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LANGUAGE EDUCATION – BRIDGING THE HUMANITIES AND LIFE SCIENCES

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Abstract. *The paper seeks to provide answers and arguments in support of the following questions which may function as working hypotheses: What are the major contributions of the humanities (language education, in our case) in modulating cultural dynamics in mixed intercultural classes and within society at large? How can we as language educators enable students in the life sciences to better integrate seemingly disunited aspects of their learning across their fields of study? How can we help learners achieve optimal socio-linguistic interaction within sustainable learning communities, according to the fullest human potential? The main interpretations and points raised by eco-linguistics and bio-semiotics assist us in our aims, as well as in evidencing the relational aspect of both cultural and natural living systems. Also, we aim to help students in the life sciences better perceive that nature is pervaded with meaning, communicative and collaborative aspects, as well as an inexhaustible range of relational patterns that go from the molecular level up to the cultural scale. This paper explores the contributions of language education to modulating cultural dynamics in intercultural contexts, enhancing interdisciplinary learning in the life sciences, and fostering sustainable, communicative communities that align with the human potential for cooperation and empathy. Drawing on eco-linguistics and biosemiotics, the study situates language as a medium through which humans can re-establish relational coherence with both culture and nature.*

Keywords*: ESP, language education, didactic strategies, teaching, humanities, life sciences.*

INTRODUCTION

The humanities, including language education in our case, occupies a crucial role in bridging disciplinary divides, fostering intercultural understanding, and cultivating sustainable modes of thinking. In contemporary academia, the divide between the sciences and the humanities often perpetuates a fragmented worldview that obscures the relational essence of both cultural and ecological systems (NUSSBAUM, 2010). Language education serves as a vital site for negotiating cultural identity, empathy, and ethical communication in increasingly multicultural classrooms that have the potential to harmonize human culture with natural systems (KRAMSCH, 2009).

In such contexts, language operates not merely as a tool for information transfer, but as a living system that mirrors ecological complexity. The concept of linguistic ecology posits that languages evolve and interact in ways similar to species in an ecosystem, through contact, adaptation, mutuality, and cooperation. For these reasons, we suggest that the humanities have ample ground for informing the life sciences, considering that "meaning is predicated on all points by situated interaction between agents, objects and their sign systems" (FAVAREAU & al., 2017:13).

From a language socialization perspective, the classroom can be conceptualized as an "ecological system" (BREEN, 2001), characterized by dynamic patterns of interaction between learners and facilitators. Within this ecological framework, the language classroom emerges as "an arena of subjective and intersubjective realities" that continuously shape, define, and transform the processes of teaching and learning (BREEN, 2001). Breen's ecological

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perspective thus underscores the complex interdependent nature of the classroom experience, emphasizing how the teaching-learning environment is constructed through ongoing social, linguistic, and cognitive interactions among its participants (DRAGOESCU URLICA, 2018:540). Thus, cultivating eco-linguistic awareness enables learners to perceive the interdependence between communicative practices and broader socio-ecological systems.

Moreover, intercultural communication within language classrooms encourages learners to negociate positions and navigate differences constructively, developing intercultural communicative competence (ICC) (BYRAM & CONLON, 2025). This competence is essential not only for global citizenship but also for sustainable social cohesion in an era of environmental and cultural crisis. Through reflective and dialogical pedagogy, language educators can promote relational awareness and a recognition that meaning is co-created across linguistic, cultural, and ecological boundaries (HALLIDAY, 2001).

The model of ICC proposed by Byram & Conlon (2025) emphasizes the transformative potential of language education in promoting democratic and dialogical values. It argues that language learning should not be limited to developing linguistic proficiency, but should also encourage learners to participate critically and responsibly in intercultural and civic contexts. Seen as a dynamic framework for addressing current global challenges, the language learning environment becomes an optimal ground for cultivating educational practices that nurture ethical reflection and critical cultural awareness.

MATERIAL AND METHODS

The study adopts a qualitative research methodology, drawing on systematic observations and insights provided by a team of academics engaged in teaching English for Specific Purposes (ESP), didactics and pedagogy for the Life Sciences, and the psychology of education (BOACĂ & GAVRILĂ, 2024; BOACĂ, MĂRGHITAN, & GAVRILĂ, 2017; BOACĂ, GAVRILĂ & MILOS, 2016) at the University of Life Sciences "King Mihai I" in Timișoara. The team has worked on ecolinguistic curriculum development, having authored university-level textbooks utilized in ESP courses, such as *Ecological English: English for Life Sciences* (DRAGOESCU, 2022; URLICA, & al., 2021; URLICA, & al., 2019).

