

# CONVERGENCES AND DIFFERENCES BETWEEN COMPLEX THINKING AND THE ECOLOGY OF KNOWLEDGE

---

## Convergencias y diferencias entre el pensamiento complejo y la ecología de saberes

RODRIGO SEVERO ARCE ROJAS\*

National University of Engineering, Lima, Peru

[rarce@uni.edu.pe](mailto:rarce@uni.edu.pe)

Orcid code: <https://orcid.org/0000-0003-0007-7174>

---

### Abstract

This review article analyses the convergences and differences between complex thought and knowledge ecology with the aim of exploring possibilities of complementation and synergies within the framework of a critical epistemology. For this purpose, a bibliographical review has been carried out, supported by deductive and hermeneutic methods. For the characterization of complex thought, the work of Edgar Morin and other authors has been reviewed. For the characterization of complex thought, the work of Boaventura de Sousa de Santos has been reviewed. From the review we conclude that both complex thought and knowledge ecology have many similarities since they share to a greater or lesser extent the principles of organized systems, dialogicity, recursion and retroactivity. In addition they are explicit in overcoming the subject-object distinction to move to a subject-matter relationship. Both proposals constitute alternatives to hegemonic scientific thought and place value on cognitive pluralism and cognitive justice. The main difference is that knowledge ecology has a more explicit commitment to the knowledge of social movements in their resistance struggles against the various forms of colonialism in force, which have a correlation with an economic system that privileges the market to life. In this sense, it is possible to recognize in the ecology of knowledge a more political character. Both proposals, although with different degrees, stand as alternatives that transform social reality.

---

### Keywords

Education, knowledge, science, sociology, thinking

**Suggested citation:** Arce, Rodrigo (2020). Convergences and differences between complex thinking and the ecology of knowledge. *Sophia, colección de Filosofía de la Educación*, 29, pp. 69-90.

---

\* Doctor in Complex Thinking. Magister Scientiae in Forest Resources Conservation and Forest Engineer. University lecturer at the National University of Engineering and the Ricardo Palma University. His research work is related to the interactions between society, nature and culture, forest philosophy and complex thinking. Specialist in dialogue, participation and participatory methodologies, prior consultation, governance, conflicts and capacity building.

### Resumen

El presente artículo de revisión analiza las convergencias y diferencias entre el pensamiento complejo y la ecología de saberes con el propósito de explorar posibilidades de complementación y sinergias en el marco de una epistemología crítica. Para tal efecto se ha realizado una revisión bibliográfica apoyada por los métodos deductivo y hermenéutico. Para la caracterización del pensamiento complejo se ha revisado la obra de Edgar Morin y otros autores. Para la caracterización del pensamiento complejo se ha revisado la obra de Boaventura de Sousa de Santos. De la revisión se concluye que tanto el pensamiento complejo como la ecología de saberes tienen similitudes pues comparten en mayor o menor medida los principios de sistemas organizados, dialogicidad, recursividad y retroactividad. Además, son explícitos en superar la distinción sujeto-objeto para pasar a una relación sujeto-sujeto. Ambas propuestas constituyen alternativas al pensamiento científico hegemónico y ponen el valor el pluralismo cognitivo y la justicia cognitiva. La principal diferencia es que la ecología de saberes tiene una apuesta más explícita por los conocimientos de los movimientos sociales en sus luchas de resistencia frente a las diversas formas del colonialismo vigente, que tienen correlato con un sistema económico que privilegia el mercado a la vida. En tal sentido es posible reconocer en la ecología de saberes un carácter más político. Ambas propuestas, aunque con diferencia de grados, se erigen como alternativas transformadoras de la realidad social.

### Palabras clave

Ciencia, conocimiento, educación, pensamiento, sociología.

70



## Introduction

This review article analyzes the convergences and differences between complex thinking and the ecology of knowledge.

The coronavirus pandemic and the resulting social confinement have made it possible to reflect on the hegemonic pattern of development that has demonstrated its limits and its social and environmental reach. The health crisis has, in turn, allowed us to visualize the social, political, and environmental crisis, and an economic recession is looming. Now, this reflection has two orientations, one that proposes how to return to the normal way of life that existed before the pandemic and another that proposes that this is an opportunity to rethink the civilizational model. Faced with the global crisis processes that affect western civilization, proposals that seek to transform relationships between human beings and between human beings and nature and the cosmos are significant. Promoting new ways of thinking, feeling, speaking and acting is fundamental for a civilizing change under the principles of sustainability, justice, equity, and peace. In this sense, both the complex thinking and the ecology of knowledge are promising epistemologies and therefore a better understanding of both proposals is required that translate into sustainable processes of transformation.

The hegemonic thinking of science characterized by being disjunctive, reductive, rationalist, objectivist, universalist, determinist, le-

galistic and linear has proven to be very effective, and will be so in the future; However, its limitations in dealing with the complexity of reality have been shown. There are many critical thinking proposals, including southern thinking, decolonial thinking, complex thinking, relational ontologies, among others. Specifically, the article makes a comparative analysis between complex thinking, whose most outstanding exponent is Edgar Morin and the ecology of knowledge, whose most relevant representative is Boaventura de Sousa Santos. Both perspectives are sources of critical and transformative thinking, even if they have different origins. However, the extent to which the two proposals correspond or differ is not sufficiently known. This analysis is relevant for establishing possible dialogical and recursive processes of feedback and mutual enrichment.

The aim is to demonstrate that both complex thinking and the ecology of knowledge share central premises and consequently both aspects would be valid sources in the formulation of alternative development proposals. The aim of this article is to find similarities and differences between complex thinking and the ecology of knowledge in order to explore possibilities of complementarity and synergies within the framework of a critical epistemology.

This topic is relevant today, because humanity needs to pay more attention to the alternatives to development, while it has become clear that the hegemonic development model, dominated by neoliberal capitalism, has not provided genuine sustainability responses and serious social deficiencies remain and has led to the alteration, degradation and pollution of natural ecosystems and urban ecosystems. The recovery of marine and terrestrial ecosystems and the quality of the air resulting from mandatory isolation have drawn attention and caused society to think about how it has related to nature and the impacts it has caused.

