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## **Rhizomes, nomads, and complexity: A new relational pedagogy for the era of networks, social media and artificial intelligence**

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### **Abstract**

Today, we live in an era characterized by unprecedented technological development and the rise of artificial intelligence mediated technosocial spaces. In this context, it becomes more and more evident we need a different conception of learning that shifts the focus from the consumption of disembodied knowledge to the catalyzation of personal and collective development through the formation of meaningful and transformative synergies. Knowledge exists only in a web of relationships and education's primary goal should be to facilitate the development of learning communities where students can engage in meaningful relational activities with their peers and with the world outside. Rhizomatic learning networks are self-organized collectives able to demonstrate emergent properties like novelty and innovation. In this article, we try to envisage a new nomadic pedagogy for the 21<sup>st</sup> century that facilitates the development of learning rhizomes, negentropic islands in an entropic environment, self-organized and evolving learning organizations. We suggest there is something in learning that you can realize, understand, and take advantage of, only if you look at it as the developmental process of a living rhizome.

**Keywords:** rhizome, rhizomatic, learning, pedagogy, autopoiesis, technology, artificial intelligence, networked learning, relational learning, education

## Introduction

Nowadays information is abundant, everything is searchable on the web, and learning resources can be easily located and retrieved. On the other hand, knowledge results from the active process of filtering, comparing, integrating, interrelating available resources, while developing new connections of meaning. Today, it becomes more and more evident we need a new conception of learning that shifts the focus from the consumption, or production, of disembodied knowledge to the catalyzation of personal and collective development through the formation of meaningful and transformative synergies. Participatory learning communities catalyze that kind of transformative learning. Rhizomatic learning networks, which is the focus of this article, are self-organized collectives able to demonstrate emergent properties like novelty and innovation. The Rhizomatic conception of learning was popularized as such through the work of Deleuze and Guattari (1987) *A Thousand Plateaus: Capitalism and Schizophrenia*. Inspired by the developmental process of a botanical rhizome (Figure 1), in the first chapter of their book, Deleuze and Guattari develop the notion of the philosophical Rhizome as an acentric multiplicity, a dynamic network of entities that is always expanding, always developing, and always in the becoming: "the rhizome pertains to a map that must be produced, constructed, a map that is always detachable, connectable, reversible, modifiable, and has multiple entryways and exits and its own lines of flight" (p. 21). The specific socio-cultural context in which the rhizome idea emerged is what Manuel Castells (1996) calls the *Network Society*, the chronotope of an ever-interconnected global village, an era of exponential growth for digital networks: "while the networking form of social organization has existed in other times and spaces, the new information technology paradigm provides the material basis for its pervasive expansion throughout the entire social structure." (p. 500)

Rhizomatic learning as a theory (re)locates learning in the web of relationships between a person and the world around them. By shifting the focus from the parts to their interrelation and interdependence, rhizomatic learning can be defined as the process of catalyzing the development of a dynamic network of knowledgeable agents, human or even artificial or technobiological actors in the present day, along with their learning resources (Figure 2). In the words of Deleuze and Guattari (1987), A rhizome "has no beginning or end; it is always in the middle, between things, interbeing, intermezzo ... Proceeding from the middle, through the middle, coming and going rather than starting

and finishing” (p. 25) In such a view, learning can be understood as a non-linear dynamic process, as the creative capacity of a learning rhizome to build upon existing resources and further develop, creating new connections, acquiring new nodes, and expanding even further in different directions (Brailas, 2020c). As Lu & Chang point out, knowledge is a dynamic network of interconnections without beginning nor an end, and without a predefined pattern, “Just like a botanical rhizome such as ginger or crabgrass extends its horizontal stems and shoots from nodes” (pp. 12–13) Learning rhizomes are dynamic networks of transformative possibilities, patterns that always moving, always rearranging, ever expanding, always in the becoming. Nevertheless, they maintain every moment an autopoietic structure.