Data analysis was guided by a range of research approaches aligned with communicative language teaching principles, ecolinguistics, and biosemiotics, ensuring a multidisciplinary perspective on language education in specialized academic contexts. The study specifically emphasizes content-based learning strategies tailored to the Life Sciences, allowing for the integration of disciplinary knowledge with linguistic competence. By combining observational insights with theoretically informed frameworks, the methodology facilitates a nuanced exploration of how language functions within ESP curricula for Life Sciences, highlighting both pedagogical practices and the semiotic dimensions of scientific language communication.

RESULTS AND DISCUSSIONS

When language instruction is integrated with ecological and biological content, it provides a rich context for interdisciplinary reflection, particularly when approached through the lenses of Ecolinguistics, Critical Discourse Analysis, and the intercultural communicative competence (ICC) framework outlined above. Engaging students in activities such as discourse analysis of environmental texts or the study of metaphors embedded in biology-related terminology can foster a deeper awareness of the ways in which language shapes scientific conceptualizations and epistemologies (STIBBE, 2021).

Moreover, embedding eco-linguistic and eco-semiotic perspectives within life sciences curricula encourages learners to perceive science as a culturally and socially situated practice. This approach foregrounds the ethical, communicative, and interpretive dimensions of scientific knowledge, highlighting how linguistic practices mediate both understanding and engagement with the natural world (MARAN, 2018). By bridging language, culture, and scientific discourse, such pedagogical strategies cultivate critical thinking, intercultural awareness, and a more nuanced comprehension of the complex interplay between human cognition and ecological knowledge.

In his analysis of ecosemiotics in relation to "changing ecologies", Maran (2018) introduces an interdisciplinary approach that merges semiotics with ecological theory to better understand how meaning operates within natural systems. He contends that sign processes should not be viewed as exclusive to human culture or language, but as fundamental to all forms of life and their interactions with the environment. This view presents ecosemiotics as a bridge linking the study of relationships between living organisms to the symbolic and cultural practices of human communication. By doing so, he redefines meaning as an inherently ecological phenomenon that evolves through continuous exchanges among species, habitats, and semiotic systems, ultimately questioning the human-centered orientation of the classical humanities.

The author (MARAN, 2018) also provides a critical perspective on how ecological change affects the deeper semiotic relations that sustain ecosystems. He draws attention to environmental degradation, habitat loss, and climate change which disrupt not only biological processes, but also the semiotic networks that enable species to adapt and communicate. By examining examples from natural environments, as well as the humanities (literature, art, *etc.*), Maran makes an ecosemiotic analysis that reveals the interdependence between cultural representations and ecological realities. This demonstrates that ecosemiotic analysis can throw light upon the complex interplay between environmental change and symbolic representation. His work thus positions semiosis as a crucial component of ecological sustainability, urging a more holistic understanding of the environment that recognizes the mutual influence between communication, culture, and the living world.

A significant challenge in contemporary higher education involves enabling life sciences students to integrate insights from the humanities in order to develop a holistic understanding of complex meaning systems. The humanities, particularly language and interpretive studies, offer frameworks that highlight the symbolic, semiotic, and communicative dimensions inherent in living systems. For instance, biosemiotics conceptualizes all life forms as engaged in continuous sign processes, interpreting and responding to environmental stimuli in ways that parallel human systems of meaning-making (HOFFMEYER, 2008). Introducing life sciences students to such perspectives encourages the recognition that communication is not limited to human societies, but permeates all levels of biological organization.

In *Can the Study of the Humanities Inform the Study of Biosemiotics?* (FAVAREAU et al., 2017), researchers from various disciplinary backgrounds inquire: How can the humanities' interpretive paradigms inform and extend the epistemic reach of biosemiotics as a transdisciplinary field? Through dialogic reflection, the authors argue that a comprehensive understanding of semiosis in living systems cannot rely solely on the empirical or mechanistic paradigms of biology. Instead, it must incorporate the interpretive, ethical, and narrative dimensions long cultivated within the humanities. Their interdisciplinary dialogue highlights

the productive tension between biological models of sign processes and humanistic perspectives on meaning, value, and communication.

Favareau et al. (2017) contend that biosemiotics risks reductionism if divorced from the critical and interpretive resources of the humanities. As they emphasize, humanistic traditions provide indispensable insights into metaphor, narrative, interpretation, and ethical reflection, all of which reveal meaning as a relational and context-dependent process rather than a fixed or coded correspondence. Without such interpretive depth, biosemiotics may inadvertently reproduce the mechanistic and positivist assumptions it seeks to transcend. The humanities, by contrast, offer conceptual instruments for understanding the lived, situated, and experiential aspects of semiosis—dimensions that biological science alone may overlook (MARAN, 2018; Kull, 2018).