In order to make the comparison between complex thinking and the ecology of knowledge, a bibliographic review has been carried out, supported by deductive and hermeneutic methods. Edgar Morin and other authors have been reviewed for the characterization of complex thought. Boaventura de Sousa Santos has been reviewed for the characterization of complex thought.

The present work is structured in three sections; the first section presents the reference framework in which the scope of complexity, complex thinking and the ecology of knowledge are described; the second section presents the comparative study; the third section comprises discussions and conclusions.



## Reference framework

To understand complex thinking it is necessary to understand what complexity entails. For Maldonado (2009) “there are basically three great understandings about the complexity of the world and nature: complexity as a method, as a worldview and as a science and among these three understandings there are several communicating vessels of different order and range” (p. 3). For his part, Osorio (2013) finds the following meanings of complexity: daily or psychological, classical science, phenomenal context of reality and metaphor.

According to Maldonado (2012) complexity is based on three distinguishing features: i) the importance of time and the arrow of time; ii) non-determinism; and iii) that changes and processes characterized by complexity concern sudden, unforeseen and irreversible movements (p. 17). Maldonado et al. (2013) point out that, in general terms, complexity refers to that class of phenomena, systems or behaviors that have no solution or possess more than one (non-linearity) (p. 15). In this sense, Carrasco and Vivanco (2011) mention that “in complexity the answer is not necessarily sought but all possible answers are. This is contrary to the deterministic system characterized by only one possible result corresponding to an event (p. 172).

Maldonado (2005, 2015) points out that complexity works with crisis phenomena, systems, times and behaviors, depending on whether: a) the crisis is already present and imminent, b) the crisis has not yet arrived but could happen and c) crises that never take place. A useful tool for the study of complexity relates to the approach of complex adaptive systems.

There is no single way to understand complexity. What can be identified are the main features of complexity and its properties. From Morin (1998), Segura (2009), and Maldonado (2001, 2003, 2005, 2011, 2013, 2014, 2014a, 2014b) it appears that the complexity also refers to the understanding of border concepts and problems, phenomena, systems and behaviors that are essentially unpredictable, changing, uncontrollable, non-parametrizable, irreversible, sudden, surprising, dramatic, systems of increasing complexity, and which are not explained in terms of causality. It can, therefore, be said that complexity is the science of rare, sudden or unforeseen events and behaviors, unique or singular situations, exceptional and extraordinary phenomena, attention to local cases, divergent phenomena, extreme events, borderline situations, critical points and states, and crisis.

Complexity alludes to multiple elements, self-organization, interactions and interdependencies, interlinkages, emergencies, entanglement, recursivity, feedback loops, feedback, networks, synergies, disorder,

chaos, ambiguity, uncertainty, random events, instabilities, bifurcations, fluctuations, turbulences, instabilities, symmetry ruptures, catastrophes, evolution, imprecisions, voids, attractors, non-linearity, no causality, no specialization, dissipative structures, algorithmic complexity, dynamic equilibriums, working primarily with nonclassical logics, in short, all those phenomena that are on the edge of chaos in the reality of the world.

Pastor y León (2007), Ricigliano y Chigas (2011) affirm that non-linearity refers to the fact that there is not necessarily proportionality between cause and effects and that small disturbances can produce big changes. This is where it is understood that non-linearity is associated with the theory of chaos.

Luengo (2016) refers to the notion of complexity, in a first approximation:

Refers to a set (system, totality, unit, etc.) composed of multiple elements (components, agents) heterogeneous (diverse) articulated (connected, interrelated, interdependent, interdefinable) among themselves in an organic (or systemic) non-linear manner, which exhibit collective behaviors and are in constant process of dynamic transformation as they vary over time (p. 3).



Moreno (2002a, 2002b) affirms that complexity is a mode of thought that links order, the universal and the regular, as well as disorder, the particular and transformations. Arnold and Osorio (1998) mention that complexity is linked to the number of elements in a system (quantitative complexity) and, on the other hand, its potential interactions (connectivity) and the number of possible states that occur through them (variety, variability) (p. 43).

Maldonado (2014a) mentions that, from a perspective of complexity, the study of the dynamics and structures of a system cannot be reduced to explanations or steps of cyclical, periodic, regular or predictable type. It is then understood the emergence of phenomena that do not necessarily have logical or rational explanations or have their own logic and rationalities (p. 73).

It is also mentioned that these systems appear between the boundaries of the disciplines which is an invitation for interdisciplinary, transdisciplinary and even undisciplined approaches. Rodríguez y Aguirre (2011) points out that complexity can be understood, therefore, “as an emerging scientific paradigm involving a new way of making and understanding science, extending the limits and criteria of scientificity, beyond the boundaries of modern science” (p. 2).

The complex thought derives from Morin's extensive work (1981, 1983, 1994a, 1998, 1999, 2000, 2001, 2002a, 2002b, 2003a, 2003b, 2004a, 2004b, 2008) expanded and enriched by various authors such as Barberousse (2008), González (2010), Rodríguez (2011a, 2011b), Luengo (2012, 2016), among others.

Complex thought is recognized as philosophy, strategy, method, attitude, and practice that differs from a simplifying form of thought, that is, a form of thought that is not disjunctive, not reductionist, not deterministic, not linear, not predictable, not reversible nor predictable. As such, it does not remain in the rationalist, objectivist, universalist, legalistic and controlling perspective of positivism. On the contrary, it is a type of thought with the capacity for conjunction, integration, synthesis and dialogue with the environment and coexistence with uncertainty. Thus, it can be said that complex thought is highly resilient. Moreover, unlike simplistic thinking, it does not seek unique answers but multiple possibilities.

The complex thought in his expanded perspective of reality is more likely to think what has not been thought before or would be thought, to look at what has not to be seen, is to hear what has not been heard, to feel what has not been felt before. According to this reality, complex thought escapes institutionalized, standardized, normalized truths because its field of action is beyond the obvious.

