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ARCA as a coexperience laboratory for teacher training mediated by digital technology

Jhon Estiwar Gómez Palacio

jhesgomez@utp.edu.co

Technological University of Pereira

Research Article

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Abstract

This article is derived from doctoral research on experiential learning patterns in teacher education mediated by digital technology. While the integration of digital technology in teacher education has generated an abundant literature on tools and competencies, scant attention has been paid to how teachers construct pedagogical understanding of their actions when integrating them. This article presents ARCA (*Acción Vivencial* [Actional Experience], *Razonamiento Hermenéutico* [Reasoning Hermeneutically], *Construcción* Simbólica [Constructing Symbolically], and *Alcance Comprensivo* [Application]), a differential co-experience methodology — co-experience being an original concept developed in this research —aimed at the comprehensive transformation of pedagogical practice in higher education contexts mediated by digital technology. The research adopted a qualitative hermeneutic-interpretive approach with faculty from the Universidad Tecnológica de Pereira (UTP), organized into two stages: first, in the role of students within training experiences mediated by generative artificial intelligence, and later, as designers of their own pedagogical experiences. The analysis articulated systematic coding in NVivo with ChatGPT-assisted interpretation, regulated by Bedoya's (2019) relational analysis and Kolb's (1984) experiential model. The results demonstrate a qualitative transformation between stages: teachers shifted from a functional and exploratory use of AI toward grounded pedagogical design, incorporating critical reflection, design ethics, and personalization of learning as organizing criteria for their practice. The most significant finding is that transformation did not depend on resolving the tensions between pedagogical tradition and technological innovation, but rather on the ability to inhabit them productively as a catalyst for reflection. The concept of co-experience that articulates ARCA names the process through which understanding is co-constructed, challenged, and collectively reworked among subjects with diverse learning dispositions, offering a conceptual and methodological contribution to the field of technology-mediated teacher training.

1. Introduction

In the last decade, teacher professional development in digital technology has become an educational policy priority on a global scale. The DigCompEdu report (Redecker, 2017) identified educator digital competence as a structural condition for the transformation of educational systems, and organizations such as UNESCO and the OECD have backed sustained investments in technological training programs. However, the accumulated evidence regarding the impact of these programs is consistently modest; systematic studies show that the majority of technology-trained teachers manage to incorporate digital tools into their routines, but without substantially modifying their pedagogical conceptions or instructional design decisions (Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2013). The emergence of generative artificial intelligence has intensified this gap: the sophistication of currently available systems generates an illusion of pedagogical transformation that is more difficult to challenge than that produced by previous technologies (Selwyn, 2022).

This paradox—teachers who operate technology without transforming their practice—is not an issue of access or motivation. It is a problem of instructional design. Technological training programs have

centered their efforts on developing operational competencies and transferring models like TPACK (Mishra & Koehler, 2006), which describes *what* knowledge a teacher needs to integrate technology, but does not prescribe *how* to design training experiences that produce this integration in a comprehensive and sustained manner. The question that the literature has answered with the least precision is how to train teachers so that they not only use technology, but also understand what they are doing when they integrate it, why they are doing it, and what transforms within them when they do it well.

A review of the specialized literature reveals at least three gaps that this research seeks to address. First, dominant training models assume a homogeneous learning sequence that fails to recognize the diversity of dispositions with which teachers approach knowledge; this limitation has been highlighted by Avalos (2011) and Kennedy (2016), who documented that the lack of differentiation in professional development programs is one of the factors explaining their low impact on practice. Second, pedagogical reflection on the use of technology tends to be positioned as an evaluative phase at the end of the training process, rather than serving as its articulating axis; Postholm (2012) and Darling-Hammond et al. (2017) identified this displacement as one of the structural limitations of teacher professional development. Third, the available concepts to describe what occurs when several teachers learn together from shared experiences but with diverse dispositions prove insufficient: collaborative learning, co-creation, and cooperative learning name phenomena distinct from the process of comprehensive co-construction that this research identified as central, and which finds no direct equivalent in existing pedagogical literature.

It is in response to these gaps that the doctoral dissertation emerged, leading to the construction of ARCA (*Acción vivencial* [Experiential action], *Razonamiento hermenéutico* [Hermeneutic reasoning], *Construcción simbólica* [Symbolic construction], and *Alcance comprensivo* [comprehensive application]), a differential methodology of co-experience oriented toward the comprehensive transformation of pedagogical practice in higher education contexts mediated by digital technology. ARCA is the result of a systematic qualitative research process that included three pilot tests and a main experience with seventy-five faculty members from the UTP, through which the model was refined, adjusted, and validated under real training conditions.

The nuclear concept articulating ARCA is **co-experience** (an original term developed in this research to name the process through which understanding is collectively co-constructed, challenged, and reworked among subjects with diverse learning dispositions). Unlike collaborative learning, co-creation, and cooperative learning, co-experience places its emphasis on shared understanding as a relational, symbolic, and transformative phenomenon, rather than on the production of a common outcome or the distribution of tasks.

This article is organized into five sections. The first develops the theoretical foundations of ARCA, tracing the conceptual architecture that links experiential learning, philosophical hermeneutics, the theory of understanding, appropriation as transformation, and force field theory of change. The second describes the research methodology, including the design of the pilot tests, the characteristics of the

main experience, and the analysis process coordinated between NVivo and ChatGPT. The third presents the structure, phases, and differential character of ARCA. The fourth outlines the results of the analysis across its two stages. The fifth offers the conclusions and implications for the design of teacher professional development programs in the era of generative artificial intelligence.

