and expression of her voice. This was typical of Puccini's operatic characters.

Radically different from the cold-hearted Turandot, and much closer to other Puccini women such as Angelica, Magda in *La Rondine*, Mimi in *La Bohème* or Minnie in *La Fanciulla del West*, Liù's character is placed on the musical and temperamental stylistic line of tenderness and delicacy. Her singing will be sweet no matter who embodies it, always demonstrating without a doubt her dedication, vocation, deep love, devotion of faith, empathy and total respect as a human being. Her gorgeous aria *Signore, ascolta!*, sung in the first scene, will be the only closed sequence in the opera, regulary followed by the audience's applause. And it is precisely this way of being that leads Puccini to decide that Liù must take her own life, rethinking the original idea in his mind about her in the entire plot. Her death becomes *necessary* for redemption: Turandot, insensitive and perverse, is transformed into a loving woman only after witnessing Liù's sacrifice, committed out of love and helplessness. We sense that Liù knew beforehand what this would do to the heartless princess, and only by making her experience the love she had for Calaf would she make Turandot feel her fatal need for metamorphosis. Puccini decides that Liù like Mimi, Angelica, Manon, Cio-Cio-San and Tosca *must* die. From the beginning she ought to succumb

to her own pain and die through violence and torture. For the composer, if Liù as with Mimi and the other divine women does not die, her character is not totally *authentic*. This therefore suggests that death is not merely an unfortunate occurrence but a vital, albeit challenging, aspect of life. This is why Puccini gives us her solo, the only closed aria in the whole opera.

In the spring of 1924, Puccini died in Belgium after completing the scene of Liù's death, the neutral point and climax of *Turandot*. After this sequence we witness the transformation of Turandot, who dramatically changes her temperament and feelings of love and faith: from the coldness she has shown singing *In questa reggia* to the pretentious and empowered scene of the riddles, to this moment when for the first time in her life she experiences a true fear of death and loneliness. Turandot is indirectly guilty of Liù's suicide and the subsequent consequences: the slave took her own life in front of her without revealing the only secret of the whole show: the identity of her loved prince. Because of this, the princess' heart goes through an unexpected transition; it is the kind of emotion she has never experienced before. We would still be dissapointed by her behavior: Liù's death did not solve her sudden change; she remained rude and emotionally detached.

Prince Calaf, shocked and astonished, runs to the princess and, in a mixture of reproach and demand, kisses her passionately. This is the culminating moment, and recalls the kiss of Kundry and Parsifal in Wagner's last opera. The jumble experienced in Turandot's being confirms her role as both murderer and dominator. Let us not forget that in the first part of the opera we have seen the Tatar constantly wondering about the princess' harshness: Shouldn't Liù's death break the ice within Turandot, touching her soul? How is it possible that Calaf's love for her was rekindled after the brutal suicide? How is it that ice can bring fire to him? A very ill Puccini took these unresolved questions with him on his trip to the hospital in Brussels where he died leaving behind the most beautiful, rich and passionate group of operas of all time. The truth is that we will never know if Puccini would have been able to find a convincing solution to these matters. Could it have occurred to him to go back to the musical theme of *Nessun dorma*?

Alfano's musical approach to the end of the opera represents a commendable attempt to replicate the essence of Puccini's original manuscript, surpassing the diversifications of Luciano Berio's alternative version. He had to tread a delicate balance between paying homage to Puccini's legacy and expressing his own artistic voice. In doing so he crafted an ending that seamlessly transitions from Puccini's material into his own, creating a unified whole for the opera. Thus, we know that Puccini did not intend for the leitmotif of *Nessun dorma* to reappear in the final chorus of his last opera. Instead, the composer had sketched out in his score the beginning of a masterful love duet analogous (in a philosophical form) to the transfiguration of Isolde in Wagner's opera. Many (including ourselves) consider *Turandot* to be the best of Puccini's works where the exoticism so longed for by the composer reaches its zenith, not only musically, in the theme or in the sources of the plot, but also through the harmonic treatment of several authentically oriental motifs interwoven with his most delightful and unmistakable melodies, the

masterful use of orchestration and a richness of human expression never before attained at this level, not even in his previous oriental experiment, the delicate *Madama Butterfly*.

Like Ice But Burns: Passion, Enigma & Symbolism

The Orientalism in Puccini's last work becomes a kind of wrapping that allows most human passions to be hidden while they grow. If we were to assign certain moral categories to any of these human outpourings we would be denying the Cartesian principle according to which passions are not inherently good or bad but only according to the use to which they are put. In this particular opera, the dominant passions are hate and its opposite, love, although the force that triggers them depends on the good or evil that arouses them. For the princess, man is the object of an emotion that reveals itself under a hideous guise; and that is why she hates him instead of loving him. In this sense, everything that could come from the male archetype — sexuality, eroticism or even pleasure— is repugnant to her, though not unbearable since her erotic realization really depends on it. This realization will not come from the pleasure of love but from the pain caused by hate, an explicit hate that drives her to an incessant revenge.

Bataille (1989) associates eroticism with suffering and this idea has a particular echo in the princess. Averse to the carnal erotic experience, she needs another reality, something that fills her life and gives content to her actions by justifying them, for instance, with distress, a natural human condition that she paradoxically experiences as gratifying. As we have said, this precise emotion is completely different from other loving emotions; it is born of the cruelty caused by her aversion to men whom she considers strange and invasive. Turandot accepts distress as a basic need or way of being and denies any possibility of escaping from it. What is the cause of this unbalanced emotion? We think it is her self–repression: in the second act, she tells Calaf, her final suitor, about her situation, the real cause of her practices: the severity with which the princess orders the execution of the princes who wish to marry her comes from the memory of a past defilement of her grandmother and from the panic that the same fate might befall her: Pure nel tempo che ciascun ricorda, fu sgomento e terrore e rombo d'armi. Il regno vinto! E Lo-u-Ling, la mia ava, trascinata da un uomo come te, straniero, là nella notte atroce dove si spense la sua fresca voce!. The bloodthirsty princess exchanges the eroticism of love for an eroticism rooted in rancor, one that brings only suffering. This action is the culmination of her fear of the other. The fact that her wooers are foreigners reinforces this denial of otherness. Fear paralyzes and incapacitates her: 'No one will ever possess me!'

The Prince of Persia, the youngest of many other executed suitors, undergoes the Via Crucis at the opera's outset. This is also seen as a vindication for the icy princess and the inflamed crowd, who want to see the bloody spectacle. The multitude shouts and insists that the executioner, who will behead the wretched young Persian, be brought in. "Would you die like him?," Timur asked Calaf. "I will succeed, father," replied the son. And so, we intuit that there is something much deeper in Turandot's attitude, something darker and more puzzling in the enjoyment of her ruthless acts which also permeate the village. Bataille clarifies it as follows:

> Eroticism is first of all the most moving of realities; but it is nonetheless, at the same time, the most ignoble. Even after psychoanalysis, the contradictory aspects of eroticism

> appear in some way innumerable; their profundity is religious—it is horrible, it is tragic, it is still inadmissible. Probably all the more so because it is divine (Bataille, 1989, p. 69).

This act may be identified through listening to the chorus: 'Sharpen the ax!' We are faced with the mystique of the immense and also the fascinating attitude towards the unknown, or better, a mystification of the sacred. Yet, the profane mystique experienced by the insensitive Chinese princess in the first and second acts turns into her ultimate conversion or even redemption. We believe of course that this sensation is caused by (some kind of) love, a frustrated feeling that was frozen in her heart and awakedned after her last sacrifice: Calaf's kiss of love. This event will restore the protagonist's human character and essence.

Unlike the selfless Butterfly, the soft Mimi, the bold Magda, or the unfaithful Manon, Liù, the other Puccini primadonna, is an unconditional tender servant, a sweet and loving girl who has secretly loved Calaf and cared for his father, the exiled king, for nothing more than the memory of a smile the young prince had given her years earlier. Until her last breath, the faithful slave remains silent, even when she is tortured by Turandot's minions. Before she dies, however, she reveals to Turandot that the prince's name is Love. If Puccini had finished his last work after Liù's suicide, the tragic purpose of the opera would have been assured: we would have had no echoes of compassion, conversion, and still less of redemption. Turandot would remain obsessed by her frozen eroticism, bloody and perverse; Calaf's arrogance would be punished, and Liù would become the true heroine, sacrificed by true love. But the argument here is different: the opera continues after Liù's self-murder and this event becomes the inexorable mechanism for Turandot's metamorphosis. The slave's death is essential to the destruction of evil and with it we know that it is possible for the world to return to its original normality:

> The classic literature of China explicitly acknowledges the propitiatory function of sacrificial rites. Such practices 'pacify the country and make the people settled (...) It is through the sacrifices that the unity of the people is strengthened' (Girard, 1979, p. 8).

Liù's ungrudging determination effectively *resolved* the existing tension between Turandot and Calaf, thereby appeasing the agitated villagers. Her death is also the means by which the meta-reality of the sacred is actualized:

> Across time, the blood sacrifice opened man's eyes to the contemplation of the vexing reality, completely outside daily reality, which is given in the religious world this strange name: the sacred. We can give no justifiable definition of this word. But some of us can still imagine (try to imagine) what sacred means (Bataille, 1989, p. 199).

The sacrifice in which Liù dies to reveal the name of names, the word of love, and the passionate kiss of Calaf, who was ready to die for the princess, result in Turandot's total transfiguration: the goddess becomes human without abandoning her divine condition, transmuted now and forever into a theandric being. But it is only through riddles and symbols that we can understand the antithetical passion which places her in an ambivalent world between ice and fire. Considering that the entire creative process behind this composition remains opaque, particularly its conclusion, the protagonists however dispel this mystery from the outset. Their actions, rooted

in recognizable patterns of everyday social behavior -ambition, pride, desire, and sacrifice- strip the narrative of mythic obscurity and ground it in human nature. As a result, the story resists a clear-cut ethical or moral reading. Instead of offering a didactic message, it mirrors the contradictions of human interaction where motives often elude simplistic judgment.

The violence of the wicked beauty, the passionate selfishness of Calaf and even the murder of the generous Liù form a triangle that explains human actions. Man's condition here seems dual and cryptic: his existence is reduced to the anxiety of an eternal interrogator constantly deciphering and navigating a stagnant sea of insecurities. The only certainty is death and the way to avoid it is to *react*, to respond decisively to the enigma *of life*. The self-absorbed Turandot poses three puzzles to her supplicants, including Calaf, knowing that they are practically insoluble. This is the first one:

> In the dark night flies a phantom of many colors. It rises and spreads its wings high above the gloomy crowd. People call to it, asking, begging for favors. At dawn the phantom disappears. But it is reborn in every heart as darkness falls. And so it goes: every night it rises again, every day it dies. What is it? (Mayer, 1995, p. 21).

Calaf quickly responds: "It is hope, for hope never lasts for long." The second riddle is this:

> It burns like a flame, but it is not fire. Sometimes it smolders like a fever, but boredom cools it. If you lose heart or die, it grows cold. But begin to dream, and the flame flares up again (Mayer, 1995, p. 23).

After a few minutes of silence, the Tatar replies: "It is blood." And then the cold princess pronounces the last of the enigmas:

> What is the ice that gives you fire and makes your fire even colder? It is pearly white and black as night. If it welcomes you, you are its slave or its king. Name this thing or die! (...) Ice that can make fire. What is it, or be done (Mayer, 1995, p. 25).

The prince shouts, "The answer is Turandot!"

Calaf has succeeded in giving three correct answers to Turandot. In these three we see in a nutshell the existential adventure of man: the imperative of his blood, the illusion of his promising hope and the contradictions of his own nature. And with this puzzle, Turandot assumes the role of divinity and not for nothing is she the *daughter of Heaven*. This is an Apollonian trait, beautifully explained by Giorgio Colli in *La nascita della filosofia*[5]. It could also be applied to this

[5] Attraverso l'oracolo, Apollo impone all'uomo la moderazione, mentre lui stesso è smoderato, lo esorta al controllo di sé, mentre lui si manifesta attraverso un 'pathos' incontrollato: con ciò il dio sfida l'uomo, lo provoca, lo istiga quasi a disubbidirgli. Tale ambiguità si imprime nella parola dell'oracolo, ne fa un enigma. L'oscurità paurosa del responso allude al divario tra mondo umano e divino (Colli, 1975, p. 43). In our translation: "Through the oracle, Apollo imposes moderation on man, whereas he, for his part, is immoderate; he exhorts him to control himself, whereas he manifests himself through an uncontrolled 'pathos': with this the god challenges man, provokes

heavenly, pure, and yet cruel woman, who is somewhat of a goddess of the eyes, subduing a proud Calaf.

There is something sinister in the attitude of the princess as there is something sinister in the *manners* of the gods. No one can escape the seduction of the Sphinx or the fascination of the divine because men are for their own death: 'Gli enigmi sono tre, la morte una' (Riddles are three, but death is only one), says Turandot to Calaf, an aspirant to deciphering the conundrum of the divine and the sacred, 'a stranger, drunk with death', as the Emperor will say, the incompetent father, a kind of static god, who only watches undaunted how the Unknown Prince is heading towards his own annihilation. Despite the Herculean trials to which the hero is subjected, Calaf responds with a Nietzschean-tragic will: 'The riddles are three, life is one!' This is the cry of Greek tragedy that Nietzsche could not hear in Wagner's *Parsifal* and found it in Bizet's *Carmen*. And while we are confronted with death, violence, enigma, riddles, and symbolism in their purest forms, the moon will stand still as a silent and expressionless witness, seeing and hearing everything as in Strauss' *Salome*.

The ministers Ping, Pang, and Pong are three minor characters that must be mentioned in our exam. In the comic-grotesque style of *Commedia dell'arte*, they provide a counterpoint to the others. At first glance, these three seem out of place (even musically), but they are not; a kind of subconscious narrator, they are the *philosophers* in/of the opera who take on different personalities as the plot progresses and becomes more complex so that they are able to express, at first, Fear of the violence that Turandot has unleashed; then, Conviction, when they try to dissuade Calaf from accepting the challenge of the posers; Nostalgia, when they remember the times when the Chinese empire was at peace; Disillusionment, with their vain devotion to reading the Holy Books, and finally Cruelty, as the instigators of Liù's torture and suicide. In the first act, they are also critical of Turandot whom they regard as a simple and ordinary woman like all the others and therefore not worth dying for. In their view, anyone who desires her is considered mad as she represents a perilous and illusory ideal: *'Turandot non esiste […] Il volto che vede è illusione!*

Conclusion

From its very first notes, *Turandot* draws the listener into a world that appears distant, fantastical, and bound by the exotic codes of an imagined Orient. Yet beneath its dazzling surface lies a profound metaphysical structure that Puccini gradually unveils through music and dramatic gesture. The opera's progression —through its relentless questions, silences, and sudden illuminations— guides us away from the spectacle of savagery and desire towards a terrain charged with symbolic weight. Far from being a mere pageant of enigmas and rituals, *Turandot* evolves into a spiritual quest, one where emotional truth and human vulnerability come into conflict with icy rationality and inherited tradition. This shift, subtly woven into the score and the

him, instigates him to disobey him. Such ambiguity is expressed in the word of the oracle, turning it into an enigma. The dreadful obscurity of the answer indicates the difference between the human and the divine world."

libretto, suggests that Puccini was less concerned with narrative resolution than with expounding an ontological trajectory, one in which redemption becomes not a resolution to stratagem but a transcendence of form. Even so, after careful consideration of the potential conclusions of *Turandot,* as influenced by the significant statements made by Ping, Pang, and Pong at the opera's ending, it becomes evident that Puccini's intention was in fact to provide a redemptive message. In the second act, when the composer was still pondering the possibilities of finishing his own score, he had already envisaged on his intellectual horizon a kind of Wagnerian ending in the manner of *Tristan und Isolde*. Instead, we are left with a P*arsifal*'s redemption scene: a Christian coda that the tragic Nietzsche might have rejected. Today, we think Puccini's *Turandot* is no longer an oriental fairy tale; it has become a meditative reflection on the divine-human dialectics, or in other words, the dichotomous confrontation between the sacred and the profane. It is from this standpoint that we can fully comprehend the philosophical and mysterious depths of the enigma which constitutes the ethos of this powerful opera.

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Between *nostos* and *curiositas*: the Odyssean myth as mirror of Hispanic literary consciousness across the Atlantic

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Introduction

"Navigare necesse est, vivere non necesse" - to navigate is necessary, to live is not. This sentence attributed to Pompey by Plutarch encapsulates the essential tension that traverses the Odyssean myth: the imperative of journey as an inescapable human destiny, more important even than life itself. The figure of Odysseus represents one of the most fertile and enduring symbolic constructions in Western culture, functioning as a prismatic archetype through which different epochs and traditions have refracted their existential, philosophical, and aesthetic concerns.

The trajectory of the Ithacan king's hermeneutics, from Homeric hexameters to postmodern revisions, constitutes an exceptional palimpsest where each generation has inscribed its cardinal preoccupations. His remarkable plasticity and capacity for adaptation- supreme paradox for a hero whose declared objective is return - justifies the inexhaustible validity of a narrative construct that continues to generate renewed significations after almost three millennia.

This study addresses a significant gap in comparative literary studies by proposing a comprehensive examination of the transformative reception of the Odyssean myth within the transatlantic Hispanic literary tradition. While substantial scholarship exists on the reception of Odysseus in other European literatures, the distinctive Hispanic contribution to this millennial tradition has received insufficient systematic attention. The research demonstrates how Spanish and Latin American authors have created unique variations that reflect both universal human experiences and specific cultural contexts shaped by colonial history, political exile, and cultural hybridization.

The fundamental premise is that the *πολύτροπος* ("many-turned") condition attributed to Odysseus in Homer's first verse has allowed the character to transcend his original context and become a universal symbol capable of absorbing new meanings in different historical and cultural contexts. As Boitani (2001) observes, the Homeric hero stands as a "sign capable of adopting a meaning whenever it encounters a signifier" (35), explaining his extraordinary capacity to generate diverse rewritings throughout the centuries.

The primary objective is to establish a comprehensive cartography of Odyssean rewritings in Hispanic literature on both sides of the Atlantic, demonstrating how the versatile nature of the Homeric hero has enabled adaptation to diverse cultural and historical contexts spanning from medieval Spain to contemporary Latin America. The study identifies key transformative moments in this reception, analyzing how different historical periods have inscribed their particular concerns onto this mythological palimpsest.

Secondary objectives include examining the dialectical tension between *νόστος* (longing for return) and *curiositas* (thirst for knowledge) established by Dante's pivotal reinterpretation in *Inferno* XXVI, and demonstrating how this paradigm has influenced subsequent Hispanic recreations. The research reveals how the transatlantic perspective has generated unique interpretative possibilities, where the Mediterranean voyage becomes a metaphor for oceanic crossing and cultural encounter.

The study also examines contemporary feminist rewritings that have expanded the mythological universe by giving voice to previously marginalized figures, challenging traditional heroic paradigms and offering alternative perspectives on themes of waiting, transformation, and agency.

The methodological approach combines detailed textual analysis with comparative and intertextual frameworks, situating individual rewritings within the broader tradition of Odyssean reception in Western literature. The study employs hermeneutic analysis following Hans Robert Jauss's reception theory principles to understand how horizon of expectations shapes literary interpretation.

Comparative literature methodologies illuminate cross-cultural influences and transformations, examining how the myth travels between cultures and linguistic traditions. The research utilizes Julia Kristeva's concept of intertextuality to analyze how Hispanic authors engage in dialogue with both the Homeric original and subsequent reinterpretations, particularly the crucial Dantesque mediation.

Historical context analysis reveals how political circumstances, particularly experiences of exile and colonialism, have shaped specific reinterpretations. The study employs Edward Said's concept of exile as constitutive intellectual experience for twentieth-century recreations, while utilizing postcolonial theoretical frameworks to examine how colonial contexts have transformed traditional interpretations.

The corpus encompasses canonical works from Golden Age authors through modernist figures to contemporary voices, ensuring comprehensive coverage of the tradition's evolution. Particular attention is paid to the geographical dimension of reception, analyzing how the myth functions differently in Peninsular Spanish contexts versus Latin American appropriations.

The Classical Foundation and Universal Evolution of the Odyssean Myth

The figure of Odysseus (Ulysses in the Latin tradition) emerges in Western literature as a symbolic construction of extraordinary complexity that has transcended its original context to become a universal paradigm of voyage, cunning, and the longing for return. The Homeric hero, characterized from the first verse of the Odyssey as *πολύτροπος* ("of many turns," "versatile," "cunning"), constitutes one of the most fertile and enduring mythical configurations of Western culture, an archetype that has evolved through the centuries maintaining its essential traits while adapting to the expressive needs of each epoch and cultural context. The multifaceted nature

of the cunning navigator, also known as *πολυμήχανος* (of many resources), *πολύμητις* (of many counsels), and *πολύτλας* (much-suffering), manifests in his capacity to assume different identities during his journey, from the "Nobody" who deceives the cyclops Polyphemus to the beggar who returns incognito to his own house in the poem's final cantos. His ten-year journey unfolds across that Mediterranean Sea which, throughout the centuries, becomes populated with mythical and legendary beings, enigmatic and fantastic projections of our fears and desires. This symbolic richness of the Odyssean sea as a space of transformation and danger has been a constant in the myth's reception to our present day.

The Homeric Odyssey, probably composed in the eighth century BC, narrates the ten years of voyage and tribulations that the Ithacan castaway must traverse to return to his kingdom after the Trojan War. As Carlos García Cual (2004) indicates, "the Odyssey can be understood as a series of traditional narrative episodes, unified by the figure of the protagonist hero and by his final objective: the return to the homeland" (53). This epic poem, organized in 24 cantos, is structured in three great blocks: the *Telemachy* (cantos I-IV), dedicated to Odysseus's son and the search for news about his father; the account of the hero's maritime adventures (cantos V-XII); and the return to Ithaca, the recognition and revenge against Penelope's suitors (cantos XIII-XXIV).

Unlike the epic archetype represented by Achilles—founded on warrior excellence (*ἀριστεία*) and glory (*κλέος*) obtained on the battlefield—Odysseus personifies a heroic model based on *μῆτις* or practical intelligence, adaptability to adverse circumstances and the capacity to navigate between diverse worlds. The king of Ithaca constitutes the quintessence of human complexity in its multiple facets: faithful husband of Penelope, responsible father of Telemachus, respectful son of Laertes and Anticlea, just sovereign before the nurse Eurycleia and the swineherd Eumaeus. Especially moving is the bond with his dog Argos who, transcending social hierarchies and distinctions between species, consummates his existence after twenty years of indefatigable waiting in a final act of recognition toward his returned master, constituting one of the most emotional scenes of the Homeric poem.

The myth of Odysseus encompasses universal experiences such as exile and immigration, prolonged stay away from the homeland, the impossibility of desired return, temptation and repentance, overcoming mortal dangers, transgression and punishment, nostalgia and, finally, return loaded with experiences and wisdom. The key passages of the Odyssean journey—the confrontation with the cyclops Polyphemus, the stays with the sorceresses Circe and Calypso, the resistance to the Sirens' song, the descent to the underworld, the shipwreck in Scheria, the disguised return to his homeland and revenge against the suitors - have crystallized in Western cultural consciousness as powerful symbols that explore essential aspects of the human condition.

The circular journey of the hero - from Ithaca toward Troy and back to Ithaca after twenty years of absence - establishes a narrative pattern that has demonstrated notable fertility in subsequent literary tradition. The tension between fascination with the unknown and longing for home, between transformation through experience and fidelity to one's own identity, between belonging to a community and individual solitude, converts the Odyssean voyage into a narrative

structure of extraordinary symbolic power. The universality of this mythological figure is due precisely to its capacity to transcend its own individuality and become a symbol capable of (re)semiotization and adopting new meanings in each epoch.