Complex thought is not intended superior or inferior, rather it promotes epistemological pluralism as it considers that all sources of knowledge are worthy of consideration and can enter into a deliberative dialogue that will make it possible to find, in a concerted or negotiated manner, an agreement that represents better alternatives with deep respect for life. It recognizes the value of a reductive approach to knowledge that has enabled humanity to achieve great techno-scientific achievements for the benefit of humanity. However, knowledge derived from the Cartesian approach has also demonstrated its limitations in the face of complex realities. The intention is therefore to enter into a synergistic dialogue that allows for respectful complementarity.

Complex thinking considers the multiple dimensions, planes, spatial and temporal scales and hierarchies; therefore, it recognizes and values the diversity of the elements, these being diverse expressions of matter/mass, energy, information and meaning. As can be seen from Tobón and Núñez (2006), complex thinking is multidimensional, multi-scaled and multi-temporal.

Likewise, complex thinking knows how to recognize the various interactions between systems, both directly related (such as the indivi-



dual-society-human species relationship) and concurrent systems (such as when social, economic, cultural, psychological, environmental and other such dimensions). In the interaction of the various elements, tangible and intangible, it is verified the capacity of self-organization and of emergence that are new properties or behaviors that are not found in their constituents in an isolated manner. It further considers that systems have dynamics that are far from balanced and that there is not necessarily proportionality between causes and effects, reflecting the high sensitivity to initial conditions.

Complex thinking opens up multiple possibilities of thinking such as systemic, critical, linear, lateral, arborescent, evolutionary, among other ways of thinking. This means that it does not remain with a conventional form of logical or casuistic thought, but has sufficient permeability to apply various methodological forms of thought. Therefore, complex thinking is not reduced to traditional logic, nor to traditional mathematics, but accepts uncertainties, discontinuities and blurred boundaries. This is a revolutionary way of thinking because it moves away from positions that seek objectivity, linearity and reject or evade uncertainties and indeterminations. This way of thinking recognizes that reality is more complex than man had imagined and had accustomed to, as a product of a strong tradition of Cartesian thought and positivist science. However, this opening is far from a reductionist holism in which “everything goes” but has the capacity to recognize the strategic, those phenomena and elements that have the capacity to be catalysts of change.

Complex thinking is condensed into the principles of organization, recursivity, retroactivity, dialogicity and hologram.

The ecology of knowledge is part of the proposal of the epistemologies of the south. The proposal of southern epistemologies is a response to Eurocentric and colonialist epistemology that claims that scientific knowledge is the only valid source of knowledge and therefore dismisses other forms of knowledge. This generates an abysmal line that generates exclusions, distances and asymmetries marked by power relations. There are epistemologies of the south because there are epistemologies of the north. In this case, it is not a geographic south but an epistemological south.

Cartesian science is characterized by being rationalist, ignoring the role of emotions; it adopts an objectivist position that generates a subject-object relationship; it assumes a universalist and monocultural perspective that pretends to be unique and valid. In the face of the arrogant position of positivist science, the epistemologies of the south value the knowledge that comes from the daily life of peoples and social move-

ments in their struggles to achieve equity, a better relationship between human beings and between human beings and nature. The epistemologies of the south are a recognition of diversity and the affirmation of life in all its manifestations. In this sense, the epistemologies of the south seek to decolonize thought.

To question the hegemony of scientific knowledge is not to deny it or to reject it because its contributions are recognized. What is proposed is the valuation of other legitimate sources of knowledge that are the product of other expanded ways of understanding knowledge that are not limited exclusively to reason and that gives rise to the emotional and spirituality of peoples. This does not mean that the southern epistemologies assume irrational positions. The idea is a symmetrical relationship between knowledge and an invitation to collaboration and co-creation. The aim is, thus, to strengthen democracy and equity.

The characterization of the ecology of knowledge corresponds to the Portuguese sociologist Boaventura de Sousa Santos (1998, 2009a, 2009b, 2009c, 2010, 2014, 2018, 2020) who is the promoter of the concept. It is within this framework of the epistemologies of the south that the ecology of knowledge can be understood, which alludes to the recognition of the various sources of knowledge and the dialogue between different forms of knowledge. From the exclusivity of reason, emotionality is incorporated, from universalism, the value of local knowledge is recognized, from the subject-object relationship to the subject-subject relationship. According to de Sousa (2009b) ecology presents the following elements: 1) inexhaustible epistemological diversity of the world, 2) radical and egalitarian co-existence, 3) contextual definition of ignorance, 4) counterhegemonic use of modern science, 5) intercultural translation, 6, knowledge-as-intervention, and 7) contextual hierarchy of knowledge.

The ecology of knowledge, and therefore the epistemologies of the south, are part of decolonial thinking. Mignolo (2007) and Fonseca and Jerrems (2012) point out that decolonial thinking is a proposal that arises from the questioning of the values of European modernity and therefore of unique thought. In this sense it seeks to decolonize thought and overcome the effects on the colonial subject.

Likewise, the ecology of knowledge corresponds to relational ontologies. Escobar (2014) notes that “relational ontologies transcend an anthropocentric vision and recognize that human and non-human (organic, non-organic, and supernatural or spiritual) are integral parts of these worlds in their multiple interrelations as sentient beings (p. 129).



## Results

Now, we continue with the comparative analysis between complex thinking and the ecology of knowledge.

Complex thinking is recognized by different authors as philosophy, strategy, method, attitude and practice. Luengo (2016) recognizes the most epistemological vein of complex thinking as it makes the basic criteria that enable the generation of complex knowledge and its cognitive operations (p.4). De Sousa (2010) considers that the ecology of knowledge is a post-abysmal epistemology (that is, it seeks global cognitive justice) or a counter-epistemology. Both epistemological proposals recognize the need for cognitive pluralism.

Morin (1998) states that the reductive vision of science produces limitations as the partiality of hyperspecialized knowledge loses its connection with the whole. Methodologically, the Cartesian science is powerful for the knowledge of the details, but it loses effectiveness in its integration. Hence, the limits of scientific rationality become apparent. De Sousa (2014) mentions that “The ecology of knowledge implies a radical break with modern Western ways of thinking and acting” (p. 40). Both complex thinking and the ecology of knowledge are recognized as self-reflective.