The contributors approach this dialogue from complementary vantage points. For example, Wheeler situates biosemiotics within the broader intellectual history of ecological thought, suggesting that it may revitalize the humanities by restoring attention to interconnectedness, creativity, and the generative potential of living systems. Cobley and Stjernfelt extend this perspective into cognitive and learning sciences, arguing that language and thought emerge through semiotic scaffolding that bridges biological embodiment and cultural transmission. Tønnessen, adopting an ethical lens, contends that if semiosis is the defining feature of life, then moral responsibility must also be understood as an emergent property of semiotic systems, grounded in the shared capacity for sign interpretation and response. Together, these perspectives affirm the necessity of a transdisciplinary semiotics that honors both the biological materiality and the interpretive creativity of meaning-making (CAPRA & LUISI, 2014; STIBBE, 2021).

Favareau et al. (2017) thus advocate for a model of *reciprocal enrichment* between the sciences and the humanities. The humanities, they suggest, gain from biosemiotics a grounding in the living processes that underlie all communication, while biosemiotics gains from the humanities a nuanced understanding of value, intentionality, and interpretation. This synthesis dissolves the artificial boundary between nature and culture, reframing both as dynamic semiotic ecologies in which meaning arises through ongoing interaction and differentiation. In this view, human culture becomes a continuation—not an exception—of the natural world's semiotic processes (DEACON, 1997; HOFFMEYER, 2008).

The paper ultimately serves as both a theoretical intervention and a methodological invitation. It challenges researchers to cultivate *semiotic humility*—an openness to complexity, metaphor, and narrative as legitimate modes of knowing. Such humility, they argue, is essential for building an integrative semiotic science capable of addressing contemporary ecological and epistemological crises. Biosemiotics, when informed by the humanities, may thus evolve into a truly ecological epistemology: one that perceives life as a continuum of sign processes, interpretation, and ethical responsibility (KULL, 2018; MARAN, 2018). Favareau et al. (2017) make a case for the re-engagement of the humanities and the life sciences through a shared semiotic paradigm. Their essay anticipates the broader intellectual movement toward *eco-semiotic* and *transdisciplinary* frameworks, where meaning is recognized as both a biological and cultural phenomenon. By repositioning semiosis as the bridge between matter and mind, they propose a model of scholarship grounded in interdependence, dialogue, and the living fabric of meaning itself.

Another crucial intersection between the humanities and life sciences is provided by the growing relevance of complex systems theory. Within this framework, the self-organizing properties of living systems cannot be fully understood without accounting for their relational

dynamics, particularly the active mapping of the environment in the pursuit of utilizable resources. Kauffman (2000) emphasizes the role of continuous feedback, wherein system states build upon previous variations, followed by exploration of the "adjacent possible" within the biosphere. This cyclical process facilitates the perpetual expansion of biological diversity, shaped by interactions among living entities that cannot be entirely predicted (KAUFFMAN, 2000:xi).

These interactions co-construct the biosphere, where agents selectively extract relevant qualities of nature to harness energy and derive meaning, thereby contributing to the ongoing formation of the universe as an expanding open system of possibilities. This dynamic space constitutes culture, which demands heightened awareness due to its profound implications for our collective future. Living organisms, conceived as autocatalytic systems, participate in reciprocal processes that co-construct each other, their ecological niches, and the broader environment in continual cycles of sustenance and innovation. Thus, complexity theory provides compelling support for the existence of intrinsic meaning and creativity in the natural world, positioning humans and other living systems as active co-creators of their environments.

Furthermore, the incorporation of ecological metaphors into language teaching, (for instance networks, cycles, and symbiosis) holds significant potential to encourage learners to apply ecological reasoning to human interactions (FILL & MÜHLHÄUSLER, 2001). By considering students as participants within an interdependent communicative web, this approach simultaneously advances linguistic competence and cultivates a sense of ecological responsibility. Such pedagogical strategies resonate with the emerging paradigm of education for sustainability, which emphasizes holistic, systems-based thinking across disciplinary boundaries (STERLING, 2010). In practice, language educators can foster sustainable learning communities through collaborative, project-based activities that engage with pressing ecological and cultural issues. For example, student-led discourse analyses and environmental debates can reveal how linguistic framing shapes public understanding and responses to sustainability challenges (ALEXANDER, 2008).