The reception of Odysseus in Western literary tradition is characterized by a marked interpretive ambivalence that begins already in Homeric epic itself, where the hero appears simultaneously as the cunning strategist favoured by Athena and the suffering man punished by Poseidon. This interpretive duality, far from weakening the myth's power, has contributed decisively to its extraordinary capacity to generate diverse and often contradictory meanings throughout the cultural history of the West.

Sophocles presents a Machiavellian Odysseus prepared for anything to fulfil his mission, for whom the end justifies the means without a trace of remorse. Even more severe, Euripides in Hecuba and The Trojan Women portrays him as a demagogic and unscrupulous politician, paradigm of the moral degradation that the author attributed to the Athenian political class during the Peloponnesian War. Against this denigrating interpretation, the Stoic school developed a positive reading of the character, converting him into a paradigm of virtues: perseverance in adversity, self-control, practical intelligence, and prudence. Seneca, in *De constantia sapientis*, emphasizes the unshakeable determination of the ingenious castaway, who despite multiple dangers always maintained his course toward Ithaca without letting himself be seduced by temptations.

Roman culture also manifested similar ambivalence toward the skilful Achaean orator. Virgil, in constructing the Roman foundational myth with the Aeneid, configured him as an ethically reprehensible antagonist, in opposition to the *pietas* of the Trojan Aeneas. The characterization of the Ithacan warrior as "durus Ulixes" in the second canto of the Aeneid and the emphasis on his role as architect of the horse's deception significantly determined the medieval reception of the character.

The turning point in Western reception of Ulysses is marked by Dante Alighieri in the Divine Comedy. In this monumental poem, composed between 1304 and 1321, the Florentine reworks the figure of the Homeric hero endowing it with complex moral and philosophical density. In Canto XXVI of the Inferno, the poet places Ulysses among the fraudulent counsellors, but grants him extraordinary dignity and moral greatness. The Dantesque Ulysses is not punished fundamentally for his cunning, but for his *curiositas*, his insatiable thirst for knowledge that led him to transgress the limits imposed on humanity. In the famous scene, Ulysses exhorts his navigation companions to accompany him on a final journey with some of the most philosophically dense words of the entire work: "Consider your origin: you were not made to live like brutes, but to pursue virtue and knowledge" (Alighieri, 2016: 291).

This reconfiguration of the Homeric hero establishes a subtle but significant link with the prophecy that Tiresias pronounces in canto XI of the Odyssey, where he predicts to the king of Ithaca - after returning home and the expected revenge- a final journey that would take him "behind the sun." Dante's reinterpretation proves particularly significant because it radically transforms the teleology of the myth. If in Homer Odysseus is defined by his longing to return to

Ithaca, in Dante that return is merely a stop on a more ambitious journey toward the unknown. The inversion that Virgil's disciple operates on the character constitutes the fundamental paradigm that will leave evident traces in both Borgesian reinterpretation of Odysseus and Cernudian recreation of the myth, thus establishing a hermeneutic genealogy that connects the medieval age with contemporary literature on both shores of the Atlantic.

The dialectic between the medieval religious paradigm and secular impulse toward exploration finds its full development during the humanist period. The Renaissance, with its direct recovery of Greek texts, allowed a rediscovery of the figure of Odysseus beyond medieval interpretations, though without being able to completely escape the powerful influence of the Florentine poet's reading. This tendency would reach its culmination during Romanticism with Alfred Lord Tennyson's poem *Ulysses* (1842), where the hero, already aged in Ithaca, longs to undertake a final journey in search of knowledge. The famous verse that closes the poem -"To strive, to seek, to find, and not to yield" (Tennyson, 2007) - converted Ulysses into an emblem of the romantic spirit of incessant search and rebellion against imposed limitations.

Literary modernity of the twentieth century has generated the most ambitious and complex reinterpretations of the myth. James Joyce's *Ulysses* (1922) transposes the structure of the Odyssey to a single day in Dublin in 1904, where Leopold Bloom, a modern Jewish Ulysses, and Stephen Dedalus, a young intellectual Telemachus, live a quotidian epic that redefines heroism in terms of resistance to modern alienation. Parallel to this, Nikos Kazantzakis in his *Odyssey* (1938) - monumental continuation of the Homeric epic in 33,333 verses - presents an Odysseus dissatisfied after his return to Ithaca who undertakes new journeys until his death in the frigid polar regions of the south. This emphasis on journey as an end in itself, more valuable than the destination itself, finds particularly felicitous expression in Konstantinos Kavafis's poem "Ithaca" (1911). In this celebrated composition, the Alexandrian poet reinterprets the Odyssean myth as metaphor for life's path, emphasizing that the true meaning of the journey does not reside in reaching the destination but in the experiences accumulated during the voyage: "Keep Ithaca always in your mind. / Arriving there is what you are destined for. / But do not hurry the journey at all. / Better if it lasts for years, / so you are old by the time you reach the island, / wealthy with all you have gained on the way" (Kavafis, 1971).

Medieval and Golden Age Foundations: Christianization and Moral Allegory

The reception of Odysseus in Hispanic literature begins with medieval Christianization of classical mythology, establishing interpretive patterns that would influence subsequent receptions. This period created the foundational tension between admiration for classical wisdom and suspicion of pagan values.

Pedro Calderón de la Barca's *El mayor encanto, amor* (1635) reworks the Ulysses-Circe encounter as allegory of moral duty versus ephemeral pleasure. Where Homer presented complex interaction between human cunning and divine power, Calderón creates straightforward moral instruction about spiritual fortitude. Lope de Vega's *La Circe* (1624) offers psychological complexity, developing the sorceress as woman in love while transforming the hero into symbol

of spiritual fortitude against sensual temptations. This Neoplatonic sublimation of the conflict between reason and passion, articulated through refined poetic apparatus, anticipates conceptual and aesthetic elements that would find full development in modern literature.

Gonzalo Pérez's Castilian translation of the *Odyssey* (1556), dedicated to Philip II, facilitated direct access to the Homeric text and significantly contributed to the myth's diffusion in the Hispanic sphere.

The Modernist Revolution: Psychological Interiority and National Crisis

The transition to modernity brought radical transformations in Hispanic reception of the Odyssean myth. The modernist movement found in Odysseus a symbol adequate to its aesthetic and existential preoccupations. José Enrique Rodó's *Ariel* (1900) utilized mythological figures to articulate Latin American identity contrasted with Anglo-Saxon utilitarianism.

The Generation of '98 employed the myth as vehicle for reflections on national identity and Spanish historical crisis. The return theme resonated with concerns about Spain's destiny after 1898. Ramón Pérez de Ayala's *Prometeo* (1916) constitutes a paradigmatic example, presenting a protagonist who undertakes symbolic journey through Italy and Spain as modern odyssey, transforming Iberian geography into mythological scenario.

Seville appears as "the country of the lotus-eaters, who feed on a flower that makes one lose memory" (Pérez de Ayala, 1965), while the protagonist's journey through Spain reveals systematic disillusionment. Unlike the Homeric poem, return home appears impossible, reflecting both existential crisis of fin-de-siècle Spain and characteristic pessimism of the Generation of '98.

The Exile Generation: Odysseus as Political Metaphor

The Spanish Civil War generated perhaps the most significant transformation of the Odyssean myth in Hispanic literature. The exile experience fostered readings that resonated profoundly with historical reality, producing two markedly different but equally significant reinterpretations that illustrate the diversity of approaches within the Hispanic exile tradition.

Luis Cernuda's radical transformation represents perhaps the most complete inversion of the Homeric paradigm in Hispanic literature. In "Peregrino" from *Desolación de la quimera* (1962), Cernuda explicitly rejects foundational elements of the *nostos*: "sin hijo que te busque, como a Ulises, / sin Ítaca que aguarde y sin Penélope" [without a son to seek you, like Ulysses, / without Ithaca waiting and without Penelope] (2002: 187). This triple negation transforms exile from historical circumstance into existential choice. The Sevillian poet's approach reflects circumstances of Spanish Republican exile, where return was not merely impossible but potentially compromising. Unlike compatriots who maintained hope of repatriation, Cernuda progressively transformed forced displacement into conscious election. His concept of being

"disponible por siempre" [available forever] establishes a new heroic paradigm based on renunciation of fixed belonging.

Jorge Luis Borges presents equally complex but fundamentally different appropriation. His sonnet "Odisea, libro vigésimo tercero" (1964) explores temporal complexity of identity through the returned hero who questions his own multiplicity: "¿dónde está aquel hombre / que en los días y noches del destierro / erraba por el mundo como un perro / y decía que Nadie era su nombre?" [where is that man / who in the days and nights of exile / wandered through the world like a dog / and said that Nobody was his name?] (2010: 206).

Borges's interpretation privileges simultaneous coexistence of apparently contradictory identities: wandering warrior and prudent king, anonymous wanderer and returning husband. This multiple Odysseus reflects Borgesian conception of identity as cyclical accumulation rather than linear development. His assertion in "El inmortal" that "Yo he sido Homero; en breve, seré Nadie, como Ulises" [I have been Homer; soon, I shall be Nobody, like Ulysses] (1977: 27) dissolves boundaries between creator and character. These contrasting approaches - Cernuda's decisive rejection versus Borges's circular conception - illustrate the Odyssean myth's extraordinary flexibility to accommodate divergent displacement experiences while addressing specifically modern concerns about identity, time, and belonging.

Contemporary Reappropriations: Feminist Voices and Postmodern Fragmentation

Contemporary Hispanic literature has generated the most radical reinterpretations of the Odyssean myth, particularly through feminist authors who have given voice to previously silenced figures. Silvia Ugidos's "Circe esgrime un argumento" presents the sorceress arguing that conventional marriage is more inimical to love and life than her own poisons, provocatively inviting Ulysses to remain with her. Marina Aoiz's "Penélope y su mudanza" shows the protagonist finally liberating herself from eternal waiting imposed by tradition, finding in chosen solitude her authentic vital odyssey. This represents fundamental shift from passive waiting to active agency, challenging millennia of literary tradition.

Cristina Peri Rossi reinterprets return in existentialist terms in "El regreso de Ulises a la patria", where her Ulysses feels profound disquiet before sedentary life, expressing that returning implies a small death. The exile condition, converted into Latin American collective destiny, finds in the Homeric epic a powerful metaphor for articulating experiences of uprooting and forced adaptation.

Pablo Neruda rewrites the myth in historical and political terms in *Canto General* (1950), where Ulysses appears as symbol of European navigator who discovers America. The poet utilizes the Greek navigator figure as metaphor for colonial encounter, representing European arrival to a continent waiting to be named, linking classical myth with American experience. The analysis reveals that Hispanic literature has developed distinctive characteristics in its appropriation of the Odyssean myth that differentiate it from other European traditions. Four fundamental features emerge: First, the colonial and postcolonial experience has generated interpretations

where the Mediterranean voyage becomes metaphor for transatlantic crossing and cultural encounter. This transformation is particularly evident in Latin American authors who utilize the myth to explore themes of discovery, conquest, and cultural hybridization. Odysseus becomes simultaneously discoverer and discovered, colonizer and colonized, reflecting complex dynamics of Latin American cultural formation.

Second, the twentieth-century experience of political exile created conditions particularly conducive to Odyssean identification, producing works where Ithaca simultaneously represents lost homeland and impossible return. The contrasting approaches of Cernuda and Borges illustrate this diversity: while Cernuda's "Peregrino" explicitly rejects the *nostos*, Borges's "Odisea, libro vigésimo tercero" explores identity multiplicity that survives both departure and return.

Third, temporal irreversibility emerges as distinctive characteristic of Hispanic reception. Unlike other European traditions emphasizing cyclical nature of the Odyssean journey, Hispanic authors frequently develop linear conceptions of time that preclude authentic return. This temporal irreversibility, whether conceived as historical (impossibility of recovering pre-war Spain) or existential (subject transformation through experience), creates particular poignancy in Hispanic appropriations. Fourth, contemporary Hispanic authors have significantly expanded the mythological universe by giving voice to previously marginalized figures, particularly female characters. This feminist reappropriation challenges traditional heroic paradigms by questioning gender assumptions implicit in classical narratives and offering alternative perspectives on agency, patience, and transformation.

The dialectical tension between *nostos* and *curiositas*, established by Dante's reinterpretation, proves crucial for understanding modern Hispanic appropriations. While some authors privilege the return impulse, others emphasize the exploration drive, generating a rich spectrum of interpretive possibilities that demonstrates the myth's continued relevance for contemporary concerns.

Conclusions

This comprehensive examination demonstrates that Spanish and Latin American authors have created a distinctive tradition of mythological rewriting characterized by unique cultural adaptations and innovative interpretive frameworks. The research reveals how the *πολύτροπος* nature of the Homeric hero has enabled profound transformations while preserving essential archetypal elements. The transatlantic perspective proves particularly illuminating, showing how cultural translation between Old and New Worlds has generated new meanings and interpretive possibilities. Colonial experience, political exile, and contemporary feminist consciousness have each contributed distinctive elements to this tradition, creating a rich palimpsest of cultural meanings that extends beyond simple literary allusion.

The study contributes to ongoing scholarly discussions about cultural reception, literary adaptation, and the universal human experience of displacement and return. It demonstrates that mythological archetypes remain vitally relevant for contemporary literature, capable of

articulating modern concerns while maintaining connection to fundamental human experiences. The enduring vitality of the Odyssean myth in Hispanic literature testifies to literature's capacity to maintain dialogue across centuries and cultures, demonstrating that ancient questions posed by Homer—about identity, homecoming, and the meaning of human journey—remain as urgent today as they were three millennia ago.

Future research should explore digital humanities approaches to mapping mythological reception across languages and cultures, examine translation practices' influence on mythological adaptation, and investigate emerging voices in contemporary Latin American literature who continue transforming classical narratives for twenty-first-century audiences.

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Hierophanic features of a pilgrim child: processes of reconversion of symbolic capital

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Introduction

This research seeks to analyze the process of redefining symbolic capital surrounding the cult of the Virgin of Atocha and, in particular, the Holy Child of Atocha. It highlights their role as a vehicle of cultural and emotional identity in contexts of vulnerability and migration. Throughout history, deified female figures have played a central role in shaping the symbolic and religious systems of different cultures. From Pierre Bourdieu's perspective (Bourdieu, 1997), these deities represent a symbolic capital that is transmitted and redefined across generations. This allows communities to articulate fundamental values such as fertility, protection, and the continuity of life (Fernández, 2022). Religious habits, understood as the set of internalized dispositions and practices, is manifested in the veneration of agrarian goddesses (Arriba, 2020).

The function of these goddesses not only responds to material needs—such as shelter, food, and fertility—but also operates on the emotional and affective plane, as David Freedberg suggests (Freedberg, 2009). The images and representations of these divinities activate somatic and affective responses in devotees, generating bonds of protection and hope that reinforce a sense of belonging and community cohesion.

In this context, the Virgin of Atocha and the unique devotion to the Child God that accompanies her in traditional iconography, which receives a particular cult in the sanctuary of Fresnillo in the Mexican state of Zacatecas. This devotion exemplifies the process whereby devotion acts as an element of cultural identity, but also as a device of symbolic capital. According to Bourdieu it is reconverted to operate in new social fields and respond to the specific needs of communities in vulnerable contexts (Bourdieu, 2014).

This paper attempts to show how this devotion, that originated in the Castilian Marian tradition and transformed into the sanctuary of Plateros, Zacatecas. It seeks especially to understand how it operates as a mechanism of legitimization, protection, and grounding for communities facing displacement and social crises. To this end, an interdisciplinary qualitative methodology was employed, integrating tools from cultural history, religious anthropology, and Bourdieusian sociology.

Using an interdisciplinary qualitative methodology, this study traces the iconographic and devotional evolution of the image, as well as the mechanisms of transmission and adaptation of the symbolic capital associated with the Child of Atocha. Particular attention is paid to the way in which the attributes of the "pilgrim child"—inspired by the pilgrim of St. James—have been appropriated and reinterpreted by migrant communities, becoming symbols of transition, aid,

and hope in the face of adversity (Johnson, 2005). The text seeks to reflect on how the transnational circulation of the image and the establishment of sanctuaries on the Mexico-United States border, reinforce collective identity and community cohesion among migrants (Machado, 2012). Thus, the cult of the Holy Child of Atocha is presented as a paradigmatic example of the capacity of religious images to adapt and consolidate in complex settings, such as border areas.

The study is based on documentary analysis of primary and secondary sources: chronicles, papal bulls, inventories, novenas, prints, votive offerings, visual records, and oral testimonies, as well as a critical review of specialized literature. The research was developed from a qualitative approach, using the following techniques: Documentary Analysis; literature review; iconographic analysis.

The results will show how devotion to Our Lady of Atocha functions as symbolic capital and legitimation when promoted by regular orders and figures of the conquest. Additionally, we will see that the Virgin and Child form a single, inseparable whole. This indicates that both elements were theologically and artistically linked from the beginning. Therefore, the autonomy of the cult of the Child of Atocha arose later in America. This led to the origin of the peculiar iconography of the Niño de Atocha as the "pilgrim child." His transfer to the Americas allowed him to circulate north to Zacatecas and then to the southern United States. The devotional phenomenon of Plateros became established beginning in the second half of the 19th century. In the 1950s, a political and religious crisis occurred in Mexico. In this section, we will explore the autonomy of the cult of the Child of Atocha and its redefinition as a protector of migrants and vulnerable communities. The phenomenon was strengthened by migration from Zacatecas to the United States, especially during and after the Bracero Program.

Our Lady of Atocha: Symbolic capital and legitimation

The Virgin of Atocha is a Marian devotion that paradigmatically illustrates the processes of reconversion of symbolic capital in contexts of imperial expansion and evangelization in the Americas (Hamilton, 1975; Brading, 1991). Her history reveals how a medieval Castilian devotion was transformed into a transcontinental religious habit, operating simultaneously as a device of colonial legitimation and a spiritual refuge for vulnerable communities.

The image, according to legend, was carved by Nicodemus, painted by Saint Luke, and brought from Antioch to Spain. This narrative, far from being a mere hierophanic allusion, establishes a symbolic capital of apostolic authenticity that legitimized the veneration of the image. Formally, the Virgin of Atocha is a dark wood carving, dating from the 13th century, classified among the "Spanish Black Virgins."

The first written record of the devotion of this image is attributed to a 7th-century document, although its historicity is disputed. Narrative consolidation came in the 17th century with the work of Friar Gabriel de Cepeda and Friar Juan Hurtado de Mendoza, who documented miracles and her role in the Reconquista. The connection with the monarchy was consolidated in the 16th century, when the Virgin was proclaimed protector of Spain and the royal family.

Over the centuries, the Hermitage of Atocha underwent renovations and expansions, and in 1523 it came under the administration of the Order of Saint Dominic. The image was the subject of numerous miraculous narratives, particularly those that emphasize its transcendental role in the Reconquista and its relationship with the rulers of Castile. The current temple was inaugurated in 1950, and the church was granted the title of basilica by Pope Pius IX in 1863 (Gómez, 1991).

The Holy Child of Atocha: autonomy and redefinition

The Madrid cult of the Virgin of Atocha is one of the oldest Marian devotions in Madrid. However, the figure of the Child of Atocha does not have an autonomous historical tradition in Spain, since the original sculpture is unitary. The Virgin and the Child form a single, inseparable whole, indicating that both elements were theologically and artistically linked from the outset. The autonomy of the cult of the Child of Atocha emerged later, especially in contexts where the child figure acquired its own prominence. This occurred in America and, particularly, in Mexico, where the Child became the object of an independent devotion with a distinct iconography (Fernández, 2003).

This phenomenon was consolidated in the small town of Plateros, Zacatecas. Plateros, also known as the San Demetrio Mines. It is a satellite town of the former Real de Minas de Fresnillo, located on the Camino Real de Tierra Adentro, a key route in the mining and commercial history of New Spain and independent Mexico. Founded in 1566 after the discovery of silver veins, the town grew around mining and services for muleteers and merchants. According to Augusto Insunza Escoto (n.d.), in those years at the end of the 16th century, the deputy of mines, Alonso de la Villaseca, donated a life-size crucifix to the church of that camp.

According to Juan Javier Pescador (Pescador, 2022), at the beginning of the 18th century, the noble and prosperous Fernando de la Campa y Cos sponsored the restoration of the temple, whose growing reputation motivated the construction of a larger space in 1789 (Fernández, 2003). This is evidenced by the façade of this sanctuary, in whose central street and second body, above the choir window, a small sculpture of the Virgin of Sorrows can be seen. Above this sculpture stands the representation of the Lord of the Silversmiths, with his backrest characteristic of his early iconography, within a mixtilinear niche that follows the contours of the image, underlining in whose honor the temple was built (López, 1995).

The sanctuary's significance increased in subsequent decades thanks to its strategic location. However, it was sometime in the first half of the 19th century, probably in the third decade of that century, when devotion to the Holy Child of Atocha gained strength and autonomy. Although an image of the Virgin Mary called Our Lady of Atocha is still preserved in the main altarpiece of the Plateros sanctuary, to one side of the miraculous crucifix, this image bears no iconographic similarity to the Madrid image, neither in proportions, shape, nor attributes. The same is true of the Child Jesus, since in none of the Spanish representations of devotion, including the most famous trompe l'oeil depictions of the divine, the child is dressed as a pilgrim (with a hat, cape, scallop shell, basket, staff, and gourd), elements that characterize the iconography of the Mexican Child of Atocha.

Iconography and transnational circulation

Various authors have investigated the origin of this peculiar iconography of the Child of Atocha as the "pilgrim child." Among the most prominent specialists is Anna María Fernández Poncela. In her research on the Plateros shrine and Mexican devotion, highlights that the image of the Holy Child brings together symbols from diverse origins: the pilgrim's shell, the staff, the basket, and the water jug or calabash. These elements recall the attire of the pilgrim on the Camino de Santiago and that became part of Mexican iconography beginning in the 19th century (Fernández, 2003). Rosa María Sánchez Lara also points out that the figure of the Pilgrim Child is the result of a symbolic and devotional construction driven by both eighteenth-century Hispanic tradition and popular New Spain devotion.

The iconographic origin dates back to a hierophanic narrative set during the Muslim occupation of Madrid, during which only children under twelve were allowed to bring food to Christian prisoners. Faced with the distress of families without young children, women prayed to the Virgin of Atocha. One day, a mysterious child began to appear, dressed as a pilgrim on the Camino de Santiago—with a hat, sandals, a cape, a staff, a basket of bread, and a jug of water—and miraculously fed the prisoners. The community identified this child as the Child Jesus himself.

From the second quarter of the 19th century, devotion to the Holy Child of Atocha in Plateros, Zacatecas, acquired notable autonomy and relevance. According to the inventories cited by Del Hoyo Calzada (Del Hoyo, 2004, p. 43), the image of the child was separated from the image of the Virgin around 1816. In 1829, the image was placed on the main altar of the church, and by 1830, the first novenas and prints identifying the Holy Child venerated there began to circulate (Del Hoyo, 2004). It seems that, beginning in the 1860s, there was a massive dissemination of the devotion of this image, driven by the circulation of lithographic prints that contributed to the strengthening and expansion of the cult during the following decades. A pair of lithographs of French origin are preserved from this process, created by Raoul Roppart and Louis Auguste Turgis, the latter being one of the most important European publishers of religious prints of the time. Probably the image produced by Turgis in Paris (Enfant de Atocha), and apparently the most popular and prolific in editions, was a reworking of an iconographic model that was already circulating in the Catholic sphere, such as the iconography of the Pilgrim Child. Turgis 's lithograph depicts the Child as follows: a young boy with long, dark hair, between 10 and 12 years old, seated in a chair, dressed as a pilgrim on the Way of St. James. He wears a tunic with lace trim at the collar and cuffs, a cape, sandals, and a wide-brimmed hat, or sombrero, adorned with a feather. A scallop shell, a universal symbol of the pilgrim, stands out on his chest. In his left hand, he holds several ears of wheat, as well as a staff topped with a gourd, while in his right hand, he carries an empty basket. Vases of flowers are shown on both sides of the image, and at the feet of the divine infant, a rose lies on the ground. At the top of the scene, three angels frame the image, reinforcing the celestial character of the representation. Perhaps this print was the one that contributed to the consolidation of the attributes of the Jacobean pilgrim in the Niño de Atocha by Plateros, since a print of it is preserved, before the separation of the image of the Virgin, where it is observed that it lacks such attributes (staff, gourd, basket and hat) that later become so characteristic.