Figure 1. *“Pando (Latin for ‘I spread out’) is a clonal colony of an individual male quaking aspen determined to be a single living organism by identical genetic markers and assumed to have one massive underground root system. The plant is located in the Fremont River Ranger District of the Fishlake National Forest at the western edge of the Colorado Plateau in south-central Utah, United States. Pando occupies 43 hectares. The root system of Pando, at an estimated 80,000 years old, is among the oldest known living organisms.”* Source: Pando (Tree) article, Wikipedia, CC-BY-SA-3.0. In a botanical rhizome there is no starting or ending point, only an under the surface horizontal development of the interconnected root system toward all possible directions. In the case of Pando, the appearing individual aspen trees above the surface are just manifestations of the same underground rhizome.

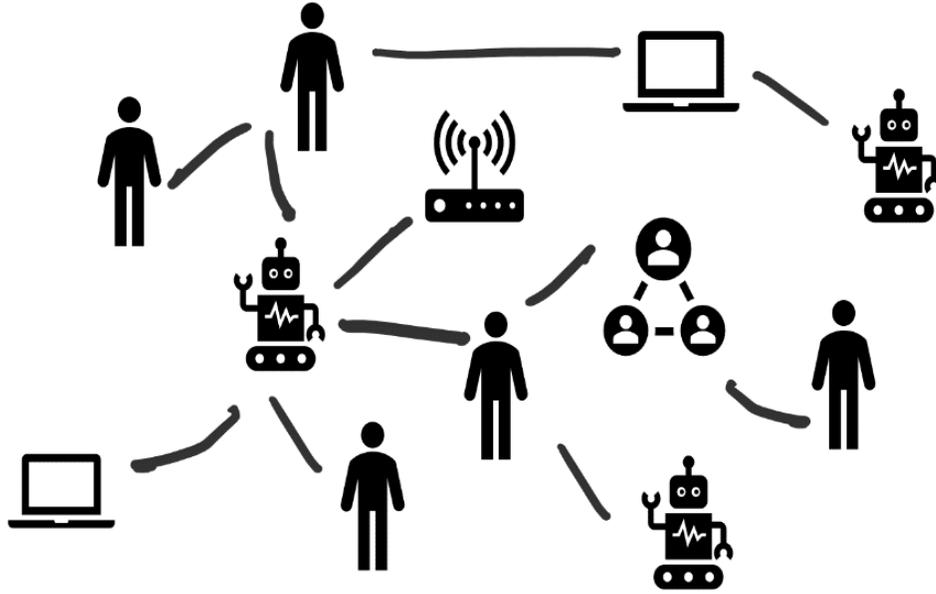


Figure 2. *A networked conception of learning. We could imagine a complex learning rhizome as a performative confluence of human and non-human actors that engages people, resources, processes, and contextual parameters in a transformative dance. In this view, the focus shifts from the parts to the pattern which connects the parts; an autopoietic pattern that is always in the becoming.*

Castells (1996) describes vividly this dynamic, always in the becoming, nature of the networking organizational form: "Networks are open structures, able to expand without limits, integrating new nodes as long as they are able to communicate within the network, namely as long as they share the same communication codes" (p. 501). Fritjof Capra points out that the network pattern is the very defining pattern of life, the way life developed and conquered the whole planet from its beginning. But this refers to a conception of network as a dynamic process not as a static structure, or a representational instance like in a printed map. According to Capra, the network pattern "is one of the very basic patterns of organization in all living systems. At all levels of life – from the metabolic networks of cells to the food webs of ecosystems – the components and processes of living systems are interlinked in network fashion." (Capra & Luisi, 2014, p. 306) Nevertheless, it is the information and communication technologies as manifested through the rise of the Internet and the cyberspace that made the existence of this pattern more evident than ever before. Social media intensified social interactions making more visible the emerging social networking patterns (Gkini & Brailas, 2015; Koletsi et al., 2021).