Soto (1999) mentions that in complex thought the cognitive subject is incorporated into the reality to be studied, thus surpassing the vision of Cartesian science that separates the object from the subject. De Sousa (2018) mentions that, in the ecology of knowledge, “the definition of objects of knowledge is not distinguished from a relationship with subjects constituted as objects of it” (p. 241). Likewise, the search for intersubjectivity is as important as it is complex. Complex thought is not an exclusively rational subject, but recognizes the whole being. For his part, de Sousa (2010) states that the ecology of knowledge refers not only to logos but also to mythos.

While complex thinking is part of the paradigm of complexity versus the paradigm of Cartesian simplification, Sousa (2009a) points out that the ecology of knowledge is an alternative to both “the crisis of the dominant paradigm” as to the postmodern response to such a crisis (p. 31). De Sousa (2009b) considers that the rational model of Western modernity is indolent, since with its arrogance it proclaims itself as the only valid form of rationality. Both proposals therefore critically share the limitations of Cartesian science and invite wider recognition of other forms of knowledge. Consequently, it can be pointed out that both proposals coincide in constituting alternatives to single and universal thought.

Morin (2007) considers that one of the principles of complex thinking is systemic or organizational one, thus recognizing internal interactions and interactions with the environment. In this way it is possible to recognize nested and hierarchical systems of mutual inter-fluence, which link the part with the whole, and the whole with the part. This makes it possible to recognize the importance of contextualization. Chacón (2015) realizes that through the principle of autonomy/dependence (eco-organization) the systemic approach to complex thinking is reflected.

While complex thinking is recognized as systemic and totalizing (recognizing the incompleteness of knowledge), the ecology of knowledge is not explicitly recognized as systemic, however it presents some elements of the general theory of systems. As stated by Sousa (2010, 2018) the fact that the ecology of knowledge recognizes that all knowledge has internal and external limits, is similar to the concept inscribed in complex thinking that every system is within another system and that these systems are in dialogicity. In this direction, Sousa (2009b) recognizes a contextual hierarchy of knowledge according to the degree of openness to the participation of social groups. It also recognizes that, despite the vocation of completeness of the various forms of knowledge, they are incomplete and, in this sense, coincide with the complex thinking that highlights the incompleteness of knowledge.

Morin (2000) affirms that in complex thinking, the multiple and heterogeneous elements, tangible and intangible, are recognized and valued, and therefore diversity is valued. Morin (1999) in linking the whole with the parts and vice versa recognizes the importance of focusing on both the element and the whole, thus broadening the spectrum of attention. Chacón (2015) alludes to the fact that the view of relations and interactions of complex thought are expressed through the principles of retroactive loop, recursive loop and dialogicity. In this sense, the approach of paradoxes and antinomies in complex thought is recognized. One element that is common to both complex thinking and the ecology of knowledge is the recognition of the interactions and interdependencies inherent in a web of interlinked relationships.

De Sousa (2010, 2018) mentions that the ecology of knowledge promotes the interdependence between scientific knowledge produced by western modernity and different non-scientific knowledge. It also recognizes that these interconnections between heterogeneous knowledge are continuous and dynamic without compromising their autonomy. As knowledge interacts and intersects, so does ignorance, consequently, for the ecology of knowledge, all knowledge is interconnection. Niño (2017)



mentions that an ecology of knowledge is based “on the recognition of the plurality of knowledge and heterogeneous values, their interconnections, their discontinuity-continuity, heterogeneity and autonomy” (p. 179). This is where the matrix of complexity of the two proposals can be recognized, as it refers to the recognition of the various elements that are interrelated and interdependent. With this outlook, the approach of Cartesian science that privilege the fragmentation of reality to know it are broken.

Morin (2000) mentions that complex thinking incorporates the principles of dialogue and recursiveness. De Sousa (2018) points out that the ecology of knowledge “promotes an authentic dialogical articulation between knowledge considered western, scientific and modern, and knowledge considered traditional, native and local, without discrediting scientific knowledge” (p. 253). Likewise, de Sousa (1998, 2009b, 2010, 2018) indicates that the ecology of knowledge seeks to generate a new type of relationship between the different types of knowledge, also, ensuring equal opportunities for all types of knowledge without meaning that all are accepted and incorporated in an uncritical and thoughtless manner, since prudence is recognized, and intercultural translation weights in the contributions of knowledge. It is recognized that not all knowledge has the same validity, but everyone has the possibility to enter into a reflective dialogue and, as a result of the dialogue, complementarities or contradictions can be recognized. In this sense, the ecology of knowledge is governed by the principles of human dignity and the possibility of democratic discussion. The final decision on the best knowledge for a situation corresponds to the precautionary principle. Consequently, for the ecology of knowledge, non-scientific knowledge is an alternative to scientific knowledge. De Sousa (2010) states that “Incommensurability does not necessarily prevent communication and even unsuspected forms of complementarity may appear” (p. 57).

On the other hand, complex thought, in the Morinian version does not explicitly speak of the diversity of existing types of thought, it can be deduced that, not remaining exclusively in rational knowledge, and giving rise to other sources of knowledge such as imagination, intuitions, emotions, spirituality, art, among others, the plurality of knowledge is being recognized. For its part, De Sousa (2010, 2018) indicates that the ecology of knowledge is based on the plurality of heterogeneous knowledge, and identifies and values other types of knowledge and criteria of rigor and validity. From this perspective, the ecology of knowledge incorporates pluralistic epistemologies, upholds cognitive justice and seeks to give epistemological consistency to plural and propositional thinking and ac-

tion. According to de Sousa (2009b), the cognitive justice to which the ecology of knowledge alludes to is a caring and respectful relationship that considers the other as an equal. What the author calls the ecology of recognition. Thus, Binimelis and Roldán (2017) affirm that popular knowledge, indigenous knowledge, urban popular knowledge and peasant knowledge, among others, have a place (p. 227).