Starting with this French print, the production of 19th-century "popular" altarpieces or votive offerings—such as those preserved in the Plateros sanctuary, the Zacatecan Museum, and the Amparo Museum—began to conform precisely to this representation. The same is true of the image that appears on the so-called Arch of the Holy Child, built around 1887 in the atrium of the Plateros sanctuary (Ramírez, 2000, p. 125).

The cult on the border: Plateros and El Paso

The cult of the Holy Child of Atocha has transcended borders thanks to migration. Zacatecas, one of the main states that expels migrants, has seen how the image of the Child of Atocha has become a symbolic and emotional link to the place of origin. The attributes of the Jacobean pilgrim are reinterpreted as symbols of the migrant experience: transit, seeking help, and protection along the way.

The devotional phenomenon of Plateros was consolidated at the beginning of the second half of the 19th century, amidst a context of political and religious crisis in Mexico. Nevertheless, the autonomy of the cult of the Niño de Atocha and its redefinition as protector of migrants and vulnerable communities was strengthened by Zacatecas migration to the United States, especially during and after the Bracero Program.

The Mexican Catholic Church has promoted the emergence of churches and chapels dedicated to the Holy Child of Atocha in areas with a strong migrant presence, both in northern and southern Mexico. Along the northern border, three parishes stand out in the metropolitan area of Tijuana and Rosarito; one parish in Mexicali; one chapel in San Luis Río Colorado; as well as one chapel and one parish in Ciudad Juárez, Chihuahua; in addition to two chapels in Nuevo Laredo and one chapel in Reynosa. In the south, the parish of Tapachula stands out. Outside of Mexico, the largest number of chapels and parishes dedicated to the Holy Child of Atocha are located along the Ciudad Juárez. Albuquerque migrant route, with six notable spaces: a parish in El Paso, Texas; the Hatch shrine; the Tularosa chapel; the Chimayo shrine; the chapel of La Española; and the missions of La Jara and La Cebolla, all in New Mexico.

Among these spaces, the Niño de Atocha Parish in El Paso is a prominent example. Located at 210 S Clark Dr, this parish has become, since 1979, a true center of cultural resistance (Catholic Foundation for the Diocese of El Paso, 2008). The image of the Niño de Atocha, a central object of rituals and celebrations, is a three-dimensional representation of the iconography of the holy images of the Divine Child or Blue Child. By sharing rituals and beliefs, migrants—not only Zacatecanos or Mexicanos, but also Hispanics who share a common faith—find solace and mutual support, which contributes to the reaffirmation of their cultural identity and the overcoming of displacement. Devotion, therefore, becomes a central element for the integration and reaffirmation of cultural identity in the transnational space, allowing migrants to maintain emotional and symbolic ties to their roots (Pescador, 2022).

Conclusion

An analysis of the cult of the Child of Atocha reveals the capacity of religious images to adapt and acquire new meanings in contexts of social and migratory change. The symbolic capital

associated with the image is updated and acquires new meanings based on the needs and experiences of the devotees.

From Bourdieu's perspective (Bourdieu, 2014), religious symbolic capital is constructed and consolidated through practices, narratives, and objects that circulate in social space. In the case of the Niño de Atocha, the image becomes a device of legitimation and symbolic efficacy that allows migrants to confront vulnerability and displacement. Iconographic analysis allows us to identify the image's adaptation to different cultural contexts. The incorporation of the attributes of the Jacobean pilgrim, which originally referred to a nineteenth-century pastoral, now responds to the migrants' need for protection and assistance on their journey to the United States. The circulation of prints, votive offerings, and miraculous stories reinforces collective identity and allows for the transmission of symbolic capital to new generations.

Therefore, Plateros's cult of the Child of Atocha is a paradigmatic example of how religious symbolic capital is constructed, transferred, and consolidated in the national and transnational social sphere. This capital is objectified and codified through images, rituals, and miraculous stories. This circulate in both physical and virtual media, functioning as devices of legitimation and symbolic efficacy.

As mentioned, in recent decades, the identification of this devotion with the Mexico-United States migration phenomenon has strengthened. The transfer of the image and the establishment of shrines and celebrations in American border cities not only reproduce religious practices but also reinforce identity and community cohesion among Hispanic migrants. The symbolic value of the image is revived and acquires new meanings in the migration context, becoming an emotional and spiritual bridge that transcends borders.

Among the limitations of this study, we can conclude that:

1. There is a very likely suspicion of influence from an iconography that developed in Europe and that had an impact on the image of the Child of Atocha in Zacatecas. This image was possibly based on French prints, because the Child did not previously possess these iconographic attributes.

2. There are no sources or research linking this iconography (that of the Pilgrim Child) to that of the Child of Atocha. The removal of the Virgin to the child must correspond to a sort of adaptation or adjustment to an iconography that was beginning to gain popularity.

3. There is no systematic search and analysis of the circulation of the image and adaptation of iconographies to examine in more detail the monitoring and evolution of the devotion.

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Populism and presidential communication in Mexico: A legacy of Andrés Manuel López Obrador

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Introduction

The six-year term of former Mexican President Andrés Manuel López Obrador commonly known by his initials, AMLO, will be remembered as one of the most controversial in history, not only for ushering in Mexico's first leftist government, but also for his distinctive style of governance and communication. Throughout his administration, he remained in the spotlight, maintaining exceptionally high approval ratings and displaying communicative abilities unmatched by his predecessors. Furthermore, his presidential communication marked a watershed moment, marking a turning point in contemporary presidential communication strategies is not only relevant, but inherently justified.

In this context, a central question emerges: What communication model did the former president of Mexico employ to institutionalize his presidential discourse? This research explores AMLO's communication strategy as a living legacy, given that its practices continue to be actively reproduced by the current head of state, Dr. Claudia Sheinbaum Pardo. To examine this phenomenon, a qualitative methodology was adopted, combining nonparticipant observation with documentary analysis. The findings reveal a contemporary communication model aligned with the demands of populist ideology and strategy, specifically with the logic of populist discourse that shaped AMLO's political narrative. This discourse ultimately crystallized into what may be termed populist communication. The significance of this research lies not only in its theoretical contributions and social relevance, but also in its timely response to a notable gap in the academic study of presidential populist communication. Despite the global rise of populist governments, scholarly engagement with their communicative frameworks remains limited.

To define the populist presidential communication model employed by Mexico's former president.

Populism and political strategy

Rancière (2014) characterizes populism through three essential features: direct dialogue with the people, the assertion that governments and elites are only concerned about their own interests, and an identity-based rhetoric of rejection of foreigners. In addition, he asserts that there is an entity called "the people", which serves as the source of power and the interlocutor of political discourse (p. 120). By contrast, Mudde (2004, cited in Amezcua, 2019) conceptualizes it in a simpler way, referring to it as a thin ideology, with the function of dividing the social and political

horizon into two homogeneous and antagonistic groups: "the corrupt elite" and "the pure people."

Ernesto Laclau (1986) affirms that there is no exact definition of populism, however:

> It presents itself as a movement capable of altering the political stability of a country, with its starting point being the reconstruction of a new order, given that the previous one is fractured. Given the weakening of institutions, the populist movement is efficient in its operations, so the best way to manage a weakened country is from the vulnerable or marginalized sectors. In other words, populism arises and operates through the articulation of unsatisfied demands, which are restructured for fulfillment. (pp. 221-222)

He likewise argues that the typical features of populism as a political strategy may be its anti–*status quo* character, the loss of credibility of politicians, the appeal to the people, and the equality of social classes; consequently, this strategy is adopted by social movements in accordance with their historical processes, that is, mobilization arises when society faces a social problem (Laclau, 1986, p. 168). Moreover, Rosanvallon (2020) argues that populist culture is established through five fundamental elements: A conception of the people; a theory of democracy; a form of representation; a political and economic philosophy; and a regime of passions and emotions (p. 3). Consistent with this perspective, Casullo (2019) highlights that the populist leader, through their discourse, instills a sense of certainty among a distrustful populace. This dynamic emerges as previously excluded and invisible social sectors seek recognition from those aspiring to govern. Thus, populism, understood as a political strategy, constructs the image of a socially and morally upright leader with whom the people can identify (Flores & Amador, 2022). Within this framework, the populist strategy of AMLO's government was articulated from the moment his candidacy was announced, aiming to ascend to power following what he framed as a "failed administration". His discourse positioned him as the solution to the unmet social demands, thereby mobilizing marginalized sectors.

Populism and discursive ideology

Laclau (2005) argues that populist discourse stems from social demands, especially unmet ones, which accumulate and trigger collective discontent. At this point, the leader appropriates these grievances to build a rhetorical framework that casts the people as a potential historical actor, initiating the populist configuration. As he notes, the unification of these demands reaches a point of vague solidarity in a stable system of meaning, that is, the contagion of the masses is achieved (p. 101). Similarly, Charaudeau (2009) asserts that the success of populism and its discursive strategy lies in channeling citizen dissatisfaction particularly among the popular classes. Through this discontent, the leader earns trust and legitimacy, capturing latent demands and amplifying the resentment toward the power elites who have long disregarded them. Consequently, Laclau (2005) maintains that populist discourse proves effective when the collective adopts the leader's symbols and language as their own, allowing the rhetorical message to resonate across society.

Meanwhile, César Ulloa (2017) contends that populist discourse includes key elements such as confrontational and polarizing content, anti-political sentiment, the vindication of the people, calls for national refounding, and the promise of a new democratic order. He clarifies that when he speaks about the people, he is referring to the traps that political actors set to refer to something ambiguous that only makes sense in the context of their dispute with their adversaries (p. 272). Against this backdrop, since AMLO's rise to the Mexican presidency, his political discourse has become the centerpiece of all his efforts. For some, it signaled hope; for others, division. Still, his rhetoric polarized the nation throughout his administration, and its confrontational tone remains embedded in the public consciousness (Flores, 2024b). Prior studies by the author have confirmed the authenticity of his populist discourse and its use of empty signifiers (Flores 2024a; Flores 2024b; Flores & Amador, 2022).

Presidential communication and its intersectionality with other forms of communication

Presidential communication is a subfield of communication studies that, although receiving moderate academic attention, remains insufficiently conceptualized. This lack of definitional clarity has created notable gaps, complicating academic analysis and hindering theoretical consolidation. Even so, certain contributions have clarified its scope, particularly those by Meyenberg and Aguilar (2015), who define presidential communication as the expression of the president's ideas, vision, personality, and decision-making. It is shaped by his personality, style of governing, way of understanding politics, and his conception of democracy (p. 191). Beyond personal traits, presidential communication must be conveyed through structured institutional messaging. As Escalona (2015) asserts, it should be understood as all communicative activity linked to he institutional structure of the public sector within a given territory (s.p.). This suggests that presidential communication is not isolated; it intersects with broader communicative domains, such as social, governmental, political, and public communication, adding variables that shape a multifaceted and expansive field of study.

In this regard, Molina (2004) defines social communication as that which the government maintains with political parties, other systems in society, and the public (p. 9). In turn, García Cortés (1983) conceptualizes it as the process by which social groups use technical means (press, cinema, radio, television, and the Internet) to transmit symbolic content to many heterogeneous and widely dispersed people (p. 28). Likewise, Mario Riorda (2006) conceives government communication as a method through which a democratic government attempts to make its purposes or orientations explicit to the public in order to obtain support or consensus in the development of its public policies (p. 7). Complementarily, Campbell and Wyszomirski (2007) affirm that the communicative process between government and society is goal oriented, seeking to inform citizens about plans, programs, and administrative policies, with the intent of generating adherence.

Canel and Sanders (2010) emphasize the function, practices, and institutional purposes embedded in government communication, whereas Aguilar (2008) highlights its normative foundation: the citizen's right to information and the state's obligation to be accountable. Carlos Cezar Layon (2018), meanwhile, defines it as communication within the state and between state

institutions and society, government entities, and society at large. In turn, political communication is conceptualized by Dominique Wolton (1995) as the space where contradictory discourses are exchanged among three legitimate actors: politicians, journalists, and public opinion (as expressed through polls). Public communication, by contrast, centers on the processes of producing, processing, and disseminating information that shape and reshape public debate. It also comprises the communication of institutions, movements, and groups that intervene in the public square (Beauchamp, cited in Demers and Lavigne, 2007, p. 67).

The notion of the public sphere, as articulated by Habermas (in Busquet Medina, 2017, paragraph 3), refers to a domain of social life wherein individuals gather, deliberate freely, identify collective issues, and, through dialogue, influence political action. Amid this evolution, the rise of the Internet, digital social networks, and new online media has led governments to redesign communication strategies, extending outreach beyond traditional platforms such as radio, television, and print, to engage more effectively with increasingly diverse and dispersed citizenry. Tarullo (2015) notes that governments have progressively incorporated new technologies as a central element of their communication with citizens. Populist administrations have exploited these tools to revive slogans such as "government close to the people" and "a government of the people," portraying them as symbols of honesty and expressions of their alleged "devotion" to the public. The aim is to build trust and promote dialogue and mutual understanding with constituents.

When communication lacks clarity, reciprocity, and horizontal interaction, remaining linear and vertical, it risks creating a significant void, potentially leading to public discontent, misinformation, and societal unrest (Flores, 2023). Conversely, well-structured, bidirectional communication fosters a culture of legality and strengthens transparent institutions (Flores, 2019).

This paper examines the former Mexican president's communication practices within the framework of populist strategy and discourse. It is based on qualitative research, using nonparticipant observation and documentary analysis. An exhaustive review was conducted across historical records and relevant disciplines, notably communication, political science, and public administration, from a social and multidisciplinary perspective. Contemporary literature was also reviewed to complete the analytical framework. In addressing the above considerations, published works were consulted, and current norms and laws were re-read. A thorough hemerographic, audio, and visual follow-up was conducted, alongside a review of the corresponding theory. The General Law of Social Communication was analyzed in detail, and expert opinions were consulted.

For nonparticipant observation, the analytical units proposed by Hernández and Mendoza (2018) were applied: a) physical environment; b) social and human environment; c) activities; d) artifacts; e) relevant events; and f) human portraits. These led to the identification of analytical categories, which became key elements of both the basic and comprehensive prototypes of AMLO's populist communication model. The corpus included 72 morning press conferences (*Las Mañaneras*) from his final year in office (January 1 to September 30, 2024), streamed on the official Facebook page of the "Government of Mexico." Notably, the selected *mañaneras*

correspond to Mondays and Fridays throughout the nine-month period. Facebook was chosen for its high public interaction and the former president's preference for the platform. Similarly, 2024 was selected as the year when his communication model and populist strategy were already consolidated. It also marked a period of farewells, nostalgia, and reflection on the fulfillment of campaign promises.

Andrés Manuel López Obrador, the populist leader, the spokesman, the medium and the message, as the main element of his model

Andrés Manuel López Obrador (AMLO) is a a political figure of international relevance who consolidated his influence both within and beyond Mexico. His political discourse and presidential communication endure as a living legacy, consistently addressing social injustice, popular struggles, nationalism, and the abuses of the privileged class. He governed Mexico from 2018 to 2024 and stands out as the first president to reach power through an alliance of leftist parties. Within this context, Laclau (2005) warns that populist leadership is a collective construction involving both leaders and followers, as the former cannot emerge without the support or presence of the latter. Carlos de la Torre (2018, cited in Amezcua, 2019) underscores the leader's self-presentation as popular and authentic, positioning them as a genuine alternative to political elites, highlighting the redemptive nature of their mission and strategic use of media. Contributing to this view, Manuel Arias Maldonado (2016) argues that populist leaders may embrace eccentricities, embodying a "media stardom" in which followers establish a connection and even intangible admiration akin to that for a pop star. Likewise, Melissa Amezcua (2019) stresses the construction of López Obrador's public image as a populist leader, grounded in his closeness to the popular classes, his narrative as a man shaped by effort and sacrifice, and his selfless involvement in social struggles, always distanced from the corrupt and conservative political elite. His evident taste for the spotlight also deserves attention, reaching such magnitude that, echoing Marshall McLuhan's famous phrase (1964, quoted in Strate, 2012, p. 62), "the medium is the message", AMLO effectively became, from day one of his mandate, not only the spokesperson of his government, but also the medium and the message itself. In doing so, he effectively annulled both the official government spokesperson and the general coordination of social communication of the presidential office. In short, he became the central and indispensable element of his communicative model.

Populist communication as a legacy

As a hallmark of his administration, the morning press conferences called *Las Mañaneras* were announced from the beginning, always headed by the then president of the nation and that by the end of the year 2023 totalled more than one thousand and two hundred (Flores, 2024a), which are still in force with his successor, as a living legacy. Likewise, as a guiding principle, the "AGREEMENT establishing the Social Communication Policy of the Federal Government" was presented, which is also still in force almost a year after the end of her administration. In this context, six elements were identified as pillars in AMLO's presidential communication model: 1. The populist leader, in his role as transmitter, represented in this case by Andrés Manuel López

Obrador, who is also an excellent speaker; 2. *Las Mañaneras* invariably held from Monday to Friday at 7:00 a.m., with an approximate duration of between two and three hours, usually held at the National Palace, with the exception of the tours to the interior of the country; 3. The populist political discourse, understood as the message; 4. Reporters assigned to the presidential press corps, converted into primary receivers of the message, intermediaries with the media and sounding boards; 5. Social media as the primary channels for a bidirectional and simultaneous communication, enabled by digital technologies; and 6. The people, as a priority interest of the president and receiver without intermediaries. In this way, a preliminary basic model can be proposed, as shown in Figure 1.

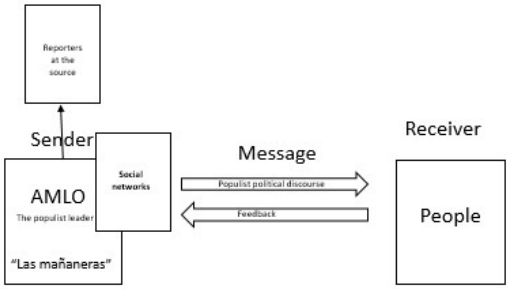

Figure 1. Basic model of AMLO's populist presidential communication.

In a second stage, incorporating the additional elements outlined in the theoretical framework, an integral model of AMLO's populist communication, still in effect, can be proposed, as shown in Figure 2.

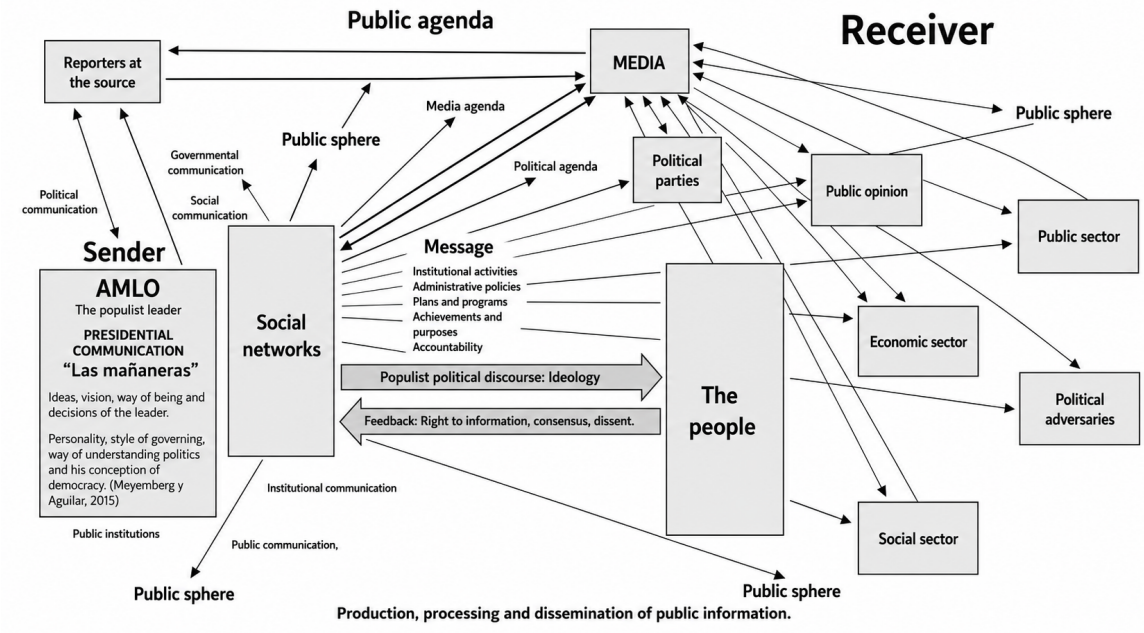

Figure 2. Integral model of AMLO's populist presidential communication.

Conclusions

It is indisputable that Andrés Manuel López Obrador's figure has occupied, continues to occupy, and will occupy a central place in Mexico's contemporary political discourse and in populist governments globally, due to his distinct modes of governance and communication. These modes constitute a living legacy, still in effect across the country, particularly evident in the communicative practices of his successor and political ally, Dr. Claudia Sheinbaum Pardo, President of Mexico (2024–2030). In this context, any discussion of recent presidential communication must inevitably refer to his discursive ideology, embodied in the rhetoric of confrontation and polarization, the vindication of the people, the refoundation of the homeland, and the promise of a new democracy (Ulloa, 2017). Moreover, his political strategy, centered on the alleged reconstruction of a new social and institutional order following the fracture of the previous one, must be considered in any analysis (Laclau, 2005). Accordingly, the results section begins with López Obrador himself, who emerges as the principal finding and the foundational element of the proposed model. As Meyenber and Aguilar (2015) argue, presidential communication is shaped by the ideas, vision, character, and decisions of the incumbent president, including their personality, style of governing, way of understanding politics and conception of democracy (p. 191). From the outset of his presidency, AMLO positioned himself not only as the spokesperson of his administration, but also as the medium and message of presidential communication. Future studies would benefit from further exploration of the populist leader's attributes, including, for instance, personality traits. The second section of the results analyzes AMLO's communication strategy as a political legacy, culminating in the construction of a two-stage model, basic and integral, which fulfills the objective of this study. Under this framework, six core elements were identified in the basic model for its proper functioning: 1. The populist leader; 2. *Las Mañaneras*; 3. The populist political discourse; 4. The presidential press corps; 5. The social networks; and 6. The people. Building on this, an integral model of presidential communication is proposed, incorporating the additional elements outlined in the theoretical framework, specifically, the intersection of presidential communication with institutional, social, governmental, political, and public dimensions. This allows for a clear visualization of the flows of transmission and feedback among the primary components of the composite model, comprising the six elements mentioned above, plus the media. The latter, guided daily by presidential messaging, replicate the topics promoted by the populist leader, thereby reinforcing public, political, and media agendas. As shown in Figure 2, the media play a central role in the model, marked by the highest number of direct interactions, both incoming and outgoing, ultimately insulating the populist leader from such exchanges. By acting, perhaps inadvertently, as a filter, shield, and defense for other social sectors, the media fulfilled a function the president did not assume directly, whose direct and sustained contact was always with the people, facilitated by the immediacy and simultaneity of social networks.