2. Theoretical Foundations of ARCA

Kolb's (1984) experiential learning model serves as the heuristic underpinning of ARCA. Kolb proposes a four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation, which have been subject to legitimate critiques. Bergsteiner et al. (2010) pointed out inconsistencies in its empirical foundation, and Healey and Jenkins (2000) warned against the reification of styles as stable personality categories. This research adopts the geometry of Kolb's cycle without adopting its psychology.

What the empirical evidence contributed is a reworking of the model, wherein the four moments operate within teachers as predominant learning patterns rather than permanent styles. In this manner, a teacher with a concrete predominance is not incapable of abstraction; they simply approach knowledge through direct action, and the methodology needs to validate this starting point before guiding them toward the other stages.

This reworking is precisely what renders ARCA a differential and flexible methodology, allowing teachers to enter the cycle from any of their evoked interests, tastes, and emotions. This flexibility finds its support in an understanding of learning as a historical and situated phenomenon, whose conceptual roots must be traced to understand the scope of the proposal.

Understanding, conceived as the core of meaningful learning, has a conceptual genealogy spanning from Socratic maieutics to contemporary teaching for understanding approaches (Perkins, 1998). Along this trajectory, two milestones are especially relevant to ARCA. The first is Dilthey's (1883/1949) distinction between explanation and understanding; while explanation seeks causes and laws, understanding is oriented toward meaning and context. The second is Gadamer's (1977) hermeneutics, for whom understanding is always interpreting, and all interpretation occurs within the encounter between horizons of meaning. These foundations make ARCA a comprehensive methodology in a precise sense, as its objective is for teachers to construct pedagogical meaning regarding what they do with the mastery and use of technological tools.

Perkins' (1998) proposal on performances of understanding is articulated with these philosophical foundations as evidence that knowledge can be transferred, adapted, and used to transform contexts. Inherently, ARCA is grounded in technological mediation, wherein a teacher can design a learning experience. This distinction organizes the entire analysis of the research results. From this analysis emerges the central concept of ARCA: co-experience. As will be seen, this concept has no direct equivalent in existing pedagogical literature, as it differs from collaborative learning by centering on the shared understanding of an experience. It distinguishes itself from co-creation in that its product is a

comprehensive transformation of pedagogical practice. And it departs from cooperative learning by proposing a collective reflective path regarding what has been lived, as detailed in the following table:

Table 1

Conceptual distinctions between experience, co-creation, and co-experience laboratories

Dimension	Laboratory of Experiences	Laboratory of Co-creation
Conceptual Origin	Derived from experiential learning approaches (Dewey, Kolb). Centers on practical and reflective life experiences to construct knowledge.	Emerges from open innovation models (IDEO, design thinking) and interdisciplinary collaborative work.
Primary Purpose	To explore how direct experience generates learning and personal transformation.	To generate innovative solutions, products, or strategies through collaborative processes.
Underlying Epistemology	Reflective empiricism and constructivism.	Social constructivism and design thinking.
Type of Knowledge Produced	Practical, experiential, or tacit knowledge.	Applied knowledge, prototypes, or innovation models.
Role of the Participant	A subject who experiences and reflects individually.	A co-author or designer who contributes ideas and prototypes collectively.
Nature of the Process	Linear or cyclical (experience → reflection → conceptualization → action).	Iterative (empathize → ideate → prototype → test).
Expected Product or Outcome	Personal transformation or situated learning.	Innovation, a solution, or a tangible product.
Use of Technology	As a support or didactic medium.	As an ideation or prototyping tool.
Scope of Application	Experiential education, professional development.	Social innovation, design, entrepreneurship.
Differentiating Contribution	Promotes learning by doing.	Educational innovation and social co-creation.

The table above captures the differences between the laboratory of experiences, which centers on the design and lived experience of meaningful situations; the laboratory of co-creation, oriented toward producing innovative solutions; and the laboratory of co-experience, which places its emphasis on understanding as a relational, symbolic, and transformative phenomenon. This distinction organizes concrete pedagogical design decisions regarding what occurs at each moment of the training process.

Co-experience emerges within appropriation as conceived by Ricoeur (1999)—the process by which that which is interpreted becomes a transformation of the interpreter. A laboratory of co-experience is, therefore, a space in which participants learn collectively to understand what they have lived, interpret it

from their particular dispositions, and transform it into new pedagogical decisions. This process, however, does not occur in equilibrium, as it is traversed by tensions between what teachers wish to transform and what they tend to preserve—between openness to change and the security of the familiar. For Lewin (1988), this contradiction was termed a force field, referring to that dynamic in which every transformation emerges from the tension between driving forces and restraining forces. In this sense, the laboratory of co-experience is a force field where understanding is continuously co-constructed, challenged, and reworked. Whether this field operates transformatively depends not only on the disposition of the participants—in this case, teachers—or the richness of the shared experience; it also depends on the manner in which technology is integrated into it. In digitally mediated contexts, such as those proposed by ARCA, technology can either enhance co-experience or neutralize it if its use lacks a deliberate pedagogical intention.

It is at this point that Coll's (2004) argument acquires a direct relevance for the present framework, as he precisely argued that the transformative potential of digital technologies is only actualized when there is an explicit pedagogical intentionality regarding how technology is integrated into joint activity. Without that intentionality, technology reinforces what exists instead of transforming it. This warning, articulated two decades ago, is more urgent in the context of generative artificial intelligence, where the sophistication of systems makes the illusion of transformation more seductive and harder to challenge.