Complex thinking generates new ways of thinking, feeling and expressing oneself. Vargas (2011) affirms that complex thinking when proposing a human ethics and an ethics with the land-homeland constitutes a proposal that harmonizes with life. Morin (1994b) points out that the complex vision of the human being, society and knowledge, is the ideological substratum of a critical pedagogy that is articulated in a project of a transformative and revolutionary nature. Complex thinking seeks to understand, explain and transform reality. De Sousa (2010) affirms that the ecology of knowledge promotes innovative and disruptive forms of knowledge as it assumes a political ethical position so they are on “this side of the line” (mentioning the invisible or those who have not had a voice) as opposed to those “on the other side of the line” (referring to those who stand beside the power of modern science) (p. 52). The concept of the abysmal line alluded to by de Sousa puts the issue of power and exclusions of all kinds into the discussion. It is, therefore, not just a question of the cognitive, but of the different relationships that have arisen between human beings and between human beings and nature.

De Sousa (2010) points out that the ecology of knowledge makes a distinction between analytical objectivity and political ethical neutrality, in this direction it is recognized as a destabilizing epistemology because it commits itself to a radical critique of policies. De Sousa (2009b) explicitly claims the character of knowledge as an intervention for transformation as opposed to knowledge as an interpretation attributable to scientific knowledge. For his part, Rincon (2016) emphasizes that “The ecology of knowledge is not only an epistemic alternative, but an ethical one, in the face of the challenges of man, nature and the planet as a whole” (p. 49).

As can be inferred from Pereira (2010), complex thinking recognizes the arrow of time in which the past, the present and the future come together and interrelate, therefore history and the context are extremely important for the understanding of the reality in question. De Sousa (2010) points out that the ecology of knowledge recognizes the situated, partial and constructed character of all knowledge. In addition, “it recognizes the radical co-presence involved in conceiving both simultaneity and contemporaneity” and consider knowledge as trans-scalar (p. 49).



De Sousa (2009b) through the ecology of temporalities recognizes the various ways of conceiving time, and through the ecology of trans-scales recognizes local and global interactions. It can therefore be said that both proposals coincide in the importance of the local, but with the capacity for dialogue with the global.

## Discussions

Technoscience based on the reductionist approach has had great achievements that translate into the great technological advances achieved by humanity. The reductive approach has been important and will be important in the future. It has, however, shown its limitations in dealing with humanity's complex problems. Quantum theory has exposed that the truths that claimed to be universal are not quite so. On the other hand, the development of computational science has allowed a significant improvement in the capacity to process information that would previously have been inconceivable. The sciences of complexity show that there are other realities beyond standardized, normalized, institutionalized truths. Although science already knew about the uncertainties and ambiguities, what it did was to evade them, to deny them in order not to disturb scientific objectivity.

Although the limitations of the Cartesian approach to science had already been noted, it has maintained and invigorated its hegemonic character. Hence it still maintains its primacy as the main source of valid knowledge. The strength of scientific knowledge is not based solely on the ability to explain the phenomena of the world, but is interwoven with political and economic relations. Thus science, consciously or unconsciously, becomes functional to the structures of power. Hence the strong criticism of a science without conscience that pretends to be neutral and apolitical. As a result of its attitude, science has separated itself from society, its struggles, its dreams, its emotions and hopes. Although the colonized peoples achieved their political independence, another form of colonization remains in force and could be called epistemic colonialism. Thus, a science of control and regulation is legitimized to favor the discipline of the population according to the prevailing development model. The symbolic value of scientific knowledge is so strong that sectors of the population attribute their situation of poverty or extreme poverty due to the "limitations" of their daily life knowledge.

It is in this context that we understand the emergence of various epistemological proposals critical of universalist and rationalist scien-



tific thought, to value other forms of generation and socialization of knowledge. Among these proposals, it has been pointed out, are decolonial thought, southern thought, relational ontologies, among others that have emerged under the cover of the epistemological, socio-critical trend. This set of technical and political proposals have similarities and differences, but they share a critical view of the rationalist, universalist, legalistic positions of Cartesian and positivist science.

Complex thinking, on the other hand, has also been influenced by a variety of proposals that have called into question the fundamentalism of reason as the sole source of knowledge. It is also possible to affirm that complex thought receives the influence of postmodern thought. As Arce (2018) points out, the complex thinking inscribed in the complexity paradigm represents a response to the simplistic thinking paradigm of Cartesian and positivist science.

From the comparison between complex thinking and the ecology of knowledge there is a similarity because in both proposals there is talk of a systemic and ecological thinking that means interrelation. When we talk about systems, it refers to the fact that they are not knowledge isolated from the environment because, as Barberousse (2008) states, it is “a co-organizing relationship with their environment” (p. 104). The main difference lies in the fact that, although the ecology of knowledge has elements of the complex systems proper to complex thought, it does not explicitly assume it. The ecology of knowledge does not come from the development of the sciences of complexity and complex thought, therefore, each aspect has its own construction process in such a way that, unintentionally, they establish bridges, parallels and distances but which strongly share the critique of the simplifying thought of hegemonic science.

While the ecology of knowledge is of particular concern to those on the other side of the line, understood as such to the invisible, to those without a voice, to those displaced by the power of knowledge, complex thinking has a special concern for everything that has not been seen, thought or felt; here lies we find another of the great coincidences. However, as the ecology of knowledge does not interact with complexity, beyond recognizing uncertainty, it does not explicitly recognize breakdowns, fractures, bursts, sudden changes, discontinuities, blurs, mists, randomness and chance, among other attributes of complex reality.

The ecology of knowledge does not explicitly use the relinking character of complex thought, but in practice it assumes it as an attribute by pointing out that all knowledge has the same opportunity to enter into dialogue. Although complex thinking speaks of dialogicity, the ecology of



knowledge is explicit in mentioning that it is not a “participatory” dialogue in which arithmetic solutions must be achieved, but rather to generate thoughtful and prudent processes of dialogue based on the principles of human dignity and the possibility of democratic discussion. It may be important to incorporate the principle of sustainability. This contribution is important for complex thinking to integrate reason, emotions, imagination, intuition, poetry without the whole appearing as an amorphous and inconsistent mass of meanings. Although complex thinking indicates that it is strategic, in the sense of knowing how to ponder the best paths, a better explanation such as ecology of knowledge could give it greater strength.

Complex thinking is not a subject that is reduced to the synaptic processes of the brain, but it is recognized that the process of knowledge involves the whole being and is linked to the environment and action. That is why the ecology of action is spoken of. The ecology of knowledge not only alludes to logos but also to myths, therefore it is giving rise to the recognition of emotionality, spirituality, narrative, discourse and history. In this sense, both proposals go beyond an exclusively rationalist vision.