Despite the model's logistical complexity and resource demands, the outcomes proved highly effective: it earned trust and respect, positioned national agendas in the public sphere, and simultaneously advanced the populist strategy while minimizing media costs. Notably, the former president faced little friction with the press, as all outlets attended *Las Mañaneras*, engaged in extended debates for two and a half hours, and the administration no longer had to engage with them for the rest of the day. Impromptu interviews and unforeseen events were likewise resolved

promptly in the following morning's session. In doing so, AMLO demonstrated that he is not only a politician well-versed in communication, but also a skilled communicator and a political strategist.

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Performing the Fantastic: A Spectacular Reading of Macbeth in Contemporary Theatre

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Introduction

This article analyzes the representation of the fantastic in four contemporary productions of William Shakespeare's *Macbeth*, staged in the 21st century:

- *Macbeth* (2018), directed by Michael Thalheimer.
- *The Tragedy of Macbeth* (2021), directed by Yaël Farber.
- *Macbeth* (2019), directed by Ghasem Tangesirnezhad and Mahsa Rahsepar.
- *Mendoza* (2012), directed by Juan Carrillo.

The primary aim of this research is to contribute to an underexplored area within theatre studies: the examination of the fantastic in contemporary theatre, with a specific focus on staging.[6] Theoretical research on speculative fictions within theatre studies is limited. While there are valuable works, such as *Lo fantástico en escena. Formas de lo imposible en el teatro español contemporáneo* (de Beni, 2012), and specialized publications such as "Modalidades de lo fantástico teatral" in *Pygmalion. Revista de teatro general y comparado* or "Teatro fantástico del siglo XX y XXI" in *Brumal. Revista de Investigación sobre lo Fantástico*, these studies have predominantly focused on dramaturgical analysis.

In light of this gap regarding the performative dimension, this study seeks to pinpoint the mechanisms through which the fantastic is materialized on stage. It starts from the premise that analyzing stage practice through its "expressive channels" allows us to identify how contemporary directing has embodied the fantastic. The goal is to uncover creative strategies and aesthetic decisions that enable the staging of speculative fictional worlds, offering useful tools for creators interested in this field.

[6] The term *puesta en escena* has traditionally been used as a synonym for theatrical performance. However, 'poner' ('to put') is a verb that suggests that what is being produced is merely a transposition of the literary text onto the stage, and therefore that directing is simply transferring written language into spoken language. The problem is that contemporary theatre often emerges from creative processes that are not necessarily textual, where a written script may be developed during rehearsals—or may not exist at all. Moreover, the idea of direction as mere interpretation has been surpassed, transforming it into an act of expression, whereby directors and those responsible for the visual design have attained the status of artists, on equal footing with their fellow playwrights. In this sense, *puesta en escena* is not a precise term—in fact, shouldn't it fall into disuse?—and the term *escenificación* (staging) is used instead, as it more accurately reflects current practices" (Martínez Valderas, Hoyo Ventura, & Teira Alcaraz, 2023, p. 21).

The guiding hypothesis of this research suggests that the selected productions reflect an evolution in stage directing, characterized by the interdependence of semiotic systems and the intensive collaboration between creative and technical teams. This synergy encourages innovation in the representation of fantastic elements and responds to the need to engage with contemporary audience sensibilities. Furthermore, it is argued that contemporary theories of the fantastic, derived from literary studies, provide a valuable and necessary conceptual framework for rigorously analyzing these stage proposals.

To verify the hypothesis and guide the analysis, six objectives have been established to methodologically structure this research:

1. Conceptualize the relevant terms through an approach grounded in literary studies of the contemporary fantastic, thereby providing a theoretical foundation for theatrical research.

2. Bridge two areas of investigation: the possible-worlds theory of fantastic fiction and the theatrical practice associated with this current.

3. Identify the fantastic features present in William Shakespeare's source text via a dramaturgical analysis.

4. Examine how the representation of the fantastic in *Macbeth* varies across cultural and artistic contexts, and how such adaptations contribute to a global reinterpretation of the play, in accordance with the concept of Global Shakespeare.

5. Analyze the creative strategies and aesthetic decisions employed by contemporary directors when staging fantastic elements in their adaptations of *Macbeth*.

6. Contribute to theoretical research on the fantastic in the performing arts, aiming to enrich the field of Theatre Studies with insights into speculative fictions and their relationship to contemporary theatrical direction.

Theoretical Framework

To delimit our focus, it is essential to direct attention toward the most recent trends in the study of fantastic fiction, specifically the theory of the "possible worlds of the fantastic." The work of Eva Ariza Trinidad, such as *Possible Worlds of the Fantastic: An Approach to World Structure* (2021) and *Accessibility Relations of the Possible Worlds of the Fantastic* (2023), provides a significant and up-to-date theoretical resource. The author defines this concept as:

> physically possible worlds, similar to the real one, in which features of physically impossible—i.e., supernatural—worlds are unveiled by a disruptive element; or physically possible worlds in which the impossible occurs—also provoking disruption. (Ariza Trinidad, 2021, p. 380)

This definition is fundamental because it departs from the classical notion of the fantastic as hesitation (Todorov, 1970) and focuses instead on the sudden incursion of the supernatural and/or an impossible event within a recognizable logic, thereby producing a disturbing effect.

Since the dramatic text itself constitutes an expressive channel and serves as the starting point for staging, it is vital to undertake a dramaturgical analysis of the source text. In light of the aforementioned theory, *Macbeth* can be examined according to the dominant traits of the fantastic:

- Reality conflict: The play continually questions the boundaries between the real and the imaginary.
- Incursion of the supernatural: Impossible events (prophecies, spectral appearances) transgress the established order.
- Inexplicability of the phenomenon (Roas, 2018; Reisz, 2001): The nature of the witches or Banquo's ghost remains ambiguous, opening a portal to a non-rational plausibility.
- Disturbing effect: The play generates a "metaphysical fear," an existential anguish that goes beyond mere fright, complemented by a rational "natural fear" of violence and death (Roas, 2018).
- Terror, the uncanny, and horror: The play explores how the familiar becomes strange and threatening (Freud, 2001; Trías, 2011), as well as horror's variants (revulsion at what is seen) and terror (anticipation of the threat) (Radcliffe, 2007).

In summary, our analysis is built upon the relationships illustrated in the following figure:

Figure 1. Breviary of our sense of the fantastic.

In summary, *Macbeth* operates as a fictional world in which various supernatural elements or impossible events (witches, ghosts, a floating dagger) erupt disruptively into a constructed reality, destabilizing our perception of the real world and provoking disturbance both in the fictional characters and in the audience.

The choice of *Macbeth* is deliberate. Its status as a canonical classic and its inherent supernatural dimension, together with the concept of "Global Shakespeare" (Guerrero, 2017), make it possible to study diverse stagings that adapt the play to different languages and cultures, thereby enriching the scholarly debate about its relevance and plasticity.

Staging the fantastic—the "visible unreality" to which Patrice Pavis (2008) refers—has long presented a historical challenge. Mounting sequences in which physically impossible worlds intrude demands remarkable theatrical ingenuity. Nonetheless, the potential is vast. In her 1826 essay "On the Supernatural in Poetry," Ann Radcliffe described the impact of a *Macbeth* performance, highlighting Sarah Siddons's portrayal as the semiotic bridge that rendered the impossible believable:

> So problematic is the effect of the witches on stage and in my mind that I would probably have left the theatre when they appeared, had it not been for the fascinating performance of Miss Siddons, who was praised throughout the play and succeeded in dissipating my disgust. In the same way she made me forget Shakespeare himself, while all awareness of fiction vanished. (Radcliffe, 2007, p. 15)

This testimony underscores the importance of expressive channels—in this case, performance—for establishing the "accessibility" between the spectator's reality and the play's fantastic world.

This research adopts a qualitative approach, using a comparative case-study design as its primary strategy. The object of study consists of the theatrical realizations of the four selected productions of *Macbeth*, which are examined through audiovisual recordings, specialist reviews, interviews, and available production documentation.

The method centers on the analysis of the expressive channels of staging, exploring how the interplay of the following elements constructs the atmosphere and fantastic occurrences:

- Dramatic text and adaptation: modifications, cuts, or additions to the original script.
- Stage space and scenography: design of the performance area, including the use of props and architectural elements.
- Lighting: creation of atmospheres through focus, chiaroscuro, and colour.
- Sound environment: incorporation of music, sound effects, and voice treatment.
- Costume and characterization: design of costumes, makeup, and prosthetics.
- Acting performance: actors' physical, gestural, and vocal work.

The analysis begins with a dramaturgical reading of Shakespeare's text to identify the scenes and situations with the highest fantastic potential (e.g., the witches' encounter, the floating dagger vision, Banquo's ghost at the banquet, and other apparitions). Subsequently, it investigates how each director translates these moments into a concrete "staging text" by means of the channels listed above. The inclusion of productions from Germany, South Africa, Iran, and Mexico further enables the application of the Global Shakespeare framework to observe how different cultural contexts shape the reinterpretation of the fantastic.

This approach yields an analytical tool that addresses theatre from a spectacular perspective, accounting for its multiple compositional codes and thereby illuminating how elements that transcend pure rationality are brought to the stage.

The analysis of the four productions shows that, despite each one possessing a distinctive aesthetic and conceptual identity, they all employ visual and sonic elements to generate atmospheres that destabilize reality and make "the impossible" appear through dark, disturbing staging choices. The fantastic thus becomes a theatrical language for exploring the hidden, the unsettling, and the forbidden—adapted to each context without losing its transgressive core.

Summary of the stagings:

- Michael Thalheimer (Germany): His production foregrounds fear and evil as corrupting forces. Influenced by Bertolt Brecht, his aesthetic-stylistic strategy is minimalist: semi-naked bodies smeared with mud and blood, chiaroscuro lighting, and dense fog. These components amplify tension and anguish. The witches and Banquo's ghost are not mere visions but physical agents of malevolence, offering a contemporary reading of human fragility in the face of power and the supernatural.

- Yaël Farber (South Africa): Farber intensifies the darkest, most supernatural aspects to probe the violence of ambition. Her stage—cold and empty—functions as a purgatorial space where terror and distress are magnified. The production creates a constant polarity between the natural and the supernatural, in which prophecies and apparitions unsettle perception. Its dramatic core lies in exposing psychological tensions to reflect on ambition, power, and destiny within a framework where "the impossible" heightens the theatrical experience.

- Ghasem Tangesirnezhad & Mahsa Rahsepar (Iran): In this version, the supernatural unfolds through physical theatre, codified gestures, and an oppressive atmosphere. The directors conjure an altered reality marked by Banquo's spectre and the witches' prophecies, accentuating horror in moments such as Lady Macbeth's descent into madness. Its dramatic conviction hinges on an ideological critique of power and the act of killing—linked to Middle Eastern conflicts—thus presenting a political and corporeal reinterpretation of the classic play.

- Juan Carrillo (Mexico): In *Mendoza*, the play is transposed to the Mexican Revolution, offering a dark, fantastic portrait of ambition and violence. With a minimalist aesthetic, Mexican cultural influences (the Witch inspired by the shaman María Sabina), and echoes

of Juan Rulfo's literature (the living dead), the company Los Colochos Teatro transforms Shakespeare's text into a contemporary critique of corruption and authority. Banquo's ghost and the overall atmosphere resonate disturbingly with Mexican history.

Analysis of Representative Scenes

Below are four detailed examples illustrating the staging strategies:

1. The Sinister Chant in Yaël Farber's Witches
   In the opening celebration banquet, Lady Macduff (Akiya Henry) intones a melancholic chant. Farber inserts here fragments of *Come away, come away* from Thomas Middleton's play *The Witch*. This choice is crucial: the director employs a text historically associated with Macbeth's "curse," since its lyrics were once believed to originate in genuine sorcery. The chant functions as a gateway into the fantastic world. Its melancholic beauty, set within a warm atmosphere (candlelight and sepia tones), creates an unsettling contrast with the extratextual knowledge of its "cursed" origins—what Eugenio Trías terms the uncanny: a beauty that acts as a veil hinting at underlying chaos.

2. The Demonic Vision in Yaël Farber's Staging
   In Macbeth's second encounter with the witches, the scene unfolds in his own chamber, suggesting a nightmare made real. Terror heightens as the apparitions invade his intimate space. The sequence culminates in the dismantling of the set by a theriomorphic demonic figure (half ram, half human) representing Banquo's future descendants. Ross Anderson's Banquo dons a ram mask, a bare torso, and military trousers. This impossible image—realized with minimalist means—perfectly synergizes with the notion of an empty space overrun by horror and the fantastic.

3. The Dagger and Repetition in the Iranian Production
   The dagger scene opens in complete darkness. The witches appear on an elevated ramp, presenting Macbeth with a crown. Against the sound of an electrocardiogram, one witch offers him the dagger. The action repeats, luring the protagonist until the weapon ends up in his boxing gloves. Meanwhile, another witch writes in Persian on a sheet of plastic: "Macbeth killed the king," foreshadowing the murder. The insistence of gesture and repetition evokes a sense of the uncanny, echoing Freud's notion that involuntary repetition can produce a magical, supernatural effect in art. The witches' sudden disappearance cements Macbeth's conviction that he has witnessed the impossible.

4. The Butoh Spectre in Michael Thalheimer's Direction
   In the banquet scene, Banquo's spectre materializes following a brutal torture. Unlike the other blood-soaked figures, Banquo appears semi-nude with white makeup and prosthetics that give his skin a peeling texture, evoking the aesthetic of Butoh (the dance of darkness). This choice aligns with the challenge of representing a necromantic figure. The spectre's whiteness—accentuated by cool lighting—contrasts starkly with the scene's raw carnality, emphasizing the metaphysical terror invading Macbeth's already

disturbed mind. The impossible event manifests not through blood but through a ghostly pallor.

In summary, the integration of dramatic text, scenography, lighting, sound design, costume, and acting demonstrates that the creation of the possible worlds of the fantastic in theatre arises from precise direction and inventive adaptation of available resources.

Conclusions

This research has demonstrated that the conceptual tools of contemporary literary theory of the fantastic are both applicable and productive for the analysis of theatrical staging. The comparative analysis of the four *Macbeth* productions confirms the initial hypothesis: the representation of the fantastic in contemporary theatre relies on a sophisticated interdependence of expressive channels, orchestrated by a directorial vision that actively seeks new ways to engage today's audiences.

A key finding—transposing Eva Ariza Trinidad's theory to the theatrical realm—is the notion of "accessibility." This concept refers to establishing a direct connection between the spectator's referential world and the possible world of the fiction. As Ariza Trinidad (2023) observes, "the reality of the reader (and of the author) … is a necessary condition for the impossible event to occur" (p. 346). In the context of theatre, the spectator's reality encompasses both their knowledge of the contemporary world and their interpretation of historical contexts—such as the Elizabethan era—perceived as past realities. The aesthetic strategies employed by the directors under study function precisely as bridges of accessibility, using a contemporary visual and sonic language to render the impossible elements of a classic text both tangible and unsettling.

Limitations and Future Research Directions

One limitation of this study has been the necessary delineation of disciplinary boundaries. Priority was given to analysing staging from the perspectives of dramaturgy, scenotechnics, and performance, while disciplines such as philology and cultural studies—though they informed the theoretical framework—remained secondary, as they did not constitute the core focus of the work.

This thesis aims to open new avenues of research on the fantastic in performance. Proposed directions include:

1. Broadening the textual scope: Extending the analysis to other classical and contemporary texts to explore a wider spectrum of staging strategies.

2. Technological and intermedial integration: Investigating productions that incorporate audiovisual technologies, intermedial resources, and interactive environments as devices for creating the fantastic.

3. Empirical audience studies: Examining reception empirically to assess how various scenic elements influence spectators' perception of the impossible.

4. Transcultural comparisons: Conducting comparative studies of scenic techniques in non-Western contexts—particularly in Asian regions—to contrast methodologies and enrich the transcultural perspective.

5. Methodological framework development: Designing a specific practical framework for creating the fantastic in theatre, serving as a guide for directors and scenic designers.

6. Taxonomy of practitioners: Cataloguing companies, directors, and collectives working with the fantastic in order to construct a taxonomy of impossible staging organized by country and aesthetic current.

In conclusion, this work contributes new theoretical and methodological perspectives for understanding, analysing, and exploring the creation of possible worlds of the fantastic in contemporary theatre.

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Likes, reactions, and debate: a digital discourse analysis of the album 'Nadie sabe lo que va a pasar mañana' by Bad Bunny

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Introduction

This research acquires both academic and social relevance as it allows for an understanding of how digital platforms have become key spaces for shaping meanings around contemporary musical products, such as Bad Bunny's album *"Nadie sabe lo que va a pasar mañana"*. Firstly, recent studies show that digital discourses on social media about musical works not only reflect collective emotions but can also be processed as valid sources for semantic and affective analysis, thanks to data extraction methodologies and natural language processing (Donnelly & Beery, 2022). Likewise, critical discourse analysis in digital environments helps to uncover dynamics of power, representation, and otherness, as evidenced in research on how the media frame the musical participation of historically marginalized groups, making visible the racialized discourses that persist even within seemingly positive narratives (Marroquín, 2022). Consequently, analyzing digital interactions around musical discourse not only enriches the field of communication and cultural studies, but also allows us to identify the sociopolitical tensions embedded in contemporary tastes, reactions, and debates.

Situación problemática

Currently, the analysis of digital discourse surrounding musical phenomena such as Bad Bunny's album *"Nadie sabe lo que va a pasar mañana"* reflects a complex interaction between identity, gender, and media participation. On one hand, recent studies indicate that Bad Bunny embodies a transgressive gender performance that challenges the boundaries of hegemonic masculinity, particularly within the context of Latin trap, revealing a tension between the disruptive and the normative in his digital representation (Rivera Figueroa, 2021). Likewise, it has been documented that in his album *X100PRE*, the artist adopts distinctly queer gestures that reframe clothing, nostalgia, and gender codes from a colonized and racialized perspective, reshaping traditional reggaetón frameworks through visual and digital discourse (Gargiulo & Lugo Vélez, 2024). On the other hand, the digital circulation of his work has intensified debates about the apparent democratization of musical discourse on social media, where technological platforms offer the illusion of access and horizontality but in practice reproduce unequal dynamics of visibility and symbolic power (Hanrahan, 2024).

Based on the problematic situation outlined, this research considers three main objectives: first, to analyze the primary emotions, concepts, and keywords expressed by users on social media in response to the release of Bad Bunny's album *"Nadie sabe lo que va a pasar mañana."* Second,

to examine discursive differences and patterns of digital interaction between men and women in relation to the album, using social media network maps. Third, to interpret the digital discourse generated around the album from a critical perspective, considering cultural, identity-based, and media consumption aspects within the Latin/Caribbean context.

This research follows a qualitative interpretative approach, employing discourse analysis as its methodological design—understood as a strategy aimed at understanding the construction of meaning within situated communicative practices. From hermeneutic epistemology, language is recognized not only as a means to describe reality, but also to produce, legitimize, or question it, thereby functioning as a form of social action (Fairclough, 2013). The corpus consisted of 100 public comments collected from the artist's official Facebook page during the first week following the release of Bad Bunny's album *"Nadie Sabe Lo Que Va a Pasar Mañana,"* based on previously established inclusion criteria. These comments were exported to Excel using Export Comments. The sample was intentionally selected, considering the initial comments published on the artist's social media. The analysis was conducted on three levels: textual, thematic, and contextual, following Van Dijk's (2002) framework, which emphasizes the need to consider both the structure of the text and the cognitive and social dimensions of discourse. Additionally, principles from the socio-semiotic approach proposed by Wodak and Meyer (2015) were incorporated, as this perspective allows for interpreting discourse as a cultural practice embedded in historical contexts and power relations. The corpus was processed using ATLAS.ti software, which facilitated the creation of participant nodes and a semantic network of the artist's followers' comments.

The following section presents the results, aligned with the three main objectives of this research, generated through discourse analysis using ATLAS.ti software, version 25.

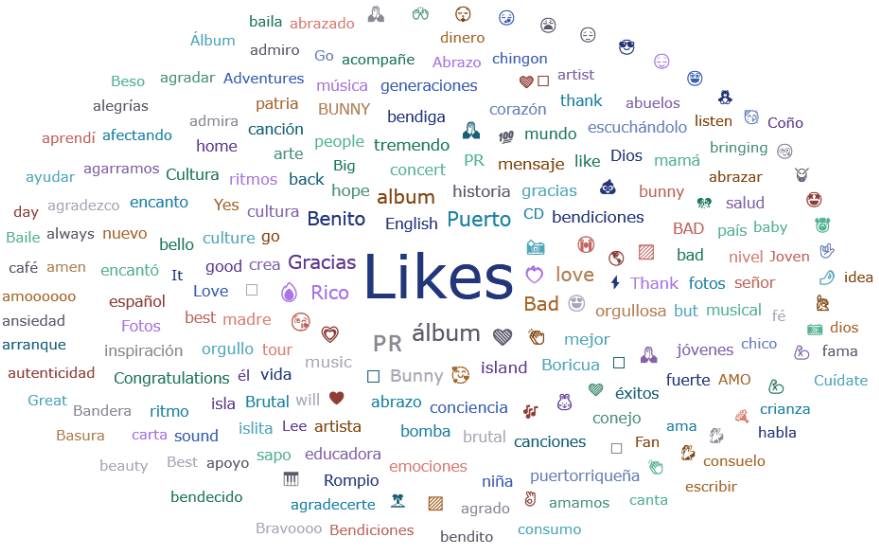

Figure 1. Word Cloud of Comments from the Digital Audience.

The word cloud generated reveals significant discursive patterns surrounding the release of Bad Bunny's album *"Nadie Sabe Lo Que Va a Pasar Mañana"*, offering insights into its social reception from a qualitative perspective. First, terms such as "Likes," "album," "Benito," "Bad," and "Puerto Rico" stand out visually, indicating a high frequency of mentions related to the artist's identity and his national impact. Likewise, emotionally charged words such as "Thank you," "Blessings," "love," "brutal," "emotions," and "authenticity" emerge, suggesting a predominantly affective response and admiration from users. Second, elements of cultural belonging and pride appear, including "Boricua," "island," "culture," and "Puerto Rican," pointing to a strong connection between the artist and collective identity. Similarly, concepts linked to family and social contexts, such as "mom," "teacher," "youth," "generations," and "grandfather," indicate that the digital discourse extends beyond musical consumption, touching on more intimate dimensions. Altogether, this visualization reflects that the album's release not only generated an aesthetic or musical reaction but also activated a web of meanings related to affection, identity, and collective memory within the digital environment.

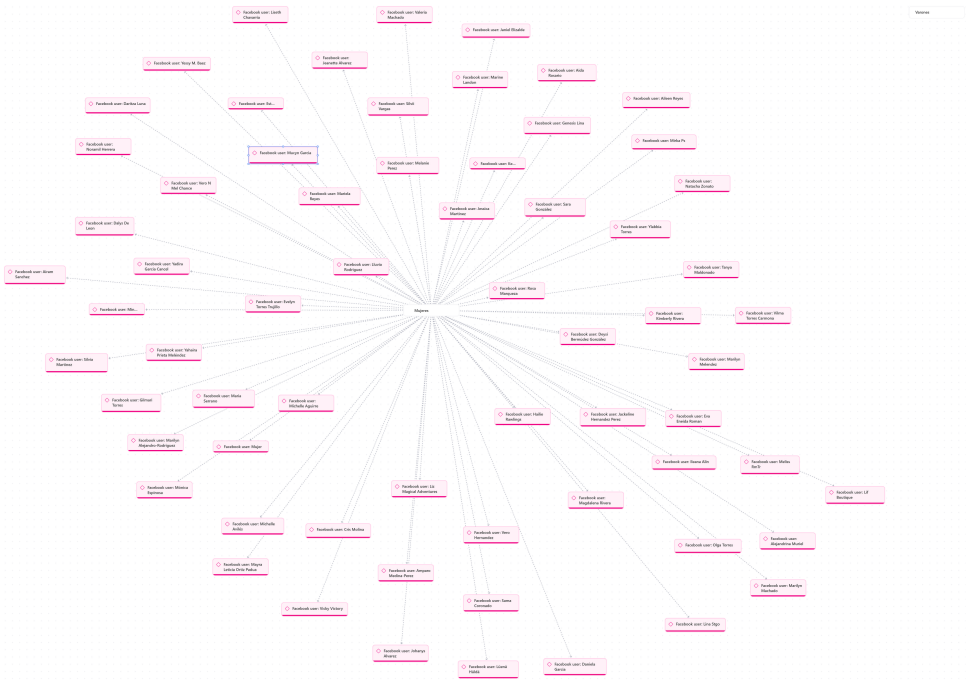

Figure 2. Sociometric Node of Women Who Commented on the Album.