In ARCA, technology operates as a cognitive and symbolic mediation. This distinction, drawn from Jenkins (2006), describes participatory culture as a setting where subjects do not merely consume but produce and transform content. It implies that instructional design must explicitly anticipate the moments when technology amplifies reflection, when it enables the symbolization of what has been learned, and when it can substitute for thinking if it is not pedagogically managed. For this reason, ARCA's hybrid design responds to a structural condition derived from the evidence that face-to-face and digital spaces fulfill different functions within the comprehensive process, and neither can replace the other. Nonetheless, to design these conditions, it is necessary to understand the internal dynamics that determine whether a teacher effectively transforms or remains fixed in their previous frameworks. The question, then, focuses on: what forces operate within that environment for change to occur or to be blocked? It is here that Lewin's (1988) force field theory offers the ARCA framework its explanatory axis.

For Lewin, any process of change operates within the tension between driving forces—first, those that mobilize toward transformation, and second, restraining forces, which stabilize the existing situation. Within the arena of technology-mediated teacher education, the study identified several persistent restraining forces, such as resistance to change, fear of lacking tool mastery, a tendency to reproduce known practices, curricular standardization, and evaluative pressure. Conversely, it also identified systematic driving forces, including pedagogical curiosity, commitment to students, a desire to innovate meaningfully, and an openness to peer dialogue.

ARCA incorporates these tensions as constitutive elements of the laboratory of co-experience, allowing them to be lived, reflected upon, symbolized, and transformed from within the training process itself.

This design decision explains one of the most counterintuitive findings of the research: the teachers who transformed the most were not those who found definitive answers to the tensions between pedagogical tradition and technological innovation, but those who learned to inhabit them productively.

The theoretical framework sustaining ARCA is a conceptually coherent architecture. Kolb provides the geometry of the experiential cycle; Dilthey and Gadamer ground understanding as a hermeneutic and historical process; Perkins renders it an observable and transferable performance; Ricoeur anchors it in appropriation as a transformation of the interpreter; Coll and Jenkins warn of the conditions without which technology reproduces rather than transforms; and Lewin offers the dynamic model explaining why change depends on managing the forces operating within both the subject and the collective. What articulates all these axes is the concept of co-experience: a laboratory where teachers learn to understand what they live, interpret it from their particular dispositions, and transform it into meaningful pedagogical decisions. ARCA emerges, then, as a methodological response to how to train teachers so that they not only integrate technology, but also understand what they are doing when they integrate it, why they are doing it, and what transforms within them when they do it well.

3. Research Methodology

The research adopted a qualitative approach with a hermeneutic-interpretive scope, consistent with its object of study: to understand the learning patterns that emerge in teacher professional development experiences mediated by digital technology. The purpose was not to measure outcomes or evaluate the efficacy of a tool, but rather to interpret how teachers construct pedagogical understanding in hybrid environments and what patterns shape this process. This orientation justified the choice of Bedoya's (2019) relational analysis as the central analytical framework: rather than coding frequencies, the focus was on the relationships that emerge between categories, discourses, and contexts, constructing meaning from the connections.

This systematic adjustment process was materialized through three pilot tests, each of which fulfilled a specific function in consolidating the model:

- **24-Hour Reality**: Conducted with forty students from the Bachelor's Degree in Technology program at the UTP, this test confirmed the potential of active methodologies to generate engagement and production, but revealed its limitation: participants developed operational competencies without extracting transferable pedagogical principles. Action without reflection produces ephemeral learning.
- **36 Didactic Hours**: Conducted with students from all programs within the Faculty of Education Sciences, this test showed that interdisciplinarity triggers tensions between learning patterns that a uniform design cannot manage: forcing teachers with an abstract pattern to act before conceptualizing produces frustration, not understanding.
- **Diploma Course in Educational Innovation**: Conducted with sixty teachers, this was the pilot test that made the central finding visible: when training is identical for everyone, teachers learn in

qualitatively different ways, regardless of the quality of the design. This heterogeneity was not a problem to be solved; it was the key to ARCA.

These three pilot tests constituted the conceptual and operational refining process that made it possible to design and execute a learning experience with the conditions necessary for co-experience to occur. Each pilot refined the instruments, adjusted the timelines, specified the roles, and clarified which moments of the cycle required face-to-face mediation and which could be sustained in digital environments. Drawing upon these accumulated insights, it was possible to convene the central experience of the research.

The main experience brought together seventy-five faculty members from different schools at the UTP across two articulated stages. In the first stage, the teachers participated as students in training experiences mediated by generative artificial intelligence for eight weeks, experiencing from the inside the processes of planning, didactic design, and evaluation supported by AI. In the second stage, these same teachers undertook the design and execution of their own AI-mediated pedagogical experiences within their real teaching contexts, subjecting them to a process of collective reflection and evaluation.

This two-stage design, in which the teacher learns and subsequently becomes the designer, was intentional. It allowed for the observation of the same population in two distinct roles, identifying the qualitative transformation that occurs when a teacher transitions from the functional use of technology to grounded pedagogical design. Data collection employed participant observation, semi-structured interviews, digital repositories of the productions, and audiovisual records of the group processes.

The data analysis operated at two articulated levels. At the algorithmic level, NVivo allowed for systematic coding, the construction of node maps, word clouds, and co-occurrence matrices, identifying symbolic and conceptual regularities.

At the hermeneutic level, ChatGPT's assistance operated across three analytical moments with distinct functions and validation criteria.