Although both proposals are recognized as ethical-political in nature, there remains the feeling of a greater political weight of the ecology of knowledge as Sousa (2010) explicitly speaks of decolonizing knowledge, reinventing power. According to García’s interpretation (2014), the epistemology of the south, and therefore the ecology of knowledge, has great potential to generate an alternative epistemology that contributes to democratization and social transformation.

Questioning the primacy of scientific knowledge does not imply denying or underestimating it, but rather resigning it to a more respectful relationship with other sources of knowledge. The fact that it expands the sources of knowledge does not imply giving rise to irrationality or to reverse arrogance. Epistemological, cognitive and linguistic injustices need to be overcome by life-affirming relationships in all their manifestations.

Applying the very attributes of complex thinking and the ecology of knowledge requires practitioners of both perspectives to enter into a complementary and synergistic dialogue so that they can take advantage of what they consider important for strengthening their own proposals. As a result of this process of mutual enrichment, alternative proposals to the hegemonic exercise of science will be created by the thoughtful and weighted incorporation of other knowledge and emotions.

The analysis of both epistemological perspectives recovers the value of complexity as a novel paradigm. Complexity breaks the charm of a disciplined society determined by the prevailing rationality of institu-



tions, policies, laws and social conventions. It also highlights the limitations of predictability and reaffirms the permanence of change.

As can be seen from its very name, the sciences of complexity have a more scientific orientation and complex thought a more philosophical approach, but they are complementary as is science, itself, with philosophy. Both perspectives embrace the general theory of systems, but in the case of complexity sciences, in addition to systemic considerations, they explicitly include crises, uncertainties. This is why the approach of complex adaptive systems offers a good theoretical framework for understanding the epistemology of complex thinking and of the ecology of knowledge.

This is how it has been possible to visualize that an epistemological system is composed of numerous and heterogeneous elements, tangible and intangible, visible and not visible, that are highly interrelated, interdependent and inter-definable. This nonlinear dynamic of interactions is what allows the processes of feedback and recursiveness. This also makes it possible to recognize the processes of dialogue and negotiation between the elements, thus verifying processes of complementarity, collaboration and synergies. The relevance of intercultural dialogues and intercultural translation is therefore understood.

The theoretical framework of complexity with its facets of the sciences of complexity and complex thought converges in the approach of complex adaptive systems and it is noted that the approach of systemic organization, with its interactions and emergencies, allows a better understanding of the nature and behavior of knowledge systems. If the perspective of crisis and indeterminations is added to this, then epistemology is better understood as a complex system in which agents, sudden or unexpected behaviors, converge in a multidimensional, multi-scale and multi-temporal perspective.

One aspect of complexity refers to the fact of phenomena at the edge of chaos or away from balance that alludes to an entropic description of systems. Moreover, the fact that there is a high sensitivity to initial conditions calls into question the fact that it is no longer possible to maintain epistemological, cognitive and linguistic injustices because it legitimizes exclusion, inequality and poverty. In this sense it is possible to recognize in complex thinking and the ecology of knowledge a commitment to justice, equity, peace, democracy and an affirmation of life in general, starting with humans, but respectfully including nature. It is the same orientation that relational ontologies have.

Both the sciences of complexity and complex thought, although they have shown great advances in terms of institutions, authors, publi-



cations, congresses, among other expressions, still constitute marginal proposals to the predominant thought. For their part, the epistemologies of the South, with their approach to the ecology of knowledge, face the barriers of hegemonic science that is more in tune with the capitalist and neoliberal economic system.

Critical proposals to the hegemony of scientific thought have a background in Participatory Action Research (Fals Borda & Rodríguez, 1987) and Participatory Technological Development (Gonsalves et al. 2006). There are also current trends in open science and citizen science that consider the importance of citizen participation in scientific research processes (Anglada & Abadal, 2018). It is also important to note that innovation techniques such as Design Thinking also use approaches that focus on the creative development of multiple options and possibilities. Thus, they are not limited to rational aspects, rather, they incorporate aspects that come from the emotions, intuition, imagination without shackles. They, therefore, value the diversity of equipment, experiences, stories and perspectives. Likewise, they are more tolerant to ambiguity, uncertainties and volatility of situations. It is recognized that the perspectives of complex thinking and the ecology of knowledge find fertile ground in them. In this same direction, Maldonado (2019) affirms that science is situated on the same plane as the arts and, therefore, it is necessary that sensibility can sprout and manifest itself freely, even letting out the passions and the dreams. In this way, science becomes an act of subversion and rebellion. Therefore, the role of complexity is to discipline, indeterminate, and unbalance established truths.

The confinement by the pandemic has made it possible to highlight the limits of the hegemonic development model by revealing social precariousness and making visible the impacts that were being caused to the planet. But it has also revealed the limits of Cartesian thought and generated the need to improve human relations, to extend the collaborative spirit, to value the “simple” things of life. It is in this context that one can visualize the epistemological potential of complex thinking and the ecology of knowledge to generate alternatives to development that allow a humanitarian reunion with ourselves and with nature, which has been neglected. The processes of reflection on the way in which the normality of life had been constructed have led to the recognition that beyond the rationality of accumulation, materialism and consumerism, there are other values that give meaning to life.



## Conclusions

The review concludes that both complex thinking and the ecology of knowledge have similarities because they share, to a greater or lesser extent, the principles of organized systems, dialogicity, recursivity and retroactivity. Moreover, they are explicit in overcoming the subject-object distinction in order to move on to a subject-subject relationship. Both proposals are alternatives to hegemonic scientific thinking and value cognitive pluralism and cognitive justice. The main difference is that the ecology of knowledge has a more explicit bet on the knowledge of social movements in their struggles of resistance against the various forms of current colonialism, which correlate with an economic system that favors the markets over life. In this sense it is possible to recognize in the ecology of knowledge a more political character. Both proposals, although with different degrees, stand as transforming alternatives to social reality.