This figure, represented as a sociometric network, displays the distribution and participation of female users who interacted on Facebook regarding Bad Bunny's album *"Nadie Sabe Lo Que Va a Pasar Mañana"*, highlighting the centrality of the "Women" node as the core axis of the analysis. Through a qualitative and visual reading, it is observed that 65 out of 100 women are explicitly identified as participants in the analyzed digital discourse, which indicates a high level of female engagement with this cultural phenomenon. This interaction not only demonstrates the female audience's interest in the artist's musical content but also reflects their appropriation

of the digital space to express emotions, judgments, memories, and identity positions. Methodologically, this figure allows for mapping connections and participation density from a relational logic, which enriches the understanding of discourse beyond textual content. Thus, a network of female voices emerges which, through their interweaving, collectively constructs a symbolic narrative about the music, the artist, and his emotional, cultural, and social impact on digital platforms.

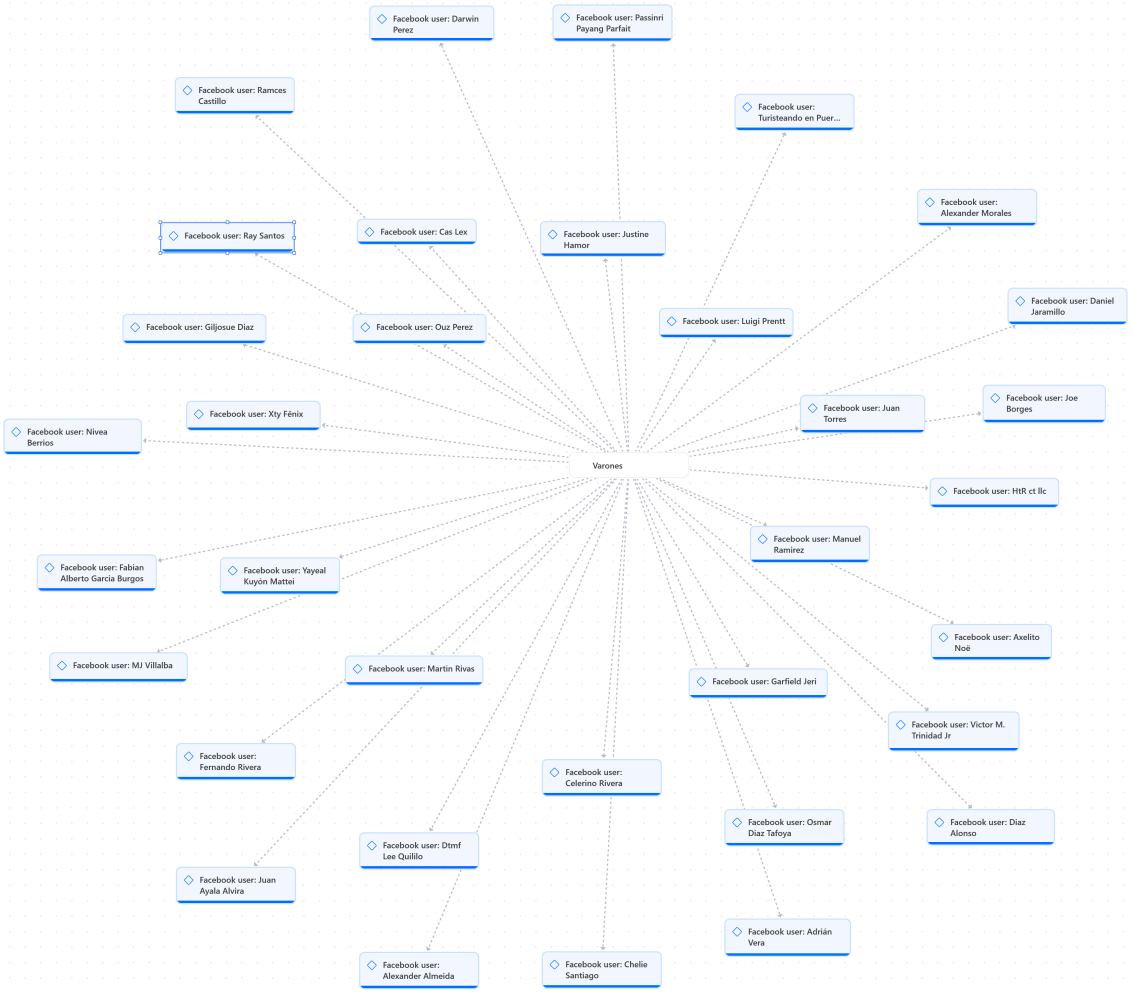

Figure 3. Sociometric Node of Men Who Commented on the Album *"Nadie Sabe Lo Que Va a Pasar Mañana"* on YouTube.

The presented figure represents a sociometric network of male participation in digital comments related to Bad Bunny's album *"Nadie Sabe Lo Que Va a Pasar Mañana"*, with the "Men" node visualized as the center from which 37 identified users emerge out of 102. This representation allows for a qualitative interpretation that, while male participation is significant, it is quantitatively lower compared to female participation (65 women), suggesting a difference in

affective and expressive engagement within the digital space. Nevertheless, the gathered names reflect a diversity of profiles, indicating that the album's impact transcends homogeneous audience segments. Moreover, this visualization highlights how men also use the virtual environment as a space for expressing opinions, identification, and dialogue around the musical phenomenon. The network reveals a discursive configuration in which men engage through various roles: as consumers, fans, critics, or simply as participants in cultural debate. This distribution reinforces the idea that Bad Bunny's artistic production operates as a symbolic activation node that mobilizes both women and men within the contemporary digital ecosystem.

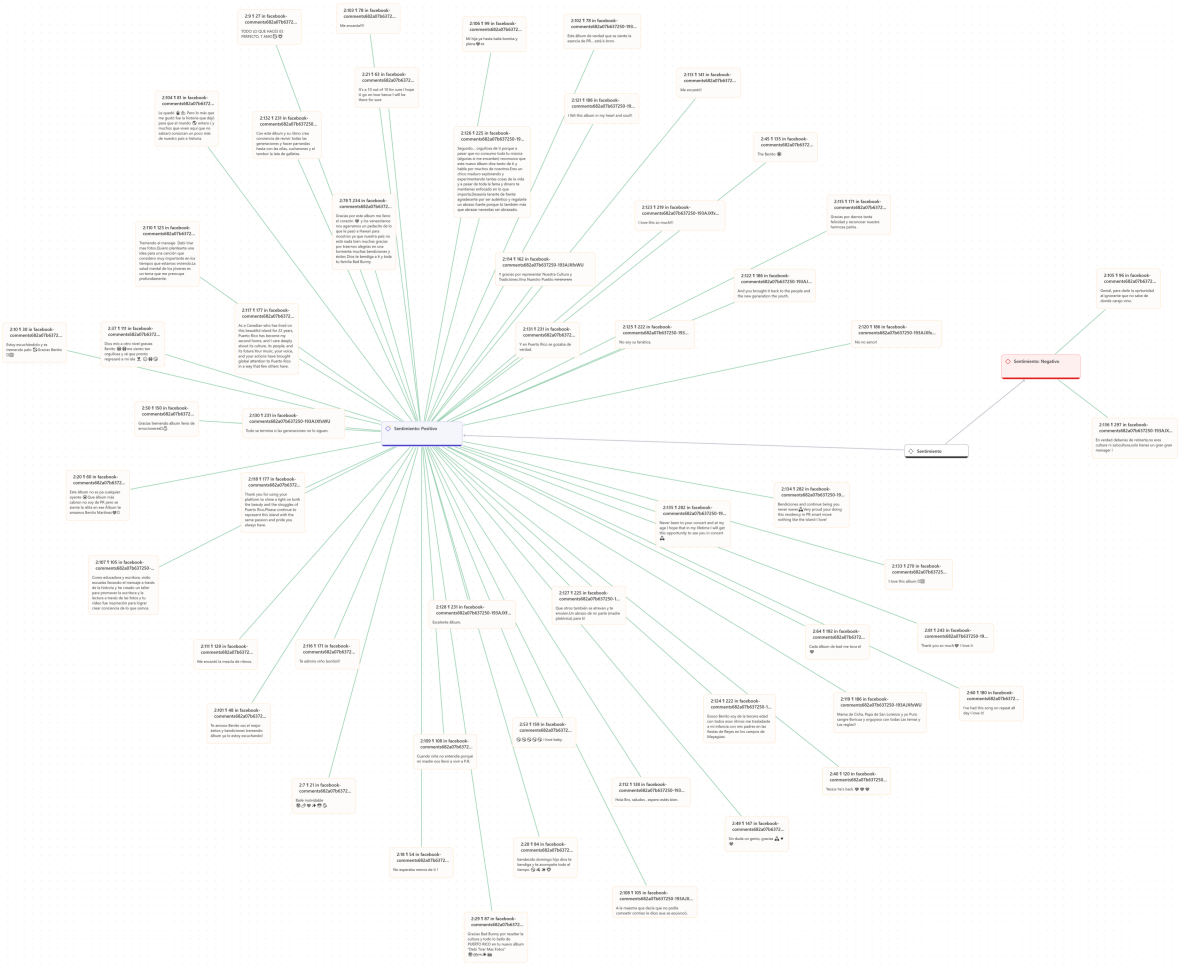

Figure 4. Comparative Semantic Network of Positive and Negative Audience Comments.

This figure represents a semantic relationship map that organizes comments collected from Facebook regarding Bad Bunny's album "Nadie Sabe Lo Que Va a Pasar Mañana," explicitly differentiating between positive and negative sentiments expressed by users. From a qualitative and hermeneutic perspective, it is observed that the vast majority of comments are grouped under the "Positive Sentiments" node, indicating a highly favorable reception of the album. The positive comments display strong emotional intensity, with expressions such as "it made me cry," "a gem," "beautiful album," "thank you, Benito," and direct references to specific songs,

reflecting an intimate and meaningful appropriation of the work. Additionally, themes such as nostalgia, generational identification, and emotional memory emerge—elements that align with interpretive analyses typical of discourse-centered qualitative methodologies.

On the other hand, the "Negative Sentiments" node contains a significantly smaller number of comments, which are not necessarily hostile but rather express moderate criticism or disappointment (e.g., "not what I expected," "too experimental"), suggesting that even critical messages maintain a tone of closeness. This quantitative and qualitative imbalance between the two affective poles shows that the analyzed musical phenomenon generates more emotional affiliation than rejection, and that users employ social media as a space to construct meaning, validate identities, and share personal experiences associated with Bad Bunny's music. Overall, the figure confirms that the digital discourse surrounding the album is predominantly celebratory, with a critical minority that nonetheless enriches the symbolic and cultural debate. This discursive network reveals how artistic works become catalysts for emotions, memories, and collective bonds within the contemporary digital sphere.

Conclusions

Based on the qualitative analysis of social media comments related to Bad Bunny's album "Nadie Sabe Lo Que Va a Pasar Mañana", three main conclusions were drawn, aligned with the proposed objectives and supported by the graphical evidence presented. First, in relation to the objective of identifying the main emotions, concepts, and keywords expressed by users, Figure 1 demonstrates that the reception of the album was predominantly marked by positive emotional content, evidenced by terms such as "thank you," "authenticity," "brutal," and "love," as well as identity references like "Benito," "Puerto Rico," and "culture." This indicates that the digital discourse extended beyond aesthetic evaluations, articulating a network of affective, cultural, and collective meanings in which the album functioned as a symbolic trigger for identity pride, belonging, and memory.

Second, regarding the objective of examining discursive differences and patterns of digital interaction between men and women, Figures 2 and 3 show greater female participation (65 out of 102 users) compared to male participation (37 out of 102), revealing a more intense involvement of women in shaping the digital discourse surrounding the musical phenomenon. This difference is not only quantitative but also qualitative, as women used the digital space to express emotions, memories, judgments, and identity positions, forming a more densely articulated symbolic narrative. In contrast, although male participation was lower, it was also characterized by a diversity of discursive roles—as fans, critics, or consumers—suggesting that the album's impact transcended gender and generated differentiated forms of symbolic appropriation.

Third, in relation to the objective of interpreting digital discourse from a critical perspective, Figure 4 presents a semantic network distinguishing between positive and negative comments, with the former being significantly more numerous and emotionally intense. The prevalence of affective and admiring messages, with expressions such as "it made me cry" or "a gem," demonstrates a strong emotional bond between the audience and the musical product, while

the negative comments, though fewer, were mostly moderate and reflective, contributing to a respectful and enriching symbolic debate. This predominance of positive affect, combined with gender-based participation differences and observed identity-related semantic content, leads to the conclusion that the digital discourse around Bad Bunny's album constitutes a complex and multidimensional manifestation where emotions, memories, cultural representations, and symbolic tensions intersect. Thus, the analysis confirms that digital platforms not only function as spaces for music circulation but also as privileged arenas for the production and negotiation of social, emotional, and political meanings linked to cultural consumption in contemporary Latin American and Caribbean contexts.

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Articulating axis in the contents of primary education

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Introduction

Art has been connected to humanity since its origins, as a form of expression, communication, and spiritual connection. Although it was not formally conceived as it is today in its beginnings, it has evolved alongside civilizations, adapting to the cultural and social needs of each era. However, the notion of understanding in relation to the arts has historically been limited, often being reduced to superficial or utilitarian interpretations. Despite this, art constitutes a fundamental dimension of the human experience, present in our daily actions, ways of life, and ways of giving meaning to the world (Gómez-Rincón *et al.*, 2024). Thanks to its versatility, it not only preserves valuable information about ancient cultures but also plays a central role in the construction of individual and collective identities.

In Mexican education, the arts have been relegated to the background. Various educational reforms have been implemented since the 19th century; however, few have managed to effectively incorporate the arts into the curriculum. There is a disparity between educational levels, so the arts often take a backseat to subjects considered priority, such as Spanish or mathematics. This phenomenon is largely due to pressures derived from standardized assessments such as the Programme for International Student Assessment (PISA).

Even though progress has been made at preschool and middle school levels, elementary education continues to show a worrying gap. According to UNESCO and the Organization for Economic Cooperation and Development (OCDE, 2016; ONU, 2023a, ONU, 2023b) this educational level is the foundation upon which the learning and skills the students will need in the future are built. La Nueva Escuela Mexicana (NEM) proposes structural changes, including greater integration of art as part of the language curriculum, intending to achieve a more inclusive and contextualized education.

In practice, artistic content remains marginalized in this sense. To achieve true transformation, more than formal reforms are needed; investment in specialized teachers, adequate resources, and a comprehensive vision that articulates art with areas of knowledge. This need is recognized in "Sustainable Development Goal" (SDG) 4, *Quality Education,* of the 2030 Agenda.

Delimitation and statement of the research problem

The study was conducted in a third-grade class at the "Profr. Oziel Hinojosa García" Elementary School (Annexed to the Normal School) in Monterrey, Nuevo León, Mexico. The group consisted of 27 students (14 girls and 13 boys) with diverse educational needs. Although they performed well in mathematics, development needs were identified in collaborative work and their approach to art. Initially, the students displayed insecurity when participating in artistic activities, so the goal was to strengthen their creativity, concentration, and social identity (Eguz, 2024).

A meaningful approach to art encourages introspection and reflection, promoting a deeper understanding of oneself and their surroundings (Gómez-Rincón *et al.*, 2024). This research aims to foster a sense of belonging, identity, and self-esteem in students, as well as contribute to the development of confident, responsible, and empathetic individuals.

The main objective is to understand the impact of addressing educational content through the arts, with the aim of developing qualities in students that favor their personal development and social integration. To this end, the following specific objectives were set: to identify the causes of the lack of importance given to art in education; to design and implement strategies that link art with NEM content; and to understand the opinions and recommendations of art experts regarding its approach in primary education. In this regard, the following research question is posed: How does addressing educational content through the arts influence the personal development and social integration of primary school students? The premise is that art, when integrated transversally into the curriculum, favors the development of qualities such as self-esteem, a sense of belonging, and empathy, contributing to the comprehensive development of students.

Research background

A review of the literature indicates that the integration of art within the school environment promotes students' comprehensive development. Participation in artistic activities has been shown to strengthen social skills, improve academic performance, facilitate the understanding of abstract concepts, increase interest in learning, and enhance logical-mathematical reasoning (Moreno & Nevárez, 2025).

The reviewed studies highlight the positive impact of integrating the arts into education. Virtanen and Seppä (2014) in Finland demonstrated that the arts foster interdisciplinary learning and critical thinking. In the US, Smith and Anderson (2017) identified a positive correlation between participation in the visual arts and academic performance. O'Neill and Lambert (2019) in the UK demonstrated that the use of drama improves students' vocabulary and communication skills.

Conceptual foundation

National Development Plan (NDP)

The 2025-2030 National Development Plan, proposed during Claudia Sheinbaum's administration, establishes as a national priority the strengthening of Mexican humanism and the

consolidation of the Fourth Transformation (4T) in the social, economic, and political spheres. Regarding education, the plan reaffirms the State's commitment to the right to an equitable, inclusive, and excellent education for all. This law, especially Article 3, highlights the importance of accessible, relevant, and up-to-date education (see Table 1).

Table 1. Main Axes of the National Development Plan (NDP) 2025–2030

Governance with justice and citizen participation	Development focused on well-being and humanism	Moral Economy and Decent Work	Sustainable development
Promote a transparent and participatory public administration by strengthening justice and citizen inclusion.	Promote policies that prioritize the comprehensive well-being of individuals by ensuring access to education, healthcare, and housing.	Foster an ethical economy that promotes decent employment, equity, and the fair distribution of wealth.	Implement strategies that protect the environment and the use of natural resources, ensuring long-term sustainability.

Note. Created by the authors after analyzing the 2025–2030 National Development Plan.

Current Curriculum "Nueva Escuela Mexicana" (NEM)

The "Nueva Escuela Mexicana" is an educational model implemented in Mexico following the 2019 constitutional reform by the Secretariat of Public Education (SEP, 2022). Its main objective is to offer an excellent, inclusive, and equitable education, aimed at addressing issues such as school dropout rates and regional inequality. This approach promotes a comprehensive education that encompasses diverse areas of knowledge, including gender perspectives, health, the environment, the arts, and socio-emotional education. It also seeks to strengthen values, the role of the family, and the physical and emotional well-being of students, as well as harmonizing school knowledge with everyday life and the community context.

Art in Mexican education

The history of arts education in Mexico traces its origins to the creation of the Undersecretariat of Public Instruction and Fine Arts in 1824, whose functions were assumed by SEP, founded in 1920. Since then, art has been conceived as an integral means for transmitting knowledge, developing aesthetic sensibility, and affirming cultural identity. During the colonial period, it was used as a tool for evangelization. In 1785, an elitist art academy was founded in Mexico, marking the beginning of the institutionalization of arts education (Esparza, 2024). During the Cardenas period, arts education was promoted with the objective of rescuing and valuing popular

traditions. However, these efforts were limited by the lack of coordination between the National Institute of Fine Arts (INBA) and the SEP (Huerta-Vázquez y Zhizhko, 2023, p. 32).

When creativity comes to life: A glimpse into art

Defining art has generated considerable controversy both in academia and throughout human history. Some argue that "art cannot, and should not, be defined" (Tena, 2022, p. 199), but in academic contexts, it is necessary to establish clear definitions to avoid conceptual ambiguity. One strategy is reflective equilibrium, which seeks to capture common intuitions with logical coherence (Moreno & Nevárez, 2025).

Fostering creativity through art in schools is essential, as both creativity and learning involve reasoning and the reorganization of information (Ong *et al.*, 2022); they are constructive processes. From a constructionist or *emic* perspective, art is conceived as a cultural construction whose meaning depends on the social context, although this approach is inherently relativistic.

Between lights and shadows: The magic of theater

Since its emergence, theatre has been the subject of study in the social sciences. However, it is complex due to its multifaceted nature. This is evident in the first theoretical attempt: Aristotle's Poetics, which proposes that to understand theatre, it is necessary to consider its different forms, its capacity for imitation, and its distinctive component: action. Today, theatre is valued not only as an art form but also as an educational, social, and cultural tool that enables individual and collective expression, reflection, and transformation (Thakur, 2022).

The invisible art we all feel: Music

Music, considered a universal science and language, expresses emotions and connects with the intimacy of human beings (Universidad Jaime I, 2023). Since ancient times, with Pythagoras, it has had a scientific basis, establishing mathematical relationships between sounds, such as the perfect fifth; this scientific dimension includes technical elements such as hertz and decibels. In this sense, its expressive power allows us to overcome cultural and temporal barriers, enabling communication between people of different backgrounds thanks to its universal notation.

Giving shape to Ideas: Exploring the Universe of Visual Arts

Visual arts are a space in which ideas and emotions are transformed through the use of materials such as painting, sculpture, or drawing. Through these visual forms, visual arts enable symbolic exploration, the construction of meaning, and personal and collective expression; a powerful tool for cognitive, emotional, and creative development. This type of pedagogical activity allows for greater autonomy, shaping and developing an understanding of their cognition, building more resilient, creative, and adaptable students (Barritt, 2021).

Soul in Motion: Dance as a Universal Language

Dance, the movement and soul of the universal language, is an ancient form of expression that expresses feelings through bodily movement (Ivelic, 2008); it integrates tensional, linear, spatial,

and projection elements, which provide a shared creative identity, achieving a three-dimensional artistic expression (Sheets, 2011). Its relationship with music and its constant evolution make it a manifestation rich in cultural and emotional interpretations.

Cinema Beyond Entertainment: Art, expression, and social reflection

Film is an artistic expression that has also established itself as a powerful means of communication. More than just entertainment, it's an art form that allows us to tell stories, convey ideas, and generate emotions, to make us not only feel but also reflect (Jaén, 2024). It combines literature, music, photography, theater, and visual arts, creating a unique multisensory and narrative experience. It is considered the most influential art form of the 21st century, with educational, cultural, and critical functions, allowing us to reflect on reality.

Cognitive Development Theory: Vygotsky and Piaget

Cognitive development has been extensively studied by various authors, including Lev Vygotsky and Jean Piaget, whose theories offer complementary approaches to understanding how children learn.

Vygotsky, a Soviet psychologist, proposed that social interaction and cultural context are fundamental elements in learning. He introduced the concept of the Zone of Proximal Development (ZPD), which represents the distance between what a child achieves on their own and what they are capable of learning with the guidance of someone experienced. This process of accompaniment, known as scaffolding, allows students to develop skills and achieve autonomy. Furthermore, he highlighted the central role of language in the development of thought, differentiating between social language (external communication) and internal language (reflection), emphasizing that learning precedes development. The learning environment is also key, as it can be perceived as a space of fear or a space to play that encourages interaction with one's surroundings (Barritt, 2021).

Swiss psychologist Jean Piaget proposed that children actively construct their knowledge by interacting with their environment. His theory is based on two processes: assimilation and accommodation; these cognitive schemas are modified to adapt to new information. He described cognitive development in four stages: sensorimotor, preoperational, concrete operations, and formal operations. Although his theory has been challenged by recent research, especially for underestimating the social influence on learning, it remains a fundamental reference in developmental psychology and education.