- In the first moment, termed semantic exploration, transcription fragments and records of between 300 and 500 words were introduced with the structured prompt: "Based on Kolb’s experiential learning concepts (concrete experience, reflective observation, abstract conceptualization, active experimentation), identify which type of pattern predominates in these context units and justify your classification with direct textual evidence." Responses were accepted only when the justification cited literal expressions from the analyzed fragment; classifications lacking textual anchoring were discarded.
- In the second moment termed interpretive contrast, the nodes constructed in NVivo were presented to ChatGPT with the prompt: "These nodes were identified through systematic coding. What relationships between them are not evident but are conceptually plausible from a hermeneutic perspective?" The suggested relationships were subjected to cross-validation with the original data:

only those that could be confirmed by at least two independent records were incorporated into the analysis.

- In the third moment, termed coherence review, the preliminary findings were presented in full with the prompt: "Are there alternative interpretations to these conclusions that the data could also support?" This moment operated as a saturation mechanism and a control for the researcher's confirmation bias.

Across all three moments, the acceptance criterion remained identical: no interpretation generated by ChatGPT was incorporated into the analysis without direct verification against the primary data. ChatGPT operated as an analytical interlocutor based on Kolb's model and Bedoya's (2019) relational analysis. The triangulation between both levels guided the construction of meaning from emerging relationships rather than from the quantitative accumulation of frequencies.

This articulation between NVivo and ChatGPT represents a methodological contribution. The research evidence shows that the dialogue between human interpretation and computational analytics enables new ways of understanding the learning experience, provided that the computational analytics are regulated by explicit theoretical frameworks. Without that regulation, AI produces interpretations that are statistically plausible but semantically arbitrary.

4. ARCA: Structure, Phases, and Differential Character

The name ARCA condenses the ontological and symbolic meaning of the proposal. From its etymological root, an ark (*arca*, *arkhé*) is a container of the essential, a principle, and a shelter. From the perspective of cultural tradition, the ark guards something valuable to preserve life during a storm; now, in a pedagogical metaphor, ARCA represents the journey of the teacher who protects their experience with technology, transforms it, and returns it to the world as understanding. That is to say, this differential model constitutes a methodological proposal oriented toward understanding teacher professional development processes in contexts mediated by technology, where teachers recognize, interpret, and project their experience with digital tools from a hermeneutic perspective. Within this perspective, they transform their experience through processes of dialogue and reflection, returning it to the educational context as applied understanding. This latter process—the comprehensive application—is expressed in the teacher's capacity to critically apply what has been understood to improve teaching, guide other colleagues, or innovate in the pedagogical use of technologies.

ARCA is therefore a differential methodology of co-experience oriented toward the comprehensive transformation of pedagogical practice in higher education contexts mediated by digital technology. The acronym designates its four constitutive phases: *Acción Vivencial* [Actional Experience], *Razonamiento Hermenéutico* [Reasoning Hermeneutically], *Construcción* Simbólica [Constructing Symbolically], and *Alcance Comprensivo* [Application]. These phases correspond to flexible entry points into a comprehensive cycle that each teacher can initiate from their predominant pattern.

Epistemologically, ARCA conceives understanding as an ethical, aesthetic, and political act that emerges from the encounter between subjects, contexts, and symbols. The laboratory of co-experience in which ARCA operates is not a space for teaching tools: it is a setting for living, engagin in dialogue, and collectively shaping the meaning of technology-mediated pedagogical practice. This conception implies that technology is not the object of training, but rather its mediation.

To begin to understand the meaning of ARCA and its cyclical process, it is important to define the concept of meta-reflection and what it implies within this proposal, as it is the concept that frames and permeates the entire process of understanding and relates to the awareness of the methodology. Its presence at the beginning and the end of the cycle constitutes the foundation of the Co-experience Laboratory cycle, where learning implies understanding, and understanding leads to transformation.

At the beginning of the process, meta-reflection acts as a hermeneutic threshold; that is to say, its purpose is to activate the consciousness of learning as an act of understanding. Here, then, the participant is prepared to look at the experience as a possibility for meaning. For this reason, it has been termed: pre-understanding to learn.

In this initial moment, the student identifies their pre-understandings, recognizing from where they learn, what they expect, and what unsettling or mobilizing factors activate their reflective disposition.

Conversely, upon concluding the cycle, meta-reflection reappears with an inverse purpose and takes the name of understanding what has been learned. It seeks to have the participant integrate the awareness of what was understood; that is, at this point, the subject recognizes how their perspective has shifted, what meanings emerged from the experience, and how that understanding can be projected toward new transformations, expressing it through narrative and allowing reflection to become deep metacognition (Ricoeur, 1999).

In this manner, the ARCA Laboratory of Co-experience is structured around four moments that express movements of understanding rather than linear phases:

***Acción Vivencial* [Actional Experience] (from feeling to doing)**

Where awareness is awakened through meaningful experience. In this moment, the participant immerses themselves in activities or situations that connect them with a meaningful problem, emotion, or question represented through artificial intelligence, simulators, or digital resources. It is in this contact with reality that the participant begins to think, feel, and construct meaning, and technology becomes a mediator of that experience—expanding the possibilities of feeling, observing, and narrating the experience, thus turning into a setting for expression and the co-construction of meanings.

Razonamiento Hermenéutico [Reasoning Hermeneutically] (from doing to understanding): Where what has been lived is reflected upon and interpreted in dialogue with others. This is the moment for the participant to pause, observe, and engage in dialogue with and about what has been experienced with the other to grant it collective or individual meaning. This phase is grounded in the hermeneutic tradition

of Gadamer (1977), who posits that understanding implies a dialogue with experience as a bridge between action and understanding; while the participant interprets what they do, learning is reconfigured as meaningful knowledge.