86



## Bibliography

- ANGLADA, Lluís & ABADAL, Ernest  
 2018. ¿Qué es la ciencia abierta? *Anuario ThinkEPI*, 12, 292-298.
- ARCE ROJAS, Rodrigo Severo  
 2016 *Aportes del pensamiento complejo a la facilitación de grupos*. París: Congreso Mundial por el Pensamiento Complejo Los desafíos en un mundo globalizado.  
 2018 Respuestas del pensamiento complejo al pensamiento simplificante. *Horizontes y Raíces*, 6(1), 32-41.
- ARNOLD, Marcelo & OSORIO, Francisco  
 1998 Introducción a los conceptos básicos de la Teoría General de Sistemas. *Cinta de Moebio*, 3, 40-49.
- BARBEROUSSE, Paulette  
 2008 Fundamentos teóricos del pensamiento complejo de Edgar Morin. *Revista Electrónica Educare*, XII(2), 95-113.
- BINIMELIS Helder & ROLDÁN TONIONI, Andrés  
 2017 Sociedad, epistemología y metodología en Boaventura de Sousa Santos. *Convergencia Revista de Ciencias Sociales*, 75, 215-235.
- CARRASCO, Ignacio & VIVANCO, Manuel  
 2011 ¿Sistemas dinámicos en ciencias sociales? *Revista de Sociología*, 26, 169-191.
- CHACÓN PRADO, Mónica de Jesús  
 2015 Congruencia del pensamiento complejo de Edgar Morín en la metodología de la educación a distancia. *Revista Espiga [en línea]*, 30, 75-81
- DE SOUSA SANTOS, Boaventura  
 1998 *De la mano de Alicia: Lo social y lo político en la postmodernidad*. Colombia: Siglo del Hombre Editores, Ediciones Uniandes.

- 2009a Un discurso sobre las ciencias. En *Una epistemología del sur: la reinención del conocimiento y la emancipación social*. México: Siglo XXI.
- 2009b *Una epistemología del Sur. La reinención del conocimiento y la emancipación social*. Buenos Aires: Siglo XXI Editores, CLACSO.
- 2009c *Una epistemología desde el Sur*. México: CLACSO y Siglo XXI.
- 2010 *Descolonizar el saber. Reinventar el poder*. Montevideo: Ediciones Trilce.
- 2014 Más allá del pensamiento abismal: de las líneas globales a una ecología de los saberes. En *Epistemologías del Sur (Perspectivas)*. Madrid: Akal.
- 2018 *Construyendo las epistemologías del Sur: para un pensamiento alternativo de alternativas*. 1a ed. Ciudad Autónoma de Buenos Aires: CLACSO.
- 2020 *La cruel pedagogía del virus*. Ciudad Autónoma de Buenos Aires: CLACSO.
- ESCOBAR, Arturo
- 2014 *Sentipensar con la tierra. Nuevas lecturas sobre desarrollo, territorio y diferencia*. Medellín: Ediciones UNAUULA.
- FALS BORDA, Orlando & RODRÍGUEZ, Brandao
- 1987 *Investigación Participativa*. Montevideo: La Banda Oriental.
- FONSECA, Melody & JERREMS, Ari
- 2012 Pensamiento decolonial: ¿una “nueva” apuesta en las Relaciones Internacionales? *Relaciones Internacionales*, 19, 103-121
- GONSALVES, Julian, BECKER, Thomas, BRAUN, Ann, FAJBER, Elizabeth & VERNOOY, Ronnie (Eds.)
- 2006 *Investigación y desarrollo participativo para la agricultura y el manejo sostenible de recursos naturales: Libro de Consulta*. Volumen 1: Comprendiendo. Investigación y Desarrollo Participativo. Perspectivas de los Usuarios con la Investigación y el Desarrollo Agrícola. Ottawa: Centro Internacional de la Papa, Laguna, Filipinas y Centro Internacional de Investigaciones para el Desarrollo.
- MIGNOLO, Walter
- 2007 El pensamiento decolonial: desprendimiento y apertura. Un manifiesto. En *El giro decolonial: reflexiones para una diversidad epistémica más allá del capitalismo global*. Bogotá: Siglo del Hombre Editores, Universidad Central, Instituto de Estudios Sociales Contemporáneos y Pontificia Universidad Javeriana, Instituto Pensar.
- NIÑO ARTEAGA Yesid
- 2017 Ecología de saberes y pedagogía: una crítica sociocultural frente a la crisis capitalista en Latinoamérica. *Rhec*, 20(20), 145-161.
- GARCÍA CHUECA, Eva
- 2014 Aprender del Sur. El pensamiento de Boaventura de Sousa Santos en la transición paradigmática. *Alice Working Paper*, 1, 25 p.
- GONZÁLES GARCÍA, Victoria
- 2010 Interpretando el pensamiento complejo: un acercamiento a Lev S. Vygotsky. *Revista Posgrado y Sociedad Sistema de Estudios de Posgrado*, 10(1), 38-63.
- LUENGO GONZÁLES, Enrique
- 2012 Mapa conceptual y vocabulario básico en torno a la interdisciplina y la complejidad. En *Interdisciplina y transdisciplina: aportes desde la investigación y la intervención social universitaria*. México: CIFS-ITESO.
- 2016 *Las vertientes de la complejidad. Diferencias y convergencias. Pensamiento sistémico, ciencias de la complejidad, pensamiento complejo, paradigma ecoló-*



*gico y enfoques holistas*. Paris: Congreso Mundial por el Pensamiento Complejo. Los desafíos en un mundo globalizado.