This research adopts a qualitative approach, characterized by its flexibility, dynamism, and adaptability throughout the process. This approach allows for a deeper understanding of the experiences, perceptions, and meanings constructed by participants in their natural context. Specifically, it uses an action research method that seeks to interpret educational reality and transform it in a participatory manner (Dahal, 2023). This methodology promotes social change and awareness by involving educational stakeholders in identifying problems and developing collective solutions.

Information processing

The study involved three focus groups: students, who were given an observation guide with ten indicators focused on art; teachers, who were interviewed using questions focused on their perspective, practice, and experience in art; and experts, whose interviews were organized around dimensions such as practice, experience, perception, and recommendations. All the instruments are designed to complement each other and identify areas for improvement in the implementation of art in the classroom.

Techniques for collecting data

To ensure that the data collection was relevant and useful in this research, two instruments were selected: an interview and observation. Qualitative interviews allow for flexible and personal collaboration between the researcher and the interviewee, facilitating the joint construction of meaning. They also require prior training to accurately capture the essence of the phenomenon, engaging all senses, not just sight. As Allen-Collinson and Owton (2025) point out, "sensory Knowledge in […] always multisensory…the use interpretation of sensory information is dependent upon social and cultural contexts" (p. 25).

Procedures

The research began with the preparation of three official letters addressed to the school administration, the head teacher, and the parents. This process allowed for clear communication with all educational stakeholders and ensured informed and ethical consent. Open-ended interviews were conducted with teachers from different stages of the program, as well as with experts in various fields of the arts. The information obtained was triangulated to design an intervention plan focused on the students' holistic development. Overall, the study followed a rigorous and ethical methodological process.

Observation guide

To ensure the validity and depth of the analysis, an observation guide with specific indicators was utilized during the implementation of the project "Girls and Boys Against Gender Stereotypes." This type of observation focuses on the analysis of aspects such as age, reactions, and interaction. The students identified gender stereotypes. The activity simulated real-life contexts to promote understanding and awareness.

At the conclusion of the project, it was found that the expected learning outcomes were achieved, producing a significant transformation in most of the students on a personal, attitudinal, and educational level. Those who initially showed little interest were those who showed the greatest changes and improved performance. Furthermore, bonds within the school community were strengthened, promoting human and social development.

It was found that, compared to other teaching strategies that only capture children's interest, the use of art promotes values, sensitivity, and humanism, factors that have become essential for the proper functioning of society. In this way, in addition to developing competent adults, it

contributes to educating responsible citizens who are aware of their environment and the reality in which they live.

Interviewing teachers or Teacher interview

Three dimensions were addressed: experiences, perspective, and practice. Polarized responses were identified regarding their approach to art. Although most had significant experiences and recognized the emotional and cultural benefits, they overlooked its impact on social and cognitive skills. Regarding perspective, it is considered undervalued. In practice, they use it as an occasional support; although some have contact with art, none consider themselves experts due to a lack of training. Some teachers agreed that, while art is often considered only an aesthetic or emotional resource, in practice they have observed profound transformations in their students. For example, Gaucín (personal communication, October 22, 2024) notes that "those who have been in frequent contact with dance tend to be more sensitive, creative, and empathetic […] while those who have not had that closeness often present emotional blocks, less self-knowledge, and difficulties connecting with others or with their own bodies." These perceptions reinforce the need to rethink the teaching perspective on art, not just as an occasional support, but as a comprehensive educational framework.

Interviewing experts

Interviews revealed a consensus regarding the positive impact of art on personal, social, emotional, and cognitive development. They agreed that art enhances sensitivity, empathy, emotional expression, and critical thinking. This view is exemplified by the words of Campa (personal communication, October 21, 2024), who states that "music has a profound impact on an individual's development […], strengthens mathematical and linguistic skills […] and transforms not only those who practice it, but also those who experience it." Likewise, Reyes (personal communication, October 24, 2024) emphasizes that people who have had contact with the arts "show greater emotional openness […] and confront problems with innovative approaches," unlike those who have not had these experiences, who tend to display a more rigid view of their surroundings.

For his part, Luna (personal communication, October 23, 2024), based on his experience as an actor, emphasizes that theater "strengthens empathy, self-awareness, and the ability to work as a team […] enriching the individual's sensitivity and critical thinking." These contributions reinforce the idea that art should not only be included as content, but as a living and transversal experience. They also noted differences between individuals who have been exposed to art and those who have not, and proposed the transversal integration of art in education, as well as the strengthening of teacher training.

Conclusion

This study advocates the structural integration of art into the NEM, granting it the same relevance as the rest of the curriculum. The main obstacles identified are the insufficient preparation of teachers and the limited availability of professional-development opportunities. To strengthen the effective implementation of arts integration in the curriculum, concrete proposals should be

included to overcome the main barriers identified. It is important to promote ongoing training programs for teachers that strengthen both their artistic and pedagogical skills, allowing them to incorporate art in a transversal and meaningful way. It is recommended to institutionalize spaces for collaboration between teachers and artists that promote the exchange of knowledge and experiences. Design interdisciplinary teaching sequences that integrate art as a vehicle for the development of cognitive, social, and emotional skills and highlight the benefits of art in comprehensive education through qualitative and systematic assessments as a pedagogical tool.

The findings confirm that positioning art as an integrating axis not only enhances learning, but also nurtures critical thinking, self-esteem, empathy, and active participation. We therefore conclude that art contributes to an education that is more inclusive, humane, and profound.

"Art not only educates; it transforms, elevates, and reveals the hidden potential within every human being."

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Sonic Pedagogies for a Life Free from Violence: The Podcast "Que amar no te cueste la vida" as an Educational and Transformative Strategy in Colombia

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This article emerges from the research project "Coping Strategies of Women Survivors of Intimate Partner Violence in Colombia," led by Areandina University

Introduction

In a world where gender-based violence continues to erode emotional bonds, truncate lives, and perpetuate historical inequalities, it becomes urgent to rethink how education, communication, and art might converge to reshape the social fabric. Colombia, like many Latin American nations, faces alarming rates that expose the structural nature of this violence, especially within intimate and familial spaces. Femicide, psychological aggression, economic abuse, and emotional control continue to claim silent victims, often naturalized beneath the veil of everyday life.

In response to this reality, alternative pedagogical proposals have emerged—rooted in sensitivity, storytelling, and collectivity—that seek to awaken consciousness and spark profound reflection. Such is the case of the podcast Let Love Not Cost You Your Life, a digital initiative spearheaded by an interdisciplinary team from the Fundación Universitaria del Área Andina. This sonic proposal aims to sensitize, inform, and empower women who have faced or are facing intimate partner violence, leveraging the transformative power of sound and testimonial narratives as tools for healing, denunciation, and critical education.

The podcast was launched in 2021 as a direct response to the rising tide of gender-based violence in Colombia, a crisis intensified during the COVID-19 lockdown. During this period, calls to emergency lines such as Bogotá's Purple Line surged by 230%, while help chat usage rose by 196%. An interdisciplinary team—comprising historians, psychologists, and legal experts—identified a widespread lack of awareness regarding the invisible forms of violence in intimate relationships, and a shortage of tools to detect and prevent them. As a result, they created a podcast that offers reflections, real-life cases, statistics, and practical advice to help listeners identify diverse forms of abuse and build healthier relationships.

The podcast is complemented by the Sorora app, developed by the same team, which offers tools such as quizzes to detect partner violence, survivor stories, and access routes for support. This integration amplifies the reach of the project, offering practical tools for prevention and psychosocial accompaniment.

This study is grounded in the belief that digital narratives do not merely communicate—they educate, accompany, and transform. Accordingly, the podcast is analyzed not only as a communicative product but as a situated pedagogical tool that promotes an ethic of care, active listening, and collective transformation. This research seeks to understand the scope of the initiative, its narrative structure, and the ways in which listeners resignify their affective experiences through the shared stories.

This project aims to analyze the impact of the podcast Let Love Not Cost You Your Life as an educational and socially transformative tool. Investigating the effects of this communication strategy is crucial to understanding how digital narratives can foster meaningful learning, support violence prevention efforts, and strengthen empowerment processes—especially within educational and community contexts.

Recent research has explored the psychosocial and cultural mechanisms that sustain gender-based violence. Rodríguez et al. (2022) argue that the normalization of coercive behaviors within familial and educational settings fosters a social tolerance for abusive dynamics—one that may be disrupted through interventions grounded in sonic technologies and digital storytelling.

López-Medina and Rojas (2023) highlight the potential of podcasts as tools for emotional literacy and empowerment among young women, underscoring their ability to merge technical knowledge with experiential narratives. This form of digital pedagogy aligns with Lagarde's (2021) concept of 'epistemic sisterhood', a network of shared knowledge that transforms pain into political action.

From a communications perspective, Yang (2023) examine how sonic narratives influence attitudes toward machismo and symbolic violence. Their findings show that dramatized scripts and testimonial formats increase message retention and audience empathy toward victims.

These contemporary perspectives intersect with classical frameworks, such as Freire (1997) and hooks (2003), while simultaneously updating the discourse by integrating new media and expressive forms into the struggle against gender violence.

Violence against women has been conceptualized as a structural issue, deeply rooted in power imbalances and perpetuated by patriarchal social and cultural constructs (Heise, Pitanguy, & Germain, 1994). Both the Organization of American States (1996) and the World Health Organization (2003) define this form of violence as any act that causes physical, sexual, or psychological harm to women, whether in public or private spheres—including emotional control, psychological abuse, and sexual coercion.

Several studies stress the necessity of addressing this issue through educational and transformative approaches. Bosch et al. (2013) and Plaza (2007) argue that symbolic and psychological violence often goes unrecognized; therefore, pedagogical processes must work to dismantle stereotypes and promote egalitarian relationships. Critical and feminist pedagogies—championed by hooks (2003), Freire (1997), and Segato (2016)—embrace experience, emotionality, and critical thinking as axes of social transformation.

Gender mainstreaming, defined by the United Nations (1997) and reinforced by Alonso and Lois (2016), is an essential strategy for ensuring equity in public policies, programs, and educational frameworks. For Alonso and Lois, this integration must be epistemological, emotional, and political, embedding emotional memories and marginalized voices within educational processes.

In this context, digital media—particularly podcasts—have emerged as key tools in critical pedagogy. McInerney and Burrell (2023) analyze how profeminist podcasts can engage men and boys in gender justice by facilitating inclusive access, nurturing empathy, and building networks for collective action. The podcast's intimate and narrative style is especially effective in reaching audiences previously unaware of gender issues.

Similarly, Fox and Singer (2025) underscore the podcast's role in complementing traditional social work education by enhancing affective and reflective capacities and offering flexible and accessible learning environments. These conclusions validate the pedagogical significance of *Let Love Not Cost You Your Life*, which, from its Colombian context, weaves sonic narratives with educational and socially transformative purposes.

Despite progress, gender-focused prevention and care strategies in Colombia still face implementation challenges. Research by Romero & Amar (2009), Vásquez (2007), and Moser (2009) reveals that many governmental programs approach gender violence from family or public health perspectives, often neglecting its symbolic, emotional, and cultural dimensions.

In contrast, the comprehensive models proposed by Díaz Marroquín (2009), Carmona (2015), and Romero (2010) advocate for psychosocial care frameworks that recognize subjectivity, trauma, and the need for non-revictimizing accompaniment. Within this paradigm, peda<gogical strategies like podcasts become safe spaces for identification, reflection, and testimonial learning.

This focus has also been supported by multilateral organizations such as UN Women (Reichmann, 2014), ECLAC (Benavente & Valdés, 2014), and UNDP (FLACSO, 2006), which have developed strategic guidelines for integrating gender approaches into public policies. In Colombia, the 2013 CONPES document and the 2016 guidelines by the Presidential Council for Women's Equity emphasize training public officials, intersectoral collaboration, and cultural transformation as pillars of prevention.

Studies by Barragán & Alfonso (2010) and Márquez (2013) demonstrate that public policies must be sensitive to women lived realities and create participatory spaces where silenced voices can emerge. In this regard, digital narratives—such as those featured in *Let Love Not Cost You Your Life*—enable an affective and political pedagogy that transforms lived experience into a source of education and mobilization.

Context

The podcast is primarily aimed at young and adult women, university students, educators, educational communities, and the general population interested in gender issues. Its open and accessible format allows for broad reach, particularly in rural or educational contexts with limited

resources, such as virtual students from the institution. Through qualitative methodologies such as content analysis, semi-structured interviews, and systematic script review, its impact as an educational, preventive, and socially transformative strategy on gender-based violence was evaluated. More than 28 podcast scripts released between 2021 and 2025 were analyzed. The methodology included thematic analysis, categorization of narrative axes, and publication.

The project analyzed the episodes of the podcast released between 2021 and 2024.

Table 1. Number of Episodes Released per Year (2021–2024) *Cluster "technology in supply chains"*

Year	*Number of Episodes*
2021	6
2022	14
2023	6
2024	6

Table 1 presents the number of episodes released annually, allowing for a visualization of the project's sustained growth. A noticeable peak is observed in 2022, during which the thematic axes of sisterhood, legal empowerment, and the construction of support networks were consolidated.

Table 2 Predominant Thematic Axes by Year

Year	*Episodes*	*Main Thematic Axes*
2021	8	Violence prevention, Statistics, Cycle of violence
2022	12	Sisterhood, Legal consequences, Empowerment
2023	6	Emotional dependency, Political participation
2024	7	New masculinities, Affective education

According to the content analysis, the most notable episodes based on topic and listener engagement as of the first quarter of 2025 were: Episode 1 (2021): "What is Intimate Partner Violence?" — Introduces multiple forms of violence: physical, emotional, and symbolic. Highlight: "Sometimes control is invisible... but it is felt. And that feeling is an alert" (Episode 1 Script, 2021).

Episodes 13 and 14 (2022): "Communication and Agreements" — Emphasizes building healthy relationships through dialogue. Quote: "Without agreements, there are no fair bonds; without listening, there is no transformation" (Episodes 13–14 Script, 2022).

Analysis of Results

The analysis of the podcast's impact revealed three interrelated pedagogical dimensions that contribute to its transformative potential: the clarity of its narrative structure, the provision of practical guidance for women listeners, and the inclusive, empathetic tone that permeates each episode. Together, these elements position "que Amar no te cueste a vida" (Let Love Not Cost You Your Life) as an accessible and critically grounded educational platform.

First, the podcast's format follows a consistent and recognizable structure across episodes—beginning with a welcoming introduction, followed by thematic development, a closing message, and a call to action. This repetition reinforces the learning process, promotes listener familiarity, and strengthens audience engagement over time.

In addition, each episode concludes with specific, actionable recommendations designed to foster personal reflection and social agency. Suggestions such as using "I feel…" statements, activating one's support network, or seeking professional assistance are directly aligned with the pedagogical goals of the project. These interventions encourage a shift from passive listening to active empowerment, reinforcing the podcast's role as a catalyst for individual and collective transformation (Fox & Singer, 2025).

Finally, the affective tone of the podcast plays a critical role in its educational efficacy. Through the direct and compassionate address of the audience—phrases such as "you who are listening"—the podcast cultivates a space of intimacy, care, and trust. This auditory closeness functions as a form of pedagogy of care, wherein the voice becomes an instrument of emotional support and narrative repair, particularly for women affected by intimate partner violence.

The analysis of 28 scripts produced between 2021 and 2025 reveals a consistent commitment to social transformation through affective, feminist, and critical communication.

The podcast employs discursive strategies that actively contribute to making invisible forms of violence visible—such as emotional blackmail, affective dependency, and symbolic control—by naming and narrating experiences often silenced in traditional educational spaces.

Furthermore, it fosters community building through the recognition of shared experiences, the cultivation of sorority, and the emotional validation of its listeners. These elements are further reinforced by a preventive approach that provides practical tools, institutional guidance, and prompts for critical self-reflection.

The educational impact of the podcast could be further enhanced by diversifying its narrative formats, strengthening the openings of episodes, and refining its stylistic coherence. As members of the project team affirm, "The podcast doesn't just inform—it weaves an affective network through stories and experiences that educate through listening and empathy."

In this sense, the sonic narrative functions as a pedagogy of care, where the voice becomes a medium for healing that which has been silenced. As Castellanos-Saavedra and Pinzón-Estrada (2024) emphasize, "The podcast's real impact emerges when its messages are collectively reinterpreted by women, generating community and coping strategies" (p. 22).

Conclusions

The findings of this research confirm that the podcast *Let Love Not Cost You Your Life* constitutes an innovative pedagogical strategy deeply rooted in feminist praxis, critical pedagogy (Freire, 1997; hooks, 2003), and transformative communication that centers the subjective experience of women.

Throughout the analysis of episodes released between 2021 and 2025, it became evident that sonic narratives not only transmit information but also mobilize affect, reframe painful memories, and activate processes of individual and collective awareness.

This educational tool—positioned at the intersection of digital, community-based, and affective approaches—enables situated and sensitive learning where listening becomes both a political and pedagogical act. The podcast's communicative proposal interweaves academic knowledge, personal experiences, and normative frameworks in a voice that challenges, supports, and transforms.

It thus constitutes an affective feminist pedagogy that contributes to denaturalizing intimate partner violence, exposing structural inequalities, and strengthening women's empowerment.

The format's versatility has proven effective in virtual, rural, and community contexts where traditional educational resources may be limited or inaccessible. This accessibility, combined with a horizontal and respectful communication style, has enabled the construction of symbolic networks of support, resistance, and transformation.

As recent studies affirm (McInerney & Burrell, 2023; Fox & Singer, 2025), podcasting offers an alternative pedagogy particularly suited to contexts of gender-based violence, where silence and isolation often prevail.

This analysis also highlighted the project's expressive and methodological richness, as well as its capacity to build community through testimony, dialogue, and sisterhood. Each episode addressed diverse themes—economic autonomy, nonviolent communication, support systems, popular feminism, care practices, and more—reflecting the multifaceted nature of structural and everyday violence experienced by women in Colombia.

Based on these findings, we recommend the following for similar initiatives: strengthen digital literacy training for women producers and listeners; develop participatory evaluation strategies to assess the podcast's emotional, subjective, and collective impact; consolidate inter-institutional alliances to ensure project sustainability and integration into public policies; and incorporate podcast excerpts into educational settings—from schools to universities and community spaces—as catalysts for reflection, debate, and transformation.

Finally, the authors consider this model a replicable experience across other Latin American territories, provided it is adapted to each community's sociocultural context, recognizing local voices, situated knowledge, and specific historical conditions.

To educate for love without violence is not merely a pedagogical motto—it is an ethical, political, and urgent commitment to dignified life, gender justice, and the construction of a more caring, equitable, and empathetic society.

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Communication through the body: a driving force in different domains

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Introduction

Communication through the body, given that the body also speaks, is non-verbal communication, which is why the messages it conveys do not use words, but a language that many do not know or do not ascribe importance to.

It is through movement, stimuli and the relationship with objects, people and environments that, from an early age, human beings discover and understand their surroundings and improve their cognitive, motor, emotional and social skills. Most of this information is obtained by the human being as a child experientially through their own body, something unique and specific in which each person inscribes their social experience and materialises their desire to resist these forces, which is why this body takes the form of the experiences of each human being. Non-verbal communication is the language of this body, a language that allows, through certain attitudes and expressions, to clearly represent an individual's feelings and convey them more easily. These body language skills are highly significant and relevant in the arts, particularly in the field of theatre, where the body – as a form of communication – enables the actor to transmute and express themselves in a game of signs that they are allowed to develop and share with the audience, even if they do not feel them, but which lead to imagined forms to emerge from their body, to whose production of meaning they have contributed through their form of acting, which, combined with the fact that they are an actor, enables them to build webs full of meaning. It was, therefore, the firm desire to disseminate the research produced on this topic that led to this theoretical approach, which seeks to attain the following objectives: to disseminate some of the possibilities of body communication; to explore its capabilities and the advantages of training it; and to motivate those who have access to this article to further study the body in the context of communication, in the aspects focused on and perhaps in others.

The methodology is the moment in the work when the method to be adopted to attain the proposed objectives is defined, how data collection will be carried out, and when a particular type of research is chosen. In this case, the choice was a qualitative methodology, more specifically document search, also known as bibliographical search, a methodological resource that allowed, through a review of diverse literature related to the topic covered in the article, to access the knowledge produced and, thus, gather existing information related to it, which helped to contextualise the work.

Body and communication

Communication, in which the body plays a critical role, insofar that it is through it that we can express our opinions, thoughts, and emotions are felt and visible, is the basis of all human

relationships. Indeed, since the dawn of time, non-verbal communication – which encompasses all manifestations of behaviour not expressed through words, such as gestures, facial expressions, body orientation, posture and others – has fascinated humanity.

Verbal and body language, look and postures get the body talking

The human body is a whole that needs to be experienced and felt as a process, as every gesture, every way of walking, looking, is not unsubstantiated; it is our manifest identity as a consequence of what we experience, which endows this body with a power that displays itself as a primordial communication with the environment in which it is located, leading it to an embodiment that ends up becoming intertwined with its surroundings.

> Contemporary science elucidates that human beings are creatures of the flesh. They are not just mind or spirit, and the body is not just a house. We are the house, and we do not live in it. What we experience and how we make sense of it depends on what kind of bodies we have and how we interact with the environments we inhabit. In other words, the body interferes with the mind and is constructed by it, just as the mind and its experiences affect the body and can mould it depending on the experience. (Greiner, 2013, p. 114)

It is through this body that the world is experienced, and each person's individuality is imprinted and transformed, as Pereira (2019) emphasises, through experiencing a range of sensations and changes. The way we make sense of the experiences we have also depends on the body each of us has and on the way, it interacts with the environments we inhabit. In this regard, Tavares (2013) states that each person builds themselves by placing each brick of experience on top of an empty space. In addition to the ability to process information, as Pereira (2019) points out, another way in which the body participates in the development of the individual is through its ability to communicate, which is not restricted to language but also starts from movement.

Shaped by the individual's interactions with the environment, the body is in constant transformation, and its verbal and non-verbal language, which is fundamental in personal relationships, makes communication more effective and expressive. However, sometimes our verbal language, which has a very significant weight in the act of communicating, and our non-verbal language, composed of gestural movements, looks and postures, are not in harmony, as they present some disagreement that escapes our perception, inasmuch that we are not fully aware of the gestures and movements we make. This is because our body uses symbolism that can amplify, contradict or make exciting what is said with words.

> The correlation between one's own body and the world is one of communication, that is, the lived body does not belong exclusively to the dimension of an object placed or located in space. The relationship I have with my lived world is a relationship of inherence, of discovery, through which the world exists for me, and I exist in it, effectively. (Azevedo & Caminha, 2015, p. 22)

Human beings engage in a daily dialogue with their bodies, which speak in different ways and unknowingly reveal, intensify, minimise and ascribe importance to many of our actions. "The body is not a neutral base, everything in it moves, is internalised and changes, including through movement" (Pereira, 2019, p. 35). Gestures, which were the first form of communication and, with the emergence of the spoken word, took a secondary role, can, together with facial expressions, speak much more than words, so whether through facial expressions, the look, body posture, tone of voice or gesture, our whole body is language. "The sheer fact that a body is present already communicates things that are independent of its reason" (Pereira, 2019, p. 42), which is why understanding how each human being moves and conceptualizes the world has to be done together.

Considering that language, by producing meaning and reconstructing meanings, becomes the mediator that unites humans in the constitutive process of social relationships, thinking of the body as language means ascribing it a communicative and relational dimension of the subjects with the world in which they live in the construction of their organic, symbolic, biological and cultural existence.

Communication and the body: what relationship?