The hermeneutic reasoning is, therefore, the phase subsequent to the educational experience that requires being subjected to analysis, contrast, and deliberation, where perspectives are shared, interpretations are contrasted, and the plurality of meanings that a single lived experience can have is discovered.

In this phase, technology transitions from being an operational instrument (as in the Experiential Action phase) to becoming a hermeneutic space; that is, a medium where the experience is made visible, shareable, and reinterpreted through three key situations:

- **Externalization of Thought**: By implementing online tools to represent learning processes through conceptual maps, texts, sequences, infographics, or diagrams, the participant's internal reasoning is visualized as ideas or connections are expressed graphically or textually.
- **Interpretive Dialogue**: Virtual environments, in turn, function as a shared hermeneutic space. Through forums, synchronous encounters, and shared documents, understanding becomes collective, as teachers discuss their perceptions regarding the pedagogical meaning of technology.
- **Rereading of Action**: Technology makes it possible to return to what has been done, review products, read the contributions of others, and reinterpret their decisions, thereby constructing meaning from interaction.

Construcción Simbólica [Constructing Symbolically] (from understanding to meaning): Where knowledge is collectively configured into cultural, narrative, or technological forms. This phase stems from the idea that understanding implies configuring the world as a narrative, giving expression to what has been lived in order to share and transform it. In other words, symbolic construction is, then, the space where experience is translated into language, image, or meaningful action through symbols, narratives, or artifacts that condense the meaning of the process.

In this phase of the ARCA model, a symbol is considered the perceptible form that condenses an act of understanding and reveals a meaning that cannot be fully expressed in words, because it contains the emotional, ethical, and aesthetic footprint of the experience. Thus, the symbol gives rise to thought, opening a horizon of interpretation that extends into a new form of meaning (Ricoeur, 1999).

Technology plays a leading role here, as it becomes a space where understanding is represented through languages of representation—offering digital platforms, multimedia resources, visual narratives, or collaborative environments to allow participants to give that symbolic form to their thought.

***Alcance Comprensivo* [Application] (from meaning to transforming)**

Where understanding expands into micro-interventions, new practices, or educational projections. This phase constitutes the moment in which understanding ceases to be an introspective act and becomes a transforming force within practice.

Here, the participant who has lived, interpreted, and symbolized their experience expands their understanding toward new scenarios—projecting what has been learned into concrete actions, pedagogical innovations, or micro-interventions within their educational context.

The student, by reflecting upon their experience and reinterpreting their practice, acts with awareness of what has been learned; that is to say, their doing becomes a comprehensive gesture because it reflects the integration of thinking, feeling, and acting.

Nevertheless, to achieve the flow of the co-experience laboratory, it becomes necessary to design and implement triggers for learning as an act of consciousness. To this end, the use of challenges is suggested to remain coherent with the experiential, reflective, and creative nature of the model. Thus, instead of prescriptive activities or repetition exercises, challenges call upon the subject to involve themselves actively in their own understanding. From this perspective, a challenge is a meaningful situation that destabilizes what has been learned and leads to new levels of understanding; for this reason, each moment of the model contemplates a different type of challenge.

In the Co-experience Laboratory, each challenge is a pedagogical provocation that seeks to mobilize different dimensions of human experience: feeling, thinking, deliberating, creating, and transforming.

The challenges are proposed to activate comprehensive processes that allow participants to recognize themselves in the experience and construct meaning together with others, so that each challenge mobilizes something within the subject:

- **Sense-Activation Challenges**: They mobilize curiosity, openness, and the disposition to learn. In this initial stage, the participant is invited to question the *why* and *what for* of the experience.
- **Co-experience Challenges**: They mobilize shared life experience, sensation, and bodily and emotional involvement with experiences mediated by technologies, simulators, or collaborative dynamics that lead them to confront their mental structures. The so-called zone of comprehensive instability is activated, where sensory or cognitive experience disorganizes what is known and opens the way to new interpretations.
- **Understanding Challenges**: They mobilize reflection, dialogue, and interpretive thought through the translation of their lived experiences into words, where interpretations are co-constructed.
- **Symbolization Challenges**: They mobilize creativity, representation, and the symbolic expression of understanding through the conversion of that understanding into a symbol, a map, a narrative, or a digital creation.
- **Projection Challenges**: They mobilize conscious action, transfer, and the transformation of practice through application or dialogue with their personal, academic, or social environment. Micro-

interventions or meaningful experiences are designed to embody the understanding achieved.

- **Interiorization and Symbolic Memory Challenges**: They mobilize the integration of the lived experience through the recognition of the symbolic imprint it leaves, articulating what becomes constitutive of one's own pedagogical identity.

Thus, the ARCA Methodology stands as a differential proposal in the field of contemporary education by blending lived experience, critical reflection, the symbolic reconstruction of knowledge, and transformative action into a single framework—all integrated into a continuous process of meta-reflection that returns meaning to teaching practice. Unlike traditional methodologies that fragment teaching into technical steps, ARCA is sustained by the dynamic unity between feeling, thinking, and acting, proposing a holistic view of learning where understanding becomes the core of the educator's professional development.