- MALDONADO CASTAÑEDA, Carlos Eduardo
- 2009 La complejidad es un problema, no una cosmovisión. *UCM Revista de Investigación*, 13, 42-54.
  - 2012 Complejidad de las ciencias sociales. Las contribuciones de la antropología. *Jangwa Pana*, 11, 10-26.
  - 2013 *Significado e impacto social de las ciencias de la complejidad*. Bogotá: Desde Abajo.
  - 2014a ¿Qué es un sistema complejo? *Rev. Colomb. Filos. Cienc.*, 14(29), 71-93.
  - 2014b Reflexión sobre las implicancias políticas de la complejidad. *ALPHA*, 38, 197-214.
  - 2015 Pensar la complejidad, pensar como síntesis. *Cinta de moebio*, 54, 313-324.
  - 2019 La educación: un caso conspicuo de rebelión en la ciencia. *Praxis Pedagógica*, 19(24), 1-8.
- MALDONADO CASTAÑEDA, Carlos Eduardo & GÓMEZ CRUZ, Nelson Alfonso
- 2011 *El mundo de las ciencias de la complejidad Una investigación sobre qué son, su desarrollo y sus posibilidades*. Bogotá: Universidad del Rosario.
- MALDONADO CASTAÑEDA, Carlos Eduardo, OSORIO GARCÍA, Néstor & DELGADO, Jesús
- 2013 *Ciencias de la complejidad desarrollo tecnológico y bioética ¿Para qué sirve la bioética global?* Bogotá: Universidad Militar Nueva Granada.
- MORENO, Juan Carlos
- 2002a Fuentes, autores y corrientes que trabajan la complejidad. En *Manual de iniciación pedagógica al pensamiento complejo*. Bogotá: Instituto Colombiano de Fomento de la Educación Superior, UNESCO, Corporación para el Desarrollo Complexus.
  - 2002b Complejización de la epistemología y epistemología compleja. En *Manual de iniciación pedagógica al pensamiento complejo*. Bogotá: Instituto Colombiano de Fomento de la Educación Superior, UNESCO, Corporación para el Desarrollo Complexus.
- MORIN, Edgar
- 1981 *El método I. La naturaleza de la naturaleza*. Madrid: Cátedra.
  - 1983 *El método II: La vida de la vida*. Madrid: Cátedra.
  - 1994a Epistemología de la complejidad. En *Introducción al pensamiento complejo*. Barcelona: Editorial Gedisa.
  - 1994b *El empeño multidimensional*. México: Anthropos Editorial.
  - 1998 *Introducción al pensamiento complejo*. Barcelona: Editorial Gedisa.
  - 1999 *Los 7 saberes necesarios para la educación del futuro*. Paris: Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura.
  - 2000 *¿Qué es el pensamiento complejo?* Bogotá: Ponencia inaugural en el I Congreso Internacional de Pensamiento complejo.
  - 2001 El espíritu del valle En *El método 1. La naturaleza de la naturaleza*. Madrid: Cátedra.
  - 2002a Los principios generativos y estratégicos del método En *Educación en la era planetaria. El pensamiento complejo como método de aprendizaje en el error y en la incertidumbre humana*. México: Universidad de Valladolid, UNESCO.
  - 2002b *El método, la vida de la vida*. Madrid: Cátedra.



- 2003a *El Método V: La humanidad de la humanidad. La identidad humana*. Madrid: Ediciones Cátedra.
- 2003b *El método 1. La naturaleza de la naturaleza*. Madrid: Editorial Cátedra
- 2004a *El Método, Tomo 6. La Ética*. Paris: Seuil, col. Points.
- 2004b *Unir los conocimientos*. La Paz: Plural.
- 2007 *La cabeza bien puesta. Repensar la reforma. Reformar el pensamiento*. Buenos Aires: Nueva Visión.
- 2008 *El año I de la era ecológica*. Barcelona: Paidós.
- OSORIO GARCÍA, Sergio Néstor
- 2013 Bioética global y pensamiento complejo: dos apuestas para enfrentar los desafíos humanos en la era planetaria. En *Ciencias de la complejidad desarrollo tecnológico y bioética ¿Para qué sirve la bioética global?* Bogotá: Universidad Militar Nueva Granada.
- PASTOR, Juan & LEÓN GARCÍA IZQUIERDO, Antonio
- 2007 Complejidad y Psicología Social de las Organizaciones. *Psicothema*, 007,19(2), 212-217.
- PEREIRA CHÁVEZ, José Miguel
- 2010 Consideraciones básicas del pensamiento complejo de Edgar Morin, en la educación. *Revista Electrónica Educare*, XIV(1), 67-75.
- RICIGLIANO, Robert & CHIGAS, Diana
- 2011 *Systems thinking in conflict assessment concepts and application*. Washington: United States Agency for International Development or the United States Government.
- RINCÓN, Robert
- 2016 La epistemología según Boaventura De Sousa Santos: ¿un modo de descubrir o de crear fuera del dominio colonial? *Revista Estudios Culturales*, 9(17), 49-68.
- RODRÍGUEZ ZOYA, Leonardo & AGUIRRE, Julio Leonidas
- 2011 Teorías de la complejidad y ciencias sociales. Nuevas estrategias epistemológicas y metodológicas. *Nómadas. Revista Crítica de Ciencias Sociales y Jurídicas*, 30, 147-166.
- RODRÍGUEZ ZOYA, Leonardo
- 2011a *Exploraciones de la complejidad: aproximación introductoria al pensamiento complejo y a la teoría de los sistemas complejos*. Buenos Aires: Centro Iberoamericano de Estudios en Comunicación, Información y Desarrollo-CIECID.
- 2011b Introducción crítica a los enfoques de la complejidad: tensiones epistemológicas e implicancias políticas para el Sur. En *Exploraciones de la complejidad: aproximación introductoria al pensamiento complejo y a la teoría de los sistemas complejos*. Buenos Aires: Centro Iberoamericano de Estudios en Comunicación, Información y Desarrollo-CIECID.
- SOTO GONZÁLES, Mario
- 1999 *Edgar Morin. Complejidad y sujeto humano*. Tesis doctoral. Valladolid: Universidad de Valladolid.
- TOBÓN, Sergio, NÚÑEZ ROJAS, Ariel César
- 2006 La gestión del conocimiento desde el pensamiento complejo: un compromiso ético con el desarrollo humano. *Revista Escuela de Administración de Negocios* [en línea], 58, 27-39.

VARGAS BARRANTES, Élida

- 2011 Educación en valores y educación para la paz desde la visión de un enfoque complejo y sistémico. *InterSedes: Revista de las Sedes Regionales* [en línea], XII(24), 146-162.

Document reception date: December 11, 2018

Document review date: February 12, 2019

Document approval date: May 25, 2019

Document publication date: July 15, 2020