Communication, in which the body plays a critical role, as it is through it that we can express our opinions, thoughts and emotions are felt and visible, is the basis of all human relationships. Indeed, since the dawn of time, non-verbal communication, which encompasses all manifestations of behaviour not expressed through words – such as gestures, facial expressions, body orientation, posture and others – has fascinated humanity.

Considering that communication between individuals takes place in a space of intersubjectivity, that is, it occurs reciprocally and without individualism, and that it is through communication that meaning is ascribed to human experience, it is also one of the greatest challenges facing humankind, since it is a condition of social life that allows the sharing of meanings, experiences, and knowledge between different individuals. It should be noted, however, that, according to Wolf (2013), to have good interpersonal relationships and enhance communication, one of the major challenges lies in the ability to read non-verbal communication, to grasp a person's emotional state, to listen to what they say and to observe their gestures and attitudes.

The body is our fingerprint. It is this body that defines each of us by the way we move, the gestures we make, or even the postures we adopt. Indeed, every movement it makes, even if unconscious, is a form of communication that can be meaningful. In this regard, according to Rosa (2011), each of us has a body with which we interact daily, a body that speaks in different ways and, without us realising it, reveals, intensifies, minimises and gives importance to many of our actions. Given the above and based on body language, we can understand our body as a powerful driving force, fundamental not only in communication, but above all in the personal and professional success.

> This aspect of the relationship between language and body language, between reason and perception, is fundamental to the approach to knowledge, especially regarding knowledge of the body; for when dealing with a multiple universe such as human communication, one-dimensional reason, prioritising only the conceptual point of view, within the limits of formal logic, is insufficient. (Nóbrega & Medeiros, 2009, p. 727)

By observing the body language of those around us, and without saying a single word to them, we can also understand their behaviour and intentions. In this regard, Wolf (2013) highlights that

> […] to have good interpersonal relationships and enhance communication, one of the great challenges lies in the ability to read non-verbal communication, grasp a person's emotional state, listen to what they say and observe their gestures and attitudes. Through perceptive action, identifying contradictions between someone's verbal communication and their non-verbal communication will improve interpersonal communication (p. 27).

The body is, above all, a centre of information that we sometimes know little about, even though its language says a lot both to us and to those around us.

Body language and art

Art is a universal language that transcends cultural and linguistic boundaries and is a vehicle of communication that conveys deep feelings that words often cannot express and, for this reason, has the ability to bring people together.

Art is, so to speak, a reflection of society that documents and criticises, but also celebrates and unites. This powerful and accessible means of communication, by allowing us to express feelings, ideas and narratives, transcends verbal barriers and involves us in a universe of emotional expressions, which makes communicating through art vital.

In works of art, the body is integrated as an artistic medium, as if it were an object. The arts of the body, such as theatre, dance and the performing arts, are languages that, from the end of the 20th century onwards, have easily established themselves as new artistic languages with a major impact.

Communication in theatre: background and concerns

Throughout time, and especially since the end of the 19th century, many have focused on the actor's preparation work, specifically on their main working tool: the body. Among the many we have mentioned, Stanislavski, the great promoter of actor training, should be highlighted. He was committed to training and preparing actors for theatrical creation and, to this end, as Castanheira (2022, p. 36) points out, "works on the improvement of the human being based on individual and group ethical and behavioural discipline, as well as a technique to develop the actor's interpretation so that it is an organic and whole creation". His commitment to the actor's training was attained through the physical training of their body, consisting of exercises based

on gymnastics, acrobatics, fencing, classical dance and other knowledge that Stanislavski compiled in a guidebook he called "System" or "Method of Physical Action". Meyerhold advocated that actors should have good physical preparation that would enable them to fully master their bodies and, for this reason, according to Berselli and Pereira (2019), he engaged in a particular investigation that led him to another specific bodywork called "Biomechanics". This system, in whose preparation Meyerhold included a variety of sports that he associated with bodily activities, allowed actors to convey with their body what at other times was only expressed through text.

For Grotowski, another great thinker who contributed greatly to the structuring of training for the actor, the most important thing was to give the body the chance to fully express itself because everything must come from it and through it. His main goal was for theatre to be a total act, and to achieve this, actors had to surrender themselves completely.

Artaud searched for a theatre capable of reconnecting humans to their essence. For this reason and, as Silveira and Gomes (2019) state, the author identified in corporeality energetic potential with the capacity to generate internal impulses that could be reverted into an inner action and make the audience, and the artist enjoy together in a ritual-show. Thus, with its theatre of cruelty, the body takes on a central role.

Eugénio Barba advocated individual work with the actor because he argued that the same training could not be applied to all actors; it had to be directed individually, in an exclusive and differentiated way, so that the actor could achieve pre-expressiveness, inasmuch that the actor's personality, sensitivity, artistic intelligence, cultural context and the scenic tradition in which they are inserted are interconnected with acting. In addition, according to Schimith (2017), active and continuous exercise in artistic practice enhances sensations, perceptions and/or senses to create an intense and integral engagement of the actor in the creative process, which, in turn, contributes to the result on stage.

Nowadays, given the development at all levels, including the technical and artistic, as Pereira (2019, p. 43) mentions, "the birth of the show already represents a break with previous aesthetic standards, where the body experiences new formulations that were not previously based on the multiplicity and interdisciplinarity of the arts that are now intertwined." For these reasons, scenic movement is, in contemporary aesthetics, the most important and powerful of all theatrical elements, given that, "deprived of words, costumes and all other elements, theatre remains theatre only with the actor and their art of movement" (Meierkhold, 1969, p. 135), as most of the elements that characterised it have changed.

Currently, according to Marisa (2020),

> [...] spectacular reception is an interpretative process, considering two levels: the aesthetic level (codes of behaviour and scenic conventions) and the extra-aesthetic level (socio-cultural universe). Thus, performance is mimesis based on socio-cultural life and, therefore, a construction that blends with reality and changes from culture to culture, from society to society. In this process, the audience is not merely a passive agent with previously defined

> and codified reactions but rather an active participant and co-producer of the performance. (p. 8)

However, the dissatisfaction of many with the theatre and the training of the traditional actor has led to this way of thinking today, thanks to the many studies that have been carried out and that have contributed to the training of a new actor whose theatrical interpretation is characterised by the exploration of the body on stage as a symbol and a means of conveying meaning. Thus, in the 21st century, according to Marisa (2020), the arts are, once again, faced with a void, and there is a search for an alternative show with new projects that encompass the current complexity of artistic proposals. Step by step, the actor was ascribed the power to use their revealing body in the creation and communication, in this way, as Greiner (2013) suggests, the body makes the story, just as the story makes the body.

The actor`s body: a body that pulses and radiates on stage

It is through the body that theatre also happens, even though, according to Machado (2014), today's stage creations present infinite processes, possibilities and experiments with a wide variety of independent dramaturgical, imagistic, spatial, textual and corporeal options, among others, in a scenario that places the actor at the centre of theatre, but with new interpretative demands and different roles. Being aware of their space of action and how it can be performed requires the actor to master spatiality.

After understanding these spatial notions, the actor looks for other forms of body language and organisation, not least because he "is not only the creator of his character, he also has the responsibility of proposing scenic languages to provide the spectator with a unique moment lived in a real moment here and now" (Castanheira, 2022, p. 9).

The actor body is a primordial source of expressive material, that, in a concept of performance, the actor exposes to the appreciation of the audience when they embody the text or make it come alive in the eyes of the audience, where they have a decisive presence in the theatrical event. A body that needs to constantly maintain and exercise its acting skills.

So that actors, who need to know, master and put their bodies at the service of their art, can achieve a body that transforms itself when they go on stage and allow them to get the results they seek. A body that, when on stage, the actor concentrates on the action seems unrealistic, but, in fact, it is the ultimate requirement and an essential tool for the actor's communication with the audience. For the actor, according to Valentim (2020),

> [...] the body is the fundamental subject of their work, where memories, sensations and experiences are stored. First of all, there is technical work that allows for rigour in body execution and mastery, and then artistic work that allows exploring the particularities of each body. (p. 14)

In sum, thinking about the actor's training from the point of view of their body implies, as Pereira (2019) states, understanding that they cannot be mere recipients of techniques and methods that they assimilate without questioning. In reality, investing in this training requires the actor to

be able, through the experiences they have had and their bodily potential on stage, to relate with the world, to discover themselves and to be able to evidence the value that experience and the role of the body have in their training, given that body work is a means of access that, consciously or unconsciously, brings the actor closer to this purpose, helps to deepen the quality of the actions they perform, serves as a support for their psychic and emotional energies, and allows them to communicate with their audience.

Communication through other artistic fields

Art is the only space where the art of the body, which increasingly creates new audiences around it, allows the emergence of the living body. Therefore, whereas communication through theatrical art was previously addressed, other artistic fields are now approached, in which the body is used as an instrument of communication.

Among them, it is worth highlighting, from the 1960s onwards, the *happening*, an artistic manifestation that takes place through improvisation, which focuses on the body and action and includes various media, such as the visual arts, theatre, *collage*, music and dance, and which Richard Schechner – who was the founder of *The Performance Group*, an experimental theatre group – coined with the term post-dramatic theatre, given that it does not identify with the well-known traditional theatre.

Body art is a form of visual art that emerged in the late 1960s in the United States and Europe as one of the most popular and controversial forms of art. In body art, the artist's own body can serve as a medium for communicating ideas, a support, or a means of expression and intervention in artistic work. It is the most important vehicle through which the artist explores their living work.

Performance, considered autonomous in the 1970s, is a hybrid artistic expression, in that it can blend different languages, namely theatre, music, and visual arts. Nowadays, through technological mediations, performance promotes other ways of presenting the body while proposing to rethink it.

This artistic expression is positioned, in the words of Cohen (1989), "[…] at the boundary between the visual arts and the performing arts, being a hybrid language that retains characteristics of the former as its origin and the latter as its purpose" (p. 7). The fact is that performance can consist of both a series of intimate gestures presented by a single artist and a theatrical manifestation with a large number of visual elements resulting from collective experiences.

In the search for an artistic identity, through the expansion of techniques and reflection on theatre-making and its relationship with new technologies, the use of performance opened up various paths, triggering and enabling the creation of a hybrid language. Visual art, related to the evolution of the human species, also consists of a set of images and expressive forms, real or imaginary, created by humans through the handling of various types of materials, thus presenting itself as one of the most intense ways of conveying messages, feelings and concerns

through a unique, intimate and silent form of communication that weaves nets that unite cultures, eras and identities.

Experiencing these artistic practices related to the arts in general, whether performative or visual, contributes, according to Cunha (2022), to the liberation and overcoming of individuals, their fears, anxieties and needs, as well as to the creation, life control and repressed energy. Therefore, in addition to moments of relaxation, well-being and comfort, they allow for the expansion of communication and personal expression potentials.

Results attained

As a result of the study, it emerged that communication through the body, which takes place through each movement, is something unique and specific, and the body – because it takes the form of each human being's experiences – is, for this reason, more than a physical body, as each of us has a body filled with events, desires, intimacies, stories, and memories. These skills allow human beings to use body language as a means of non-verbal communication and to use it through certain attitudes and expressions to represent their feelings. Indeed, according to Pereira (2019), all work begins in the body, in movement, in the body's relationship with the space that surrounds humans, expanding to everyday relationships with the world in which they live, so that for humans to think about the body without obstacles, they must understand that everything starts from the body and movement as a way of being and acting in the world. Regarding the scenic body – which emerges, in contemporary times, as a prominent entity in the theatre, as it is through this body that the birth of the theatrical performance takes place – it can be understood, in Marisa's opinion (2020), as an energetically strong but virtualised body, a body that achieves maximum energy and technical performance, but which no longer reorganises itself on affections and meaning and which relegates a subjective and creative body to a secondary role. This body represents a break with previously established aesthetic standards, insofar that it now experiences new formulations in an interweaving of different arts, with the actor's bodywork currently seen as the result of a practice where all expressiveness is justified through a well-developed kinaesthetic perception and an intimate awareness of one's own body. This practice is achieved through training whose main rule is never to stop, but rather to vary the body's dynamics, namely the dynamics of the movements, their intensity, rhythm, fluidity, in short, whatever is necessary, as long as it does not break the common thread of the work done so far, as this would lead to a waste of accrued energy.

Conclusion

In concluding this work, which proposed to address communication through the body in different contexts and whose objectives were to present the results obtained from theoretical research carried out through bibliographic research of various authors on the subject, as well as to motivate those who have access to this article to further study communication through the body and its movements in the aspects focused on and perhaps in others, it can be seen, given the results pointed out, that communication through body language is a non-verbal communication related to the way our body expresses itself through a set of gestures, facial expressions, glances, postures and other conscious or unconscious movements, more or less explicit, conveys relevant

information, particularly in the body/art relationship, that is, when an artist uses their body in artistic practices, such as happening theatre, performance and visual arts, among many others, which delve into the depths of human feeling and touch areas that discursive rationality often cannot reach. However, given that easier access to technology means that the virtual world is increasingly invading our daily lives, it is important to bear in mind that, although traditional art forms continue to be relevant in bodily communication, the digital realm is part of a process of expansion and is a new modus operandi for art and, consequently, for communication. Furthermore, the use of technological mediations already promotes different ways of presenting the body, which, while inviting us to rethink it, also calls us to reflect on the future challenges of art and the body.

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Andean Cinema and Aymara Cosmovision: Memories of Violence and Justice in Yana-Wara

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This text is written as a tribute and profound acknowledgment to Óscar Catacora (R.I.P.), our friend and spiritual brother, for leaving us with transcendental works such as Wiñaypacha and Yana-Wara, which contribute to reflecting on Andean cinema as a space of memory and cultural resistance. We also extend our gratitude to Tito Catacora for providing access to the film for this research.

Introduction

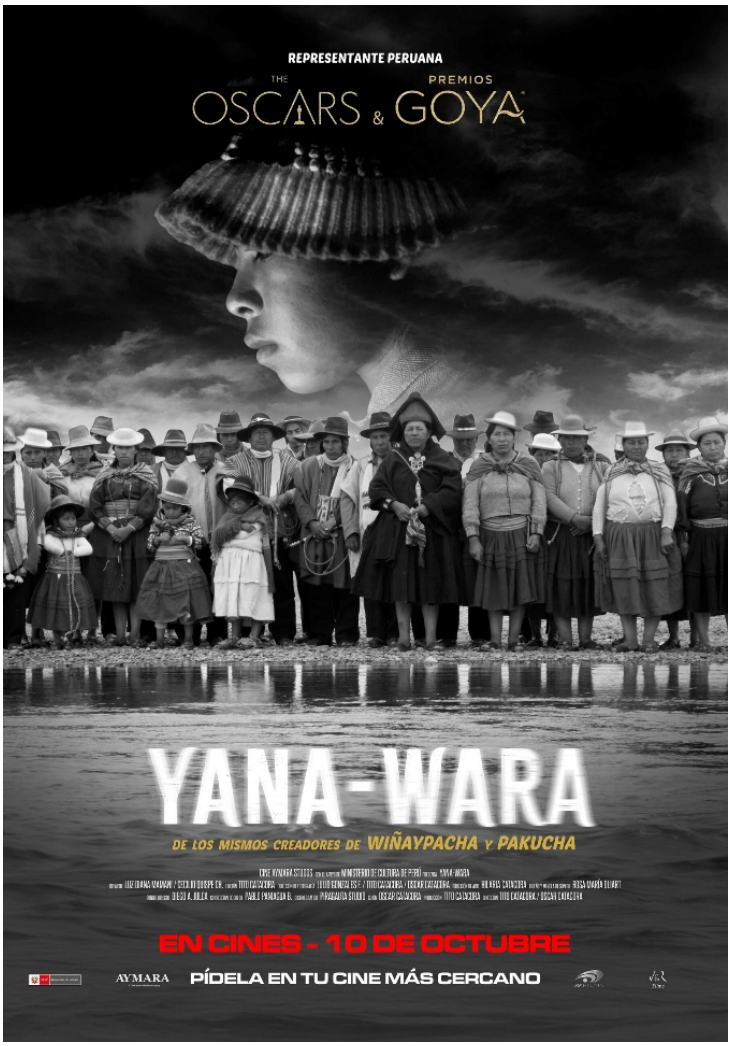
Cinema in Peru's indigenous languages has become a fundamental tool for narrating the memories and social tensions of indigenous communities, traditionally rendered invisible by official discourse. In recent decades, Andean audiovisual production has transcended its local character to reach international circuits, asserting not only its own aesthetic but also a critical perspective on power structures, historical inequalities, and the persistence of ancestral worldviews. Recent works such as Yana-Wara aim not merely to tell stories but to challenge viewers, placing at the center the moral and cultural dilemmas of Andean peoples in a cinematic proposal that combines social denunciation with poetic sensitivity.

Socio-cultural Context of Andean Cinema

Peruvian Andean cinema has emerged in recent decades as a space of cultural resistance and identity affirmation against the hegemony of urban and mestizo narratives. Since the 2000s, and more strongly in the last ten years, productions in indigenous languages have consolidated, recovering the worldviews, conflicts, and memories of highland Andean communities. As Rivera Cusicanqui (2010) argues, audiovisual works can become a "decolonial artifact" by challenging official narratives and restoring the voice of historically silenced peoples.

Within this framework, the work of Óscar Catacora—especially Wiñaypacha (2017) and Yana-Wara (2023)—represents an aesthetic and political commitment to the authentic representation of the Aymara world. Both films are spoken entirely in the Aymara language and feature non-professional actors from rural communities, adding a dimension of cultural verisimilitude. De la Cadena (2015) states that these narratives are significant because they reveal "relational worlds" where spirituality, territory, and community life are intertwined. Thus, Andean cinema is not merely entertainment but also a vehicle of collective memory and social denunciation.

Figure 1. Poster of the film Yana-Wara, Peru's official entry for the 2024 Oscar and Goya Awards.



The Social Issue Represented in Yana-Wara

Yana-Wara tells the story of an orphaned and mute girl who suffers sexual abuse and is later murdered in a context marked by structural inequality and state neglect. The narrative unfolds through the communal trial of the girl's grandfather, Don Evaristo, who reconstructs the child's tragedy through his testimony. The film revolves around three central axes: gender-based violence, communal justice, and Andean spirituality, expressed through symbols and silences that give the work the tone of a classical tragedy.

The use of the Anchanchu—a malevolent spiritual entity from Aymara mythology—symbolizes collective fear and the boundaries imposed by the local worldview. As Albó (2012) points out, in indigenous communities, justice and spirituality are not separate spheres but interconnected dimensions that guide social life. In this sense, the film not only portrays a crime but also

challenges viewers to reflect on how Andean communities conceive justice, punishment, and suffering.

Scientific Relevance and Contribution of the Study

This study is relevant because it analyzes how cinema can represent socio-cultural realities from non-hegemonic perspectives. Communal justice, far from being a mere punitive practice, is portrayed in Yana-Wara as a form of cultural resistance to state neglect. Martín-Barbero (1987) argues that the media are not merely channels of communication but cultural mediations where meanings and power relations are negotiated. From this perspective, the analysis of the film seeks to understand how Aymara cinema re-signifies violence and justice from an Andean perspective, constructing narratives that challenge Western viewpoints.

Furthermore, Yana-Wara proposes a visual poetics that turns pain into memory: the use of black and white, prolonged shots, and narrative silence reinforce a sense of mourning and contemplation, generating what De la Cadena (2015) calls "forms of presence," which make the invisible visible. Analyzing this film thus allows reflection on cinema as a space of symbolic resistance and as an instrument for reconstructing marginalized subjectivities.

Film Technical Sheet

Original Title : Yana-Wara.

Release Year: 2023

Directors : Óscar Catacora and Tito Catacora

Screenplay : Óscar Catacora

Language : Aymara

Duration : 105 minutes

Genre : Social drama with supernatural elements

Production : Cine Aymara Studios – Puno, Peru

Location : Peru

Awards : Best Peruvian Film, University of Lima Film Week (2023); Peruvian official selection for the 2024 Oscar Awards

Synopsis : The film narrates the life of Yana-Wara, a mute orphan girl who is a victim of sexual abuse. Her murder triggers a communal trial in which ancestral justice and spiritual beliefs converge.

This study aims to analyze the social and symbolic representations of structural violence, communal justice, and the Andean worldview in the film Yana-Wara, understanding its relevance as a cultural and political discourse within contemporary Andean cinema. The approach is based on the premise that cinema in indigenous languages is not merely an aesthetic exercise but a space of symbolic dispute where collective meanings are constructed and hegemonic narratives are questioned (Martín-Barbero, 1987).

In this framework, the analysis focuses on examining the narrative and visual elements that express gender-based and structural violence, with particular emphasis on the figure of Yana-Wara as a symbol of broken innocence and the silence imposed on victims—an idea that coincides with Rivera Cusicanqui's (2010) notion of cultural productions as "decolonial artifacts" capable of making historically silenced realities visible. Likewise, the study interprets communal justice as a form of cultural resistance to state neglect, analyzing its tensions with formal justice and considering, as Albó (2012) suggests, that community-based justice practices constitute a collective response deeply rooted in the spiritual and social values of the community. Additionally, it examines the incorporation of spiritual and supernatural elements, particularly the Anchanchu—an Aymara mythical entity associated with collective fear and social control (Bertonio, 1984)—to understand how the Andean worldview articulates explanations of pain, punishment, and memory, which De la Cadena (2015) refers to as "relational worlds." Finally, the research reflects on the visual poetics of the film—the use of black and white, natural landscapes, and narrative silences—as an aesthetic proposal that transforms pain into memory and reaffirms the role of cinema as a cultural mediation and a space for constructing collective memories (Martín-Barbero, 1987).

The research is framed within a qualitative and interpretive approach, aimed at uncovering the symbolic and social meanings present in Yana-Wara's audiovisual narrative. As Flick (2015) argues, qualitative analysis seeks to understand social phenomena from the perspective of actors and the contexts in which they are situated, privileging interpretation over measurement. This approach is relevant because the film constitutes, more than a linear narrative, a cultural text loaded with implicit meanings that express worldviews, power relations, and collective memories.

The adopted method is hermeneutic audiovisual content analysis, understood as an interpretive procedure that goes beyond merely describing scenes to reconstructing the meaning that narrative, visual, and symbolic elements acquire in relation to the Andean worldview. According to Ricoeur (2000), hermeneutics enables a "multiple reading" of a text, allowing access to the deeper meanings underlying a cultural work. This approach aligns with Martín-Barbero's (1987) perspective that media products should be analyzed as cultural mediations, that is, as spaces where collective meanings are negotiated.

Audiovisual content analysis techniques were employed, focusing on detailed observation and thematic coding of significant scenes. The analysis categories were constructed inductively, though guided by the study's objectives, prioritizing four axes: (1) the representation of structural and gender-based violence, (2) the role of communal justice, (3) the presence of spiritual

elements, and (4) the visual poetics of the film. Each axis was interpreted in relation to the Aymara worldview and the cultural values that the film reproduces or questions.

The units of analysis correspond to the film's most significant sequences: (a) those narrating Yana-Wara's abuse and life as expressions of structural violence and the silencing of victims; (b) the scenes of the communal trial, where collective deliberation and punishment appear as practices of cultural resistance; and (c) the passages featuring the Anchanchu, whose symbolic weight allows interpretation of how the spiritual world influences everyday life. Additionally, shots emphasizing the use of black and white, natural landscapes, and prolonged silences were included, as these elements constitute what De la Cadena (2015) describes as "forms of presence," sensitive manifestations that express memory and mourning.

The qualitative analysis of Yana-Wara identified a set of social and symbolic representations that transcend the cinematographic narrative, becoming a cultural discourse on violence, justice, and Andean spirituality. The results are organized into four main axes: structural violence and silence as denunciation, communal justice as cultural resistance, Andean spirituality and worldview, and visual aesthetics as a poetics of memory. Each of these sections reveals not only the narrative content of the film but also the ways in which it dialogues with the cultural practices and beliefs of Aymara communities, granting cinema a fundamental role as symbolic mediation and as a tool of collective memory (Martín-Barbero, 1987).