5. Results

In the first stage, with teachers in the role of students, the NVivo analysis showed a learning profile centered on the functional exploration of AI tools. The concrete pattern concentrated 26.2% of the units of analysis linked to the exploration and classification of tools, and 18.5% related to the construction of personal learning environments, as evidenced in the table below:

Table 2

Predominant learning patterns and categories across both research stages

Pattern	Predominant Categories — Stage 1	%	Predominant Categories — Stage 2	%
Concrete	Exploration and classification of AI tools	26,2%	Development of key competencies and skills	19,54%
	Construction of personal learning environments (PLE)	18,5%	Experiential learning methodology	14,94%
			Real-world problem solving	10,34%
Creative	AI as an educational tool	34,3%	Meaningful learning	3,45%
	Learning/teaching within one's own professional field	31,4%	Educational innovation	1,15%
	Evaluation and feedback	14,7%		
	Development of creative skills	11,8%		
Abstract	Transformation of pedagogical practice	42,3%	Adaptability and personalization	2,3%
	Redefinition of TLEs (Teaching-Learning Environments)	26,9%	Focus on creativity and innovation	3,45%
Reflective	Critical evaluation of methodologies	40,0%	Fostering critical reflection	13,79%
	Reflection on the role of technology	24,0%	Ethical and social focus	6,9%
	Recognition of developed skills	18,0%	Continuous and formative evaluation	4,6%
			Self-evaluation	2,3%

This table demonstrates that teachers actively engaged, explored, compared, and incorporated tools into their digital repertoires, but without yet articulating that exploration with questions regarding the pedagogical meaning of what they were doing.

The creative pattern occupied second place, articulated mainly around AI as an educational tool (34.3%) and the use of AI to learn or teach within one's own professional field (31.4%). Creativity, at this stage, was driven by the novelty of the tool rather than by a reflection on pedagogical design. The reflective pattern had the lowest overall presence, concentrated on the critical evaluation of methodologies (40%) and reflection on the role of technology (24%)—a reflection that was still external and directed toward the instruments, rather than internal and directed toward their own practice.

This diagnostic profile was precisely the starting point that ARCA required so as not to impose a sequence on the teachers that began with abstraction or conceptualization: to start from their concrete

and creative pattern, and progressively guide them toward grounded reflection and pedagogical construction.

In the second stage, where the teachers designed and executed their own AI-mediated experiences, a qualitative transformation was revealed, as evidenced in the following table:

Table 3
Qualitative transformation indicators between Stage 1 and Stage 2

Indicator	**Stage 1**	**Stage 2**
Focus on creativity and innovation	18%	75%
Experiential methodology	9%	25%
Product-centered evaluation	5%	25%
Real-world problem solving	3%	17%
Collaborative work	0,5%	4,6%
Inclusion and diversity	1%	3,45%

The reflective pattern rose to second place in frequency, with a significant strengthening of previously marginal categories: critical reflection and self-evaluation, continuous and formative evaluation, and an ethical and social focus. Self-criticism, which was previously non-existent in the records, emerged as an indicator of professional maturity. Teachers stopped analyzing methodologies from the outside and began reviewing their own pedagogical decisions from within.

In the abstract pattern, the transformation was equally significant. In the first stage, the transformation of pedagogical practice and the redefinition of teaching-learning processes were articulated from a predominantly technical perspective. In the second stage, that approach gave way to more critical and adaptive understandings: teachers abandoned a rigid vision of planning to embrace pedagogical design as a flexible, situated process oriented toward the real needs of the students. The personalization of learning ceased to be a general aspiration and became the organizing criterion of the classroom experience.

In the creative pattern, the most significant transformation was that which separates the exploring teacher from the architect teacher: creativity stopped being driven by technological novelty and became a conscious practice linked to pedagogical relevance and design ethics. Generative AI lost its prominence as an object of fascination to become a resource at the service of grounded didactic decisions.

Consequently, the relational analysis identified a group of teachers who moved through all four patterns across both stages, questioning their own practices, transforming them, and designing more relevant and contextualized learning environments. The most precise indicator that the comprehensive cycle had

been completed was that teachers used AI not to obtain answers from their students, but to generate questions for them. This shift from AI as a generator of answers to AI as a mediation for pedagogical queries is exactly what ARCA defines as deep pedagogical understanding.

Finally, the transversal patterns also evidenced the emergence of ethical principles as design organizers. The teachers who completed the cycle incorporated reflections on plagiarism, technological dependency, equity in access, and AI system biases as constitutive elements of their didactic proposals. This result is coherent with the epistemological conception of ARCA; a methodology that conceives understanding as an ethical act produces results in which ethics is a constitutive dimension.

One of the most paradoxical findings is that ARCA did not resolve the tensions between the instrumental and comprehensive use of technology, between pedagogical tradition and innovation, or between standardization and personalization, but rather integrated them as constitutive elements of the laboratory. In this way, the teachers who transformed the most were those who learned to inhabit these tensions productively, using them as an engine for reflection, as an evaluation criterion for the tools, and as a formative design principle. This capacity to coexist with tension without becoming paralyzed is, possibly, a competence rarely addressed in teacher training programs focused on technology. Its contribution to the educational field manifests at several levels. At the epistemological level, ARCA redefines understanding as a process of symbolic and ethical construction, in which knowledge is generated from experience and returns to it transformed. At the pedagogical level, it offers teachers a methodological pathway that positions them as reflective and creative subjects, capable of questioning their own practice and reconstructing it from lived experience. At the technological level, it introduces a meaningful digital mediation, where tools cease to be simple instrumental extensions and become spaces for cognitive and emotional exploration. And at the formative level, it promotes an education where the teacher learns to understand, and that understanding translates into autonomy, critical thinking, and purposeful action.