Through these forms of active engagement, learners come to understand language not merely as a cognitive instrument but as an ecological tool which enables meaningful participation within broader communicative networks. Sustainable learning communities, therefore, embody principles of cooperation, reciprocity, and empathy, reflecting the interdependent dynamics characteristic of natural ecosystems while simultaneously enhancing effective human communication (CAPRA & LUISI, 2014). By linking language education to ecological consciousness, such pedagogical models cultivate both critical awareness and ethical engagement, positioning students as responsible agents within the interconnected social and environmental landscapes they inhabit. Within such communities, socio-linguistic interaction functions as a feedback system that maintains equilibrium and fosters collective growth. By emphasizing dialogic pedagogy, language educators can nurture environments where learners co-construct meaning through active participation and mind-changing attitudes (TILEA, RESCEANU, & RESCEANU, 2021).

Our study also emphasizes the significant role of eco-linguistics and biosemiotics as integrative theoretical frameworks that inform and enrich our educational practice. These approaches offer robust conceptual foundations for examining the relationship between human language and broader communicative processes within the natural world. Eco-linguistics, in particular, investigates how linguistic structures both reflect and shape ecological relationships, advocating for language practices that promote life-sustaining values and environmental

responsibility (STIBBE, 2021). Complementarily, biosemiotics extends the concept of communication beyond the human domain, conceptualizing semiosis, *i.e.* the production, exchange, and interpretation of signs, as a fundamental characteristic of all living systems (BARBIERI, 2009).

From this vantage point, cultural and natural systems are understood to share a common semiotic basis, functioning as interconnected networks of meaning-making that sustain relational coherence and systemic balance. This perspective challenges the traditional dichotomy between culture and nature, encouraging educators to cultivate what Kull (2018) calls "semiotic empathy", a heightened awareness of and sensitivity to the processes of meaning-making across species and ecological systems. Within language education, fostering such awareness enables learners to engage with both human and nonhuman forms of communication with respect, curiosity, and critical reflection, thereby integrating linguistic competence with ecological and ethical consciousness.

Extending the integration of eco-linguistic and biosemiotic perspectives, it becomes evident that language functions not only as a medium of communication but also as a participatory mechanism in shaping human perception of ecological realities. The classroom, in this sense, can be conceived as a semiotic ecosystem, where learners and educators co-construct meaning through dynamic exchanges with texts, peers, and the surrounding natural and cultural environment (STEFFENSEN & HARVEY, 2018; STIBBE, 2021). By framing linguistic interactions within ecological metaphors, such as feedback loops, networks, or symbiotic relationships, students are encouraged to perceive language as inherently relational, adaptive, and embedded within wider life systems.

Recent scholarship has increasingly emphasized the significance of distributed cognition in understanding language and meaning-making (COWLEY, 2011; STEFFENSEN, 2009). Distributed cognition posits that cognitive processes and communicative activity are not confined to individual minds but are inherently extended across social and ecological contexts, building on interactions within coordinated systems. In this framework, meaning emerges through dynamic engagement between communicators and their environment, rather than being located exclusively within internal cognitive structures. Van Lier's (2004:91-92) conceptualization of affordances as "action in potential" similarly foregrounds the interactive dimension of cognition, highlighting how opportunities for action and meaning arise through the interplay between agents and the environment. By emphasizing relational and contextual factors, this perspective situates the construction of meaning within ecologically extended and socially coordinated practices.

Furthermore, Steffensen (2009:677) extends this argument by proposing that language derives its cognitive power from the ways in which socially and ecologically shaped niches are structured. He characterizes language metaphorically as "airborne synapses" within distributed cognitive systems, providing an extended ecology in which human cognizers participate in languaging. Through this lens, language is not merely a system of arbitrary symbols but functions as a medium through which individuals and communities coordinate, negotiate, and co-construct meaning across complex interactive networks. Cowley (2011:8) complements this perspective, arguing that reframing ecological culture depends on a shared history of engagement with both the world and each other. Here, meaning is produced not solely in response to environmental stimuli, but through the collective processes of using and sharing language. This orientation challenges conventional notions of language as a static set of units or codes, replacing them with ecologically grounded, socially coordinated practices of semiotic activity. Cowley's (2011) "language stance" thus conceptualizes semiosis as inherently

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relational, dialogical, and co-constructed, emphasizing the importance of collective engagement and cultural coordination in establishing what is considered meaningful (COWLEY, 2011:16).

From this perspective, language is understood as an organic and adaptive phenomenon that emerges through coordinated interactions rather than through fixed coding or decoding mechanisms (KRAVCHENKO, 2007; LOVE, 2004: 524). Cowley (2008:5) describes language as a medium for "doing things together," situating communication within consensual, contextually embedded practices rather than top-down cognitive control (Cowley, 2008:2). Steffensen (2009:677) reinforces this view, arguing that human cognizers operate within an "extended ecology" provided by language, which functions as both a cognitive and social environment facilitating interaction, collaboration, and learning. In this extended ecological framework, communication is simultaneously a tool for cognition and a mechanism for sustaining and coordinating social and cultural life.