Structural Violence and Silence as Denunciation

Yana-Wara symbolically and critically exposes the conditions of structural violence affecting highland Andean communities. The protagonist, an orphaned and mute girl, represents not only the fragility of childhood in contexts of exclusion but also the silencing imposed on victims of gender-based violence. Her muteness is not merely a narrative trait but a metaphor for what Rivera Cusicanqui (2010) calls "the colonized bodies of silence," referring to subjects whose voices have been historically denied by patriarchal and colonial systems.

The scenes depicting Yana-Wara's daily life, marked by sexual abuse, reveal the normalization of violence in environments where machismo is deeply rooted. The film avoids graphic explicitness, instead employing prolonged silences and meaningful gazes, creating what De la Cadena (2015) describes as "forms of presence," where what is left unsaid acquires narrative force that challenges the viewer. This aesthetic strategy not only denounces violence but also forces reflection on the mechanisms of oppression that often remain invisible in contemporary Andean society.

Table 1. *Structural Violence and Silence as Denunciation*

Category	Symbolic Meaning	Key Scenes / Units of Analysis	Interpretation
Structural and gender-based violence	Opposition between child fragility and entrenched machismo	Yana-Wara's daily life, abuse scenes	Represents the historical exclusion and silencing of indigenous women (Rivera Cusicanqui, 2010)
Silence as denunciation	Metaphor of the historical silence of victims	Yana-Wara's muteness and prolonged gazes	What is unspoken gains narrative force, denouncing social oppression (De la Cadena, 2015)

Communal Justice as Cultural Resistance

The communal trial of Yana-Wara's grandfather constitutes one of the central axes of the film and reflects the persistence of justice practices inherent to the Andean world. These practices, as Albó (2012) argues, are not merely punitive systems but mechanisms of social cohesion in which sanctioning seeks to restore community balance rather than impose individual punishment.

In the narrative, the community elders act as mediators and judges, reproducing a normative order based on collective consensus. Tension arises when this model is contrasted with the absence of the State, highlighting a critique of the structural marginality faced by these communities. Communal justice, although severe, appears as an act of cultural resistance against state neglect, reaffirming the principle of community autonomy. This representation aligns with Martín-Barbero's (1987) notion that peripheral cultural spaces function as mediations where the meanings of justice and power are negotiated and re-signified.

Table 2. *Communal Justice as Cultural Resistance*

Category	Symbolic Meaning	Key Scenes / Units of Analysis	Interpretation
Communal justice	Restoration of social balance in the face of state neglect	Trial of Yana-Wara's grandfather	Expresses community autonomy and social cohesion as a form of resistance (Albó, 2012)

Andean Spirituality and Worldview

The presence of the Anchanchu in Yana-Wara introduces a supernatural component that should not be interpreted merely as a fantastic resource but as a symbolic representation of collective beliefs regulating social life. According to Bertonio (1984), the Anchanchu is a malevolent spirit inhabiting forbidden places, whose appearance is associated with misfortunes, diseases, and deaths. In the film, its inclusion does not attempt to explain the crime irrationally but rather to show how Andean communities intertwine the spiritual and the material to understand events.

This element reinforces what De la Cadena (2015) describes as "relational worlds," where humans, spirits, and nature interact on the same plane of reality. The Andean worldview does not separate the sacred from the everyday; on the contrary, supernatural entities like the Anchanchu fulfill a normative function, with collective fear acting as a mechanism of social control and cultural norm preservation. In this sense, the film does not merely portray individual tragedy but reconstructs the symbolic fabric of a community that finds in its myths an explanation and a way to cope with pain.

Table 3. *Andean Spirituality and Worldview*

Category	Symbolic Meaning	Key Scenes / Units of Analysis	Interpretation
Anchanchu	Collective fear as a mechanism of social control	Appearance of the malevolent spirit in night scenes	Spirituality regulates behavior and explains pain as part of the social order (Bertonio, 1984; De la Cadena, 2015)

Visual Aesthetics as a Poetics of Memory

The use of black and white, prolonged shots, and the constant presence of natural landscapes configure an aesthetic proposal that turns Yana-Wara into a poetics of memory. This visual decision is not accidental: black and white suggest desolation and timelessness, reinforcing the idea that the narrated violence is not an isolated event but part of a long history of collective suffering.

The static shots and contemplative sequences, where characters merge with the landscape, evoke what De la Cadena (2015) calls "forms of presence," sensitive manifestations that convey mourning beyond verbal language. The prolonged silences, in turn, do not merely accompany the protagonist's muteness but function as political denunciation: Yana-Wara's imposed silence symbolizes the historical silence of indigenous women in the face of violence. In this sense, the film does not simply narrate a personal tragedy but stands as an act of collective memory that appeals to audiences through sensitivity and contemplation.

Table 4. *Visual Poetics and Collective Memory*

Category	Symbolic Meaning	Key Scenes / Units of Analysis	Interpretation
Visual poetics	Collective mourning and timelessness	Black and white shots, landscapes, and prolonged silences	Cinema becomes cultural mediation and a poetics of memory (Martín-Barbero, 1987)

Conclusions

The film Yana-Wara transcends its cinematic role, becoming a cultural and political discourse that denounces structural and gender-based violence and the historical exclusion of indigenous women. Through the protagonist's silence, it portrays symbolic resistance, aligning with Rivera Cusicanqui's (2010) view of silenced bodies as "decolonial artifacts" and spaces of memory that expose hidden oppression.

Communal justice is presented not merely as a normative mechanism but as an act of cultural resistance against state neglect. The scenes of the communal trial show how the community, represented by its elders, seeks to restore social balance rather than impose punitive sanctions. This finding reaffirms Albó's (2012) assertion that indigenous justice practices are expressions of community autonomy deeply rooted in collective and spiritual values.

The presence of the Anchanchu confirms the validity of the Andean worldview as a relational system where the material and spiritual coexist on the same plane. Its inclusion not only reinforces the cultural explanation of pain and punishment but also highlights how myths function as mechanisms of social control, in line with De la Cadena's (2015) notion of "relational worlds." Thus, the film does not employ myth as a mere fantastic resource but as a constitutive part of daily Andean life.

The visual poetics of Yana-Wara—characterized by the use of black and white, natural landscapes, and prolonged silences—turns the film into an exercise in collective memory. This aesthetic proposal not only accompanies the protagonist's mourning but transforms pain into a visual testimony, reaffirming what Martín-Barbero (1987) defines as cultural mediations: spaces where meanings are disputed and memories reconstructed. Yana-Wara confirms that contemporary Aymara cinema is not merely an artistic product but a symbolic instrument of resistance that makes historically marginalized subjectivities visible and contributes to recovering narratives intrinsic to the Andean world.

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Collage as a Visual Expression of Gender-Based Violence from a University Perspective

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Introduction

Gender-based violence is a complex and multifactorial phenomenon (Martínez, 2022) , whose structural nature encompasses social, political, and relational dimensions, manifesting itself systematically throughout the world (Ramírez et al., 2020, cited by Hortal, 2023) . According to , this is defined as violence directed against women simply because they are women or that disproportionately affects them, including actions that cause physical, mental, or sexual harm or suffering, threats, coercion, and other forms of restriction of freedom. A study conducted by the World Health Organization revealed that one in three women globally has experienced physical or sexual violence (Trias et al., 2024) ; however, this violence also manifests in any type of abuse or aggression based on gender identity or sex, affecting not only women but also men and non-binary people (Hortal, 2023) .

Gender agendas highlight that inequalities between men and women do not merely stem from biological differences but are deeply rooted in the historical assignment of roles and responsibilities, which have persisted from antiquity to the present day (Yucra-Mamani & Tovar-Yucra, 2022) . In this regard, education, employment, and participation in organizations were traditionally male-dominated spaces, while the private sphere, the home, and caregiving tasks have been associated with women (Goicochea, 2020) .

Given its structural impact, gender-based violence is recognized as a social pathology that transcends cultural differences and harms not only the direct victims but also their children, close relatives, people in their social circle, and the community as a whole (Namay-Anticona et al., 2025) , and therefore requires urgent attention and effective strategies for its eradication.

The university environment is no stranger to this issue; students are not only witnesses to this reality but can also become agents of change through artistic expression. Collage, as a visual art form, offers a platform to highlight the impact of gender-based violence, raise community awareness, and promote critical reflection. Within this framework, the research question arises: How is gender-based violence visually represented through collage from a university perspective? This study seeks to answer this question by analyzing visual works produced by university students, considering that collage, due to its fragmentary and expressive nature, allows

for the condensation of powerful images, symbols, and messages regarding suffering, denunciation, and resistance in the face of violent situations.

The objective of this chapter is to analyze collage as a visual expression of gender-based violence from a university perspective, with the aim of identifying the symbolic and compositional elements and discourses that shape these representations. Through iconological analysis, the deeper meanings of the created images are interpreted, highlighting how university visual art contributes to social debate, awareness-raising, and the construction of collective consciousness. Furthermore, the study adopts a perspective that integrates communication, art, and gender.

Expressive Dimensions of Collage

The term "collage" comes from the French "collé," meaning "glued," and refers to a technique that allows for the creation of a new visual whole by assembling various shapes, figures, or materials (Gerstenblatt, 2013) . As a creative method, it is based on constant experimentation, which allows for the exploration of unexpected visual combinations and the generation of multiple forms of expression (Gorman et al., 2023, cited by Day et al., 2024) . Beyond its technical dimension, collage transcends as an expressive, narrative, and critical medium, capable of integrating materials, meanings, and emotions to communicate complex realities.

In the context of socially engaged art, it emerges as a particularly significant form of expression, making it an ideal resource for social critique and active participation. In this regard, it is stated:

Collage has established itself as a key tool within social and cultural activism, standing out for its expressive power and transformative potential. Since its origins, it has been adopted by disruptive artists who use it to denounce injustices and bring social issues to light. Today, beyond its aesthetic dimension, collage is valued for its ability to articulate critical messages and raise awareness, becoming an effective medium for driving change in society.(Art Today, 2024)

Creating a collage involves not only an expressive intent but also the careful selection of materials that contribute to the symbolic construction of the desired work:

To create a collage, flat materials such as newspaper clippings, photographs, cardboard, or various types of paper can be used, as well as three-dimensional objects from different sources: plastics, metals, fabrics, everyday utensils, or natural elements such as feathers, sand, stones, and leaves. Even the most unusual materials can be incorporated, provided they contribute to the expressiveness of the work. In addition, a suitable rigid backing (cardboard, cardstock, or watercolor paper) is required, along with adhesive to secure the elements, scissors for cutting, and, if desired, paint to complement the visual composition. (Gallado, 2003, cited by Crespo, 2016)

Today, digital collage has expanded its creative possibilities by allowing the manipulation of images through technological tools, facilitating the integration of photographs, illustrations, typography, and visual effects with greater precision and freedom. This form preserves the experimental spirit of traditional collage but adapts it to the virtual environment, which proves useful. Furthermore, the combination of digital and traditional techniques has given rise to hybrid

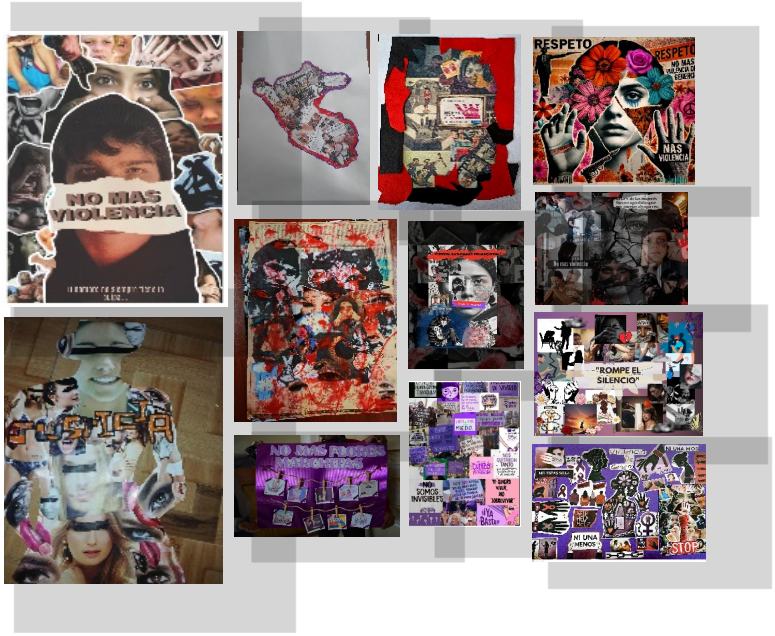
forms that enrich the expressiveness of the visual message, as they fuse physical textures with digitally generated graphic elements, thereby expanding its narrative and symbolic scope.

The results of the study are presented below, organized according to the three levels of analysis proposed by Panofsky. This structure allows for a progressive and in-depth understanding of the collages analyzed, ranging from the formal description of visual elements organized in figures and tables to the symbolic and contextual interpretation of the messages expressed by the students regarding gender-based violence.

Primary or pre-iconographic level

Figure 1.

Visual elements: colors, shapes, and composition of the collages



Source: Collages by Communication students at UNAP, 2025.

In the collages created by the students, there is a marked predominance of the colors purple, black, and red; these tones not only capture visual attention but also carry significant symbolic weight. The choice of colors reinforces the expressive intent of the compositions, endowing them with an emotional impact that resonates with the theme of gender-based violence.

In terms of visual forms, it is evident that the cutouts were carefully assembled according to the theme and the type of figure depicted. Rectangular and spindle-shaped forms, silhouettes, flowers, faces, and hands predominate, often combined with painted elements. The collages were presented in various orientations—vertical, horizontal, in the shape of a map of Peru, or through silhouettes of female and male faces—suggesting an intention to represent both the national space and individual experience.

Regarding composition, the combined use of various techniques was identified: newspaper and magazine clippings, drawings, paintings, and digital images. In most pieces, no defined focal point is established, allowing for an even distribution of visual attention throughout the entire work. However, this saturation of elements creates a certain visual imbalance and causes points of interest to become diluted. As for the textual element, it appears in multiple locations, sizes, and colors, and in several cases overloads the image, pushing the illustrations into the background and emphasizing the weight of the textual message in the visual narrative.

Figure 2.

Symbolic elements present in the visual compositions

Source: Collages by UNAP Communication students, 2025.

Figure 2 shows collages that incorporate various visual symbols; among the identifiable elements are the male and female gender symbols, chains, broken chains, handcuffs, purple ribbons, broken hearts, drops of blood, outstretched hands, sealed mouths, and fragmented human figures. These symbols are arranged in different locations within the composition, some in the foreground and others integrated among images or text. Repeated icons in different sizes and colors are also used, creating a constant visual rhythm. These visual elements help structure the compositional space and immediately capture the viewer's attention.

Figure 3.

Visual scenes identified in the collages

Source: Collages by UNAP Communication Studies students, 2025.

Figure 3 shows compositions that include multiple visual scenes constructed from image collages and graphic elements. These scenes depict specific situations such as: arguments between couples, shouting, gestures of submission, acts of aggression, chained women, broken chains, faces with covered mouths, faces showing signs of physical violence, as well as female figures raising their voices or extending their hands in a stop sign. The scenes are organized into sequences or groupings that suggest specific actions or moments, creating a narrative visual flow within the collage. The spatial arrangement and selection of images allow for the visual identification of scenes charged with dynamism and tension, which dominate the visual field and structure the graphic message of each work.

Table 1.

Textual Messages in the Visual Compositions

Visually dominant texts	Repeated texts	Relevant texts
No more violence	Stop (11)	They kill us for being women
Respect	Help (9)	Violence is not love
No more wilted flowers	Violence (4)	Your voice can save lives
Stop	You are not alone (4)	We all have rights
Justice	Not one less (3)	Mom, if you can't find me, look for me
Freedom	No to gender-based violence (3)	in the stars And what about violence against men?

No means no to gender-based violence No to gender-based violence Break the silence Break the chains of gender-based violence	No more gender-based violence (3) Gender-based violence (3) No (3)	It's not always the man's fault Violence leaves scars; ignorance leads to femicides Men can also request protection from violence (Art. 30364) Neither submissive nor silent—a strong, empowered woman National Program Law No. 30364 No matter where you come from, in Puno, do not tolerate gender-based violence Every human has rights No more violence Silence = violence

Source: Collages by Communication students at UNAP, 2025.

Of the 33 collages created by the university students, 29 incorporate textual elements, while 4 consist exclusively of images. In total, 196 text fragments were identified, of which 13 were visually dominant texts, 9 were texts that appeared more than 3 times, and the remainder were identified as relevant texts that highlight the issue of violence against women.

Spanish is the predominant language in these works, featuring phrases such as: "No more violence," "Break the silence," "Not one more," "They kill us for being women," "Violence is not love," "Your voice can save lives," "Not one less," "We all have rights," "Mom, if you can't find me, look for me in the stars," and the repetition of terms such as "justice" and "stop the violence." Although some expressions in English were also recorded, such as: "16 days of activism against gender-based violence," "don't say anything," "every human has rights," "no more violence," "no violence," and "silence = violence," "help," and "stop," it should be noted that the last two have been used repeatedly.

Secondary or Iconographic Level

In the visual discourse of the collages analyzed, color plays a central expressive role in conveying emotions and sociocultural meanings associated with gender-based violence. Figure 1 highlights a predominance of the colors red, black, and purple; the color red, frequently linked to passion and anger, takes on a strong symbolic charge by representing violence, suffering, and blood, thus evoking the physical and emotional wounds suffered by victims; this color conveys the urgency of the problem and the need for immediate action by society and the state; The color black refers to mourning, imposed silence, and the hidden pain of victims; this color also represents the invisibility of assaults within the private and family sphere, where suffering often remains in the shadows. For its part, the color purple is directly associated with feminist movements and the fight against gender-based violence; its presence alludes to collective

resistance, empowerment, and the dignification of affected women, functioning as a visual call for justice.

The visual forms present in the collages (silhouettes, faces, hands, flowers, and rectangular or spindle-shaped figures) convey symbolic meanings related to gender-based violence. The silhouettes and faces represent individual experiences, while the hands express resistance or submission; the flowers allude to femininity and fragility. The arrangement of these forms in vertical or horizontal orientations—or in shapes such as the map of Peru—projects violence as a nationwide issue, visually linking the personal with the collective.

In terms of composition, the visual arrangement is rich in symbolic elements (texts, signs, and silhouettes) that create non-linear yet emotionally coherent narratives. In several collages, the visual sequence narrates the process of the beginning of an intimate relationship, the gradual emergence of violence, the repetition of the cycle of aggression, the accumulated suffering, and finally the moment of rupture or reporting. This visual structure reflects the knowledge or lived experience of many women and highlights the structural nature of gender-based violence, as well as the possibility of liberation.

The symbols present in the collages take on diverse meanings; thus, the female and male gender symbols represent power relations and inequalities between the sexes, while chains, handcuffs, and especially broken chains symbolize oppression, control, and the breaking of that subjugation. The purple ribbons refer to feminist movements and the fight against violence; the broken hearts, drops of blood, and sealed mouths evoke emotional pain, physical suffering, and the silence imposed on victims; the outstretched hands convey a cry for help and, in other compositions, a boundary against abuse. The repetition and strategic arrangement of these symbols visually reinforce the message.

The iconographic analysis highlights gender-based violence in Peru, addressing scenes of violence against women, the family, and in the workplace. The images convey sadness, helplessness, and depression. The scenes depicted in the collages take on a narrative value that allows for a visual interpretation of the cycle of gender-based violence. The sequences constructed from images of arguments, assaults, and submission reveal situations of normalized abuse within intimate relationships; the presence of chained women or those with their mouths covered alludes to control, censorship, and the loss of autonomy, while faces marked by physical violence highlight the direct consequences of abuse. In contrast, the figures raising their voices or raising their hands in a gesture of resistance express a break from oppression and the beginning of a process of empowerment. These scenes, articulated within a fluid visual structure, allow for the construction of a narrative of denunciation and resilience.

The texts described in Table 1 fulfill a key symbolic function by reinforcing the visual message of denunciation against gender-based violence; phrases such as "No more violence," "Break the silence," and "Not one less" refer to widely recognized slogans in feminist movements. The repetition of terms such as "stop," "Help," or "No" intensifies the tone of urgency and resistance. Some messages invite reflection, such as "They kill us for being women" or "Violence is not love," while others address less visible perspectives, such as violence against men. This

textual diversity reflects a growing social awareness, and its visual arrangement enhances the emotional and narrative impact. The inclusion of non-English expressions suggests a connection to global discourses on human rights.

Tertiary or iconological level

Together, the collages express a critical stance against gender-based violence, highlighting not only suffering and oppression but also resistance, empowerment, and a call to action. Categories such as visibility, awareness-raising, education, reporting, empowerment, and support networks emerge from the analysis, reflecting an awareness of the problem's complexity and the need to intervene on multiple fronts.

Textual messages such as "No more violence," "Break the silence," "Not one less," and "Your voice can save lives" act as mobilizing slogans, rooted in the feminist struggle and the demand for justice. Their repetition across multiple collages demonstrates not only a clear communicative intent but also a symbolic practice that reinforces the collective nature of the visual discourse.

Likewise, explicit critiques of machismo and the normalization of violence against women in family, work, and social settings were identified. While most collages focus on violence against women, one exception depicts a scene of aggression by a woman toward a man, which indicates an emerging reflection on the complexity of power dynamics; however, the absence of explicit representations of violence affecting members of the LGBTIQ+ community stands out, revealing a limited inclusion of sexual and gender diversity in the visual approach to the issue.

The predominance of a heteropatriarchal logic is evident in most of the compositions, where the female figure appears as the central victim and structures that uphold male domination and heterosexuality as the hegemonic social norm are reinforced (Gómez, 2018). Many collages reproduce patriarchal and macho imaginaries deeply rooted in everyday life. In this sense, a perspective marked by coloniality is also evident, as the subjectivities expressed respond to Westernized and homogeneous constructions of the female victim, leaving aside other forms of experience and resistance specific to diverse cultural contexts.

Although, as gender studies point out, heteropatriarchy perpetuates structural inequalities and traditional science, with its androcentric bias, has rendered women and gender diversities invisible (Abellán, 2024), the visual and textual gestures linked to empowerment, denunciation, and the demand for justice represent acts of symbolic rupture. These visual discourses, emerging from a critical creative practice, open up the possibility of a reconfiguration of meaning, challenging patriarchal structures and advocating for equality, justice, respect, and inclusion.

Conclusions

The collage has established itself as a powerful tool for visual expression among university students, constructed through the combination of cutouts of figures, silhouettes, hands, faces, flowers, chains, and narrative scenes, mostly accompanied by explicit texts in Spanish. This visual proposal reflects a clear compositional intent, with easily recognizable elements that seek to capture attention and introduce the issue of gender-based violence.

The symbols and scenes depicted—such as broken chains, sealed mouths, broken hearts, and women raising their voices—articulate a shared visual language that conveys denunciation, suffering, resistance, and hope. Running texts like "No more violence" or "Break the silence" reinforce these messages, creating a coherent visual discourse that denounces the many forms of violence against women.

Taken together, the university students' collages express a critical stance toward gender-based violence through a visual practice that oscillates between the reproduction of heteropatriarchal imagery and the beginning of a symbolic rupture. Although a representation centered on binary thinking and on women as the primary victims persists, visual gestures of empowerment, denunciation, education, visibility, awareness, and support networks emerge, which also constitute categories. These visual discourses reveal tensions between historical structures of exclusion and new forms of challenging the patriarchal order, which promote a more inclusive, just, and pluralistic representation.

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ISBN: 978-9942-53-157-5

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