Google n-gram viewer is a tool that allow users to search for the appearances of any n-words sequences in the corpus of all digitized published books from 1800s and onwards. As we can observe by searching for the term *rhizomatic* it appears only sporadically during the 20<sup>th</sup> century, while is increasingly used after 1980, a year that coincides with the publication of the seminal postmodernist work by Deleuze and Guattari *A Thousand Plateaus: Capitalism and Schizophrenia*. We observe that the use of the term *rhizomatic* develops in parallel with the use of the term *Internet* in the published corpus digitized by Google (Figure 3). Maybe Google itself can be understood as a developing learning rhizome trying to achieve an Omega point, the ultimate noosphere in the words of Teilhard de Chardin (Zwart, 2022).

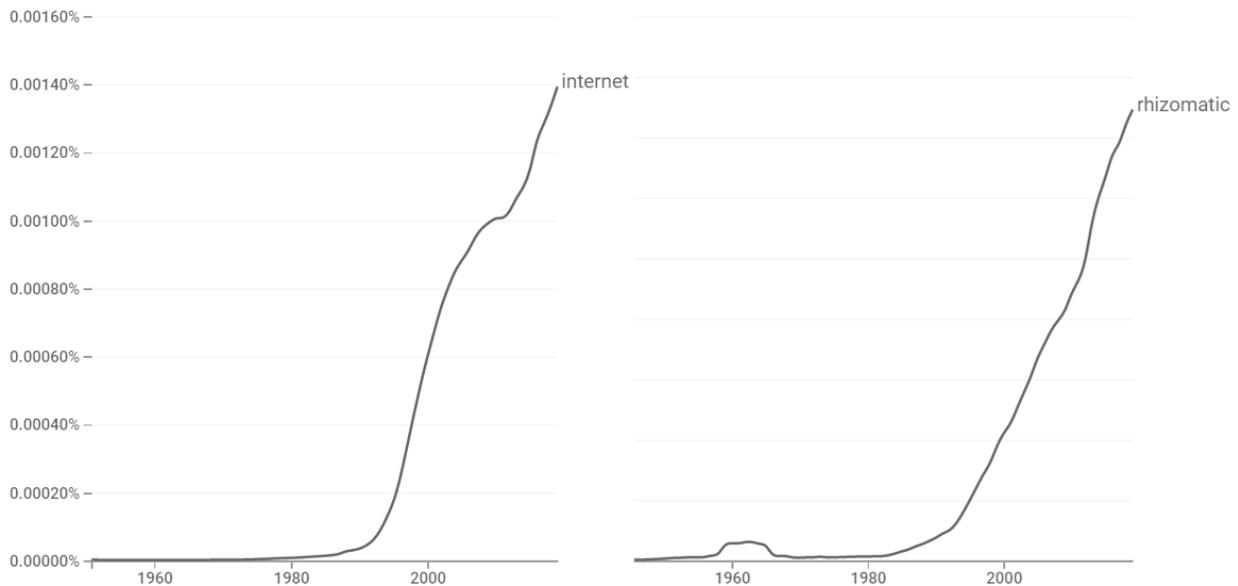


Figure 3. Graph produced by Google N-grams viewer. The Internet development as the manifestation of a rhizomatic network pattern.

In a networking conception of learning, learners can be understood as autonomous, while interdependent, nomads creating and traversing their personal learning networks in their own ways in the context of a community of co-learners and in the context of a chaotic external environment of available learning resources and potential pathways. The role of the educator in a rhizomatic ecology of learning is to perturbate rather, instead of directing, participants in order to create alternative connections, new (sub)networks of thinking, and new patterns of relating with each other, and with other available human or non-human nodes, and learning resources in an empowering confluence, a co-evolutionary dance (Brailas, 2020c). Nevertheless, it is not the educator that “teaches” the

students. The rhizome as a whole becomes an autopoietic learning process, the teaching apparatus, a multiplier of perspectives, and an amplifier of synergies: "the rhizome creates the background, the contextual validity, and the situated meaning for individual actions. By developing learning rhizomes, self-organizing confluences of human and non-human in the becoming, we participate in anotropic performative dances which help us unfold our full living potential." (Brailas, 2020, p. 313). *Confluence* is a term often used by Gergen (2009) to vividly render the dynamic nature of an *assemblage* in the theoretical framework of Deleuze and Guattari which can refer to "machines or particular arrangements within a context for which pieces of heterogeneous human, material, and nontangible elements, conditions, or forces interact to coproduce something in the process of becoming." (Lu & Chang, 2022, p. 13)