6. Conclusions

ARCA emerges from an empirical finding that theory had foreshadowed but formative practice had not extracted with sufficient methodological consequences. Teachers do not all learn in the same way, and a methodology that fails to recognize this diversity produces, at best, functional learning but not pedagogical understanding. The specific contribution of ARCA resides in the principle that organizes the phases of experiential learning from Kolb (1984), where entry is flexible and determined by the predominant pattern of each teacher.

The notion of co-experience underlying ARCA offers its own pedagogical concept to name the process through which understanding is co-constructed, tensioned, and collectively reworked among subjects with diverse learning dispositions. This concept has implications for the design of professional learning communities, for the training of teacher educators, and for educational research seeking to understand how real pedagogical transformation occurs within technology-mediated contexts.

The results confirm that the qualitative transformation of pedagogical practice depends on a formative design that articulates experience, reflection, conceptualization, and action as interdependent moments, and that conceives the tension between pedagogical tradition and technological innovation as a formative resource. When these conditions are built with pedagogical deliberation, digital technology ceases to be an object of fascination or resistance to become what ARCA proposes it to be: a cognitive and symbolic mediation at the service of an understanding that remains, fundamentally, a human act.

The central thesis sustained by ARCA carries implications that transcend both the Colombian context and the higher education level; in the era of generative artificial intelligence, the urgent pedagogical question is not how to teach educators to use AI, but rather how to design formative experiences that convert the use of AI into pedagogical understanding regarding what is done with it. This conversion does not occur spontaneously—it requires methodology. And that methodology, according to the data, must be differential.

Declarations

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Clinical trial number: not applicable.

Ethics approval: This study derives from a research project approved as no-risk research by the Research Ethics Committee of the Universidad Tecnológica de Pereira (CEI-UTP; approval code 172-271125, minutes No. 20 of 24 November 2025). The research was carried out in accordance with the ethical and legal standards followed by the committee (Resolution 8430 of 1993, Resolution 2378 of 2008, the Declaration of Helsinki, and the CIOMS guidelines), and with the support of the doctoral program and the Faculty of Education Sciences of the Universidad Tecnológica de Pereira.

Consent to participate: All participants provided informed consent before taking part in the study.

Consent to publish: Not applicable. The article does not report identifiable individual data.

Data availability: The datasets generated and analysed during the current study are not publicly available due to the privacy of the participants (interview transcripts and audiovisual records) but are available from the corresponding author on reasonable request.