Ecological approaches further emphasize the embodied and embedded nature of cognition and meaning-making. Cowley (2011:9) describes how language draws upon "organic memory" and becomes embedded in cultural practices that function as repositories of accumulated meaning. From the standpoint of biologically extended cognition (Steffensen, 2009), semiosis predates the emergence of brains, arising in primitive life forms such as bacteria and other simple organisms engaged in symbiotic interactions. These early forms of coordination illustrate that meaning is fundamentally relational and arises from interaction with the environment and other organisms.

Consequently, language comprises multi-perceptual layers and develops through the acquisition of coordination skills within these relational networks (COWLEY, 2011:9-11). As social interaction reaches higher levels of complexity, consensual cultures emerge that assign value to communicative products and collaboratively constructed meanings, further embedding language in the ongoing co-construction of cultural and environmental realities.

Extending the integration of eco-linguistic and biosemiotic perspectives, it becomes evident that language functions not only as a medium of communication but also as a participatory mechanism in shaping human perception of ecological realities. The classroom, in this sense, can be conceived as a semiotic ecosystem, where learners and educators co-construct meaning through dynamic exchanges with texts, peers, and the surrounding natural and cultural environment (STEFFENSEN & HARVEY, 2018; STIBBE, 2021). By framing linguistic interactions within ecological metaphors, students are encouraged to perceive language as inherently relational, adaptive, and embedded within wider life systems.

From a pedagogical standpoint, incorporating ecological reasoning into language instruction encourages reflexivity and ethical awareness. Learners come to recognize that communication is not value-neutral; it actively constructs social and environmental realities (ALEXANDER, 2008). For instance, analyzing how environmental issues are linguistically framed in media texts enables students to identify implicit assumptions, biases, and the ethical consequences of discourse choices. Such critical engagement fosters a capacity for "semiotic empathy," in which learners appreciate the interdependence of human and nonhuman actors within communicative and ecological networks (KULL, 2018). By cultivating this sensitivity, educators can help students develop both critical literacy and ecological citizenship, integrating moral reasoning into their linguistic and cognitive practices.

Moreover, eco-linguistic and biosemiotic approaches encourage an expanded understanding of languaging processes and cognition. Distributed and extended cognition frameworks suggest that meaning-making emerges from interactions among individuals,

artifacts, and environmental affordances, rather than residing solely within the mind of a learner (COWLEY, 2011). In language classrooms, this implies that collaborative activities, such as group discourse analysis or participatory problem-solving projects, serve as microcosms of ecological systems, wherein knowledge, values, and communicative competence co-evolve.

Integrating these approaches has implications for rethinking educational outcomes. Beyond traditional measures of linguistic proficiency, the focus shifts toward developing learners who are capable of ethical, ecologically-informed decision-making and adaptive reasoning. Students trained in this way are positioned to navigate complex socio-ecological challenges, as they learn to perceive the interdependencies between communication, culture, and the environment. In this sense, the classroom functions as both a cognitive laboratory and a moral ecology, fostering agents who can actively participate in shaping sustainable futures through informed, reflective, and contextually grounded linguistic practice.

CONCLUSIONS

The paper has exemplified the hypothesis we formulated that the humanities, in our case language education for specific purposes, hold transformative potential. By engaging eco-linguistic and biosemiotic frameworks, educators can help students in both the humanities and life sciences recognize the deep continuity between communicative, cultural, and ecological systems. Through fostering intercultural dialogue, relational awareness, and sustainable linguistic practices, we nurture the fullest human potential: to live responsibly within the semiotic web of life.

These combined perspectives would lead toward developing an integrated vision of humanity and nature, where we acknowledge our interdependence with other life forms. Thus, reintegrating the humanities with the natural sciences is essential for addressing the ecological and social crises of the Anthropocene. Language education, informed by eco-linguistics and biosemiotics, can function as a bridge discipline that teaches relational thinking and ecological literacy alongside communicative competence. As Bateson (2000) emphasized, learning to perceive "the pattern that connects" is the key to both mental and ecological health.

Ultimately, fostering students' capacity for integrative thinking across cultural, linguistic, and biological dimensions prepares them to participate in sustainable communities that reflect the interconnectedness of life. The humanities, far from being ancillary to the sciences, are central to cultivating this holistic sensibility. Language education thus becomes an act of ecological participation: teaching not only how to speak, but how to live meaningfully within the living world.

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