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Figures

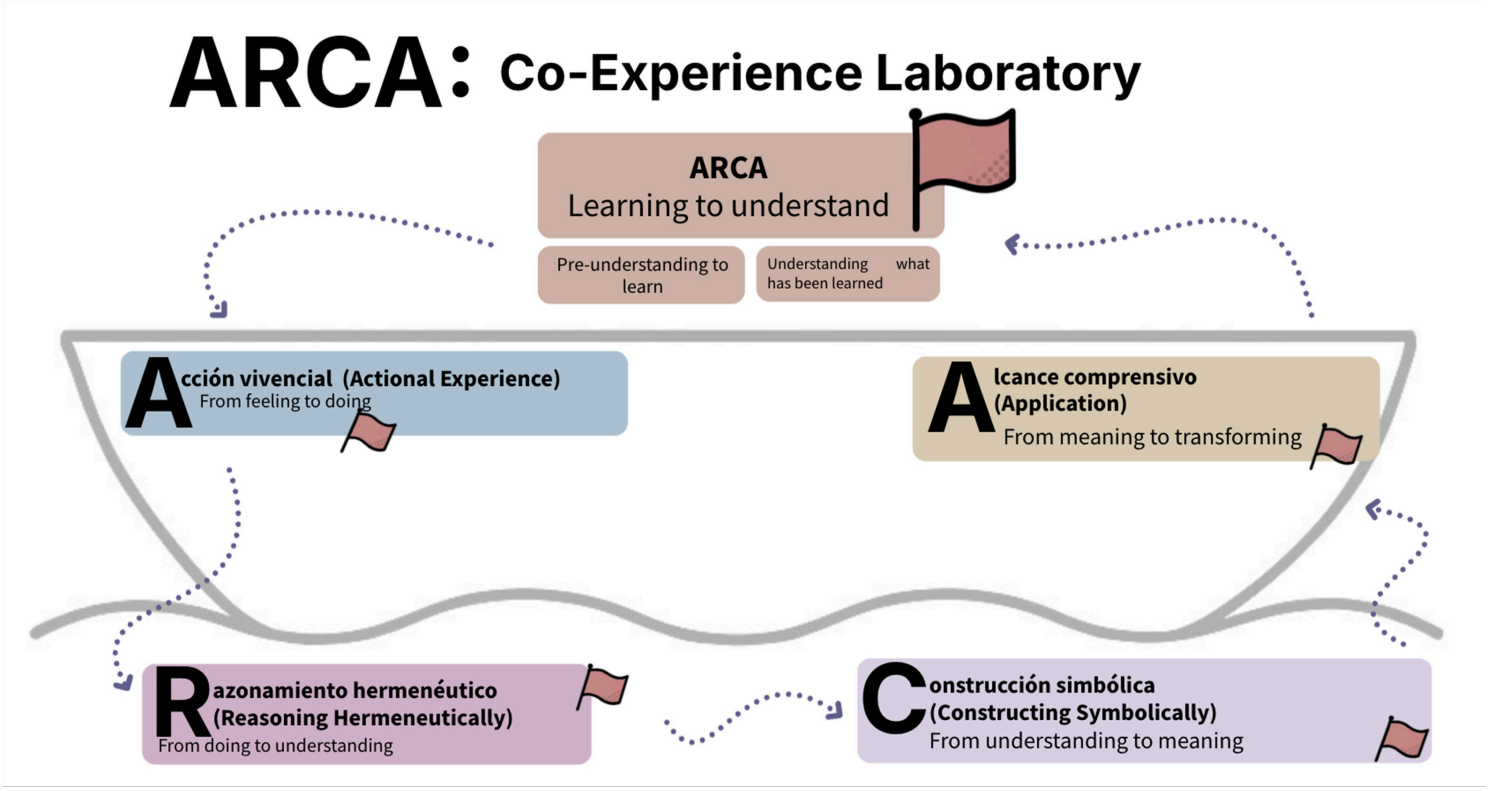


Figure 1

ARCA Co-Experience Laboratory: cyclical structure and differential entry points. The four phases — Experiential Action, Hermeneutic Reasoning, Symbolic Construction, and Comprehensive Scope — are organized as a non-linear cycle framed by two meta-reflection moments: Pre-understanding to Learn (entry) and Understanding what has been Learned (exit). Dotted arrows indicate flexible entry points according to each teacher's predominant learning pattern

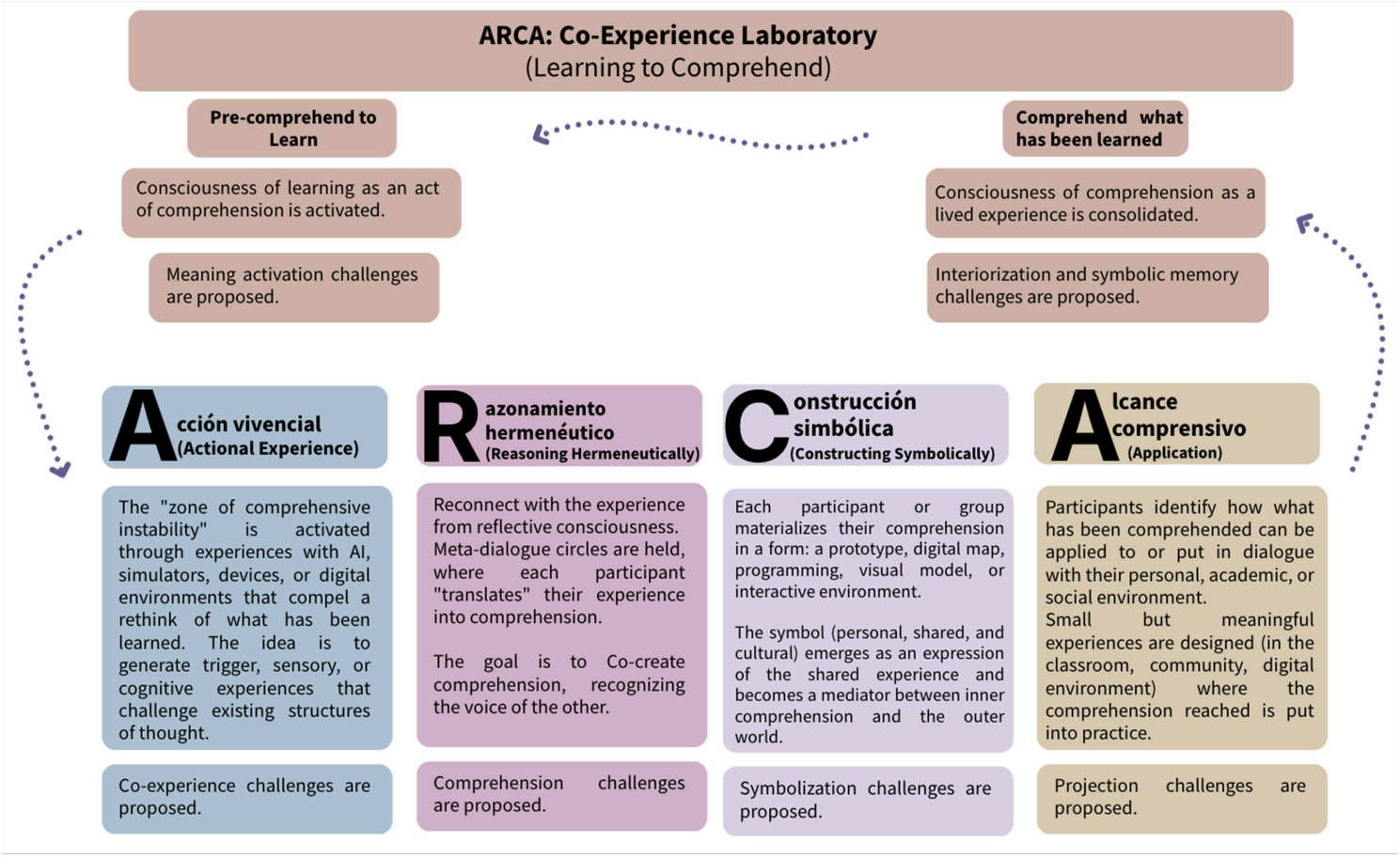


Figure 2

ARCA Co-Experience Laboratory: phases, processes, and challenge types. Each phase specifies the cognitive process activated, the pedagogical strategies proposed, and the type of challenge designed to mobilize learning as a conscious act. The cycle opens and closes with meta-reflection moments that frame comprehension as a transformative pedagogical experience.