### **Rhizomatic Learning as a process of autopoiesis**

In the networked socio-technological context of the second half of the 20<sup>th</sup> century, it was inevitable for scholars to be inspired by the network and rhizome metaphor and try to apply it in the educational field. In *Deschooling Society*, Ivan Illich (1970) used the term *learning webs* to describe a non-hierarchical and bureaucratic educational system, a horizontal web-like alternative that provides "all who want to learn with access to available resources at any time in their lives; empower all who want to share what they know to find those who want to learn it from them" (p. 75). As regarding the specific use of the term *rhizome/rhizomatic*, in a Google Scholar search, we can trace one of the first explicit uses of the composite term *rhizomatic learning* back in 2003, in the PhD thesis by Harald Kraus including a section entitled "Rhizomatic Learning: an Introduction?" Kraus calls for a practical application of the rhizome conception, in a pedagogy that acknowledges "a need for conditions in which 'lines of flight' are not prevented or cut short, but instead are encouraged: the more resources and experiences that are made available, the more chance the learner has of developing a deeper, one might say three-dimensional web of socio-cultural associations." (pp. 222–223). In 2004, in the book chapter *Technology-enhanced language learning environments: A rhizomatic approach*, Andrew Lian describes a learning system for language learning based on postmodern thinking where the process of learning is identified as a process of meaning making by the individual participants. The power of such an approach to learning "lies not only in each of its parts but particularly in the high level of connectivity between its parts: essentially a rhizomatic approach." (p. 1) In the modern unpredictable world, "to learn implies an act of comprehension which challenges the learner's personal representational and logical systems ... it is an act of violence (in the sense of violating the regularities inferred by the

individual on the basis of the past)." (Lian, 2004, p. 3) Lian also highlights the previous work done by Petar Guberina, conceptualizing deafness not so much as a physical deficit of the individuals but as having a different pattern for organizing the world in comparison to the neurotypical ones. Again, there is here a shift on the focus from the qualities of the parts to *the pattern which connects* in the words of Gregory Bateson (1979). In regard to this view, a characteristic example of Batesonian thought is his counting of a hand's finger: He did not focus on the number of fingers (five units) but on the number of relationships between the thumb and each other finger, a kind of operational definition. Therefore, it is more practical to say that an individual has four pairs of fingers in each hand (Bateson, 1972).

Lind (2005) highlights the importance of a rhizomatic view on children's learning focusing on the interplay between visual, verbal, and linguistic patterns: "Elements or signs that connect in an unpredictable manner characterise a rhizomatic process. This process is not ruled by a plan for definite goals" (p. 257). Irwin et al (2006), demonstrate how *rhizomatic relationalities* drive knowledge development: "theory is no longer an abstract concept but rather an embodied living inquiry, an interstitial relational space for creating, teaching, learning, and researching in a constant state of becoming ... this means theorizing through inquiry, a process that involves an evolution of questions." (p. 71) Sharma (2006) argues that "to propose a 'rhizomatic pedagogy' is, in many respects, oxymoronic. The institutional hegemonies and cultural authorities operating in the university space make such an endeavour a precarious activity." (p. 214) In the same direction, Livingston (2000) develops a rhizomatic conception of the curriculum as a medium that encourages learners to produce multiple performances, so as to "affect central power mechanisms, proliferate infinite political thoughts, and shatter the concepts of classes, sexes, gender, and race ... to show how everything is indeed ambiguous and what has been created by people can also be uncreated by people." (p. x).

Cormier (2008), in his work *Rhizomatic education: Community as curriculum*, proposes a rhizomatic model of learning where curriculum "is not driven by predefined inputs from experts; it is constructed and negotiated in real time by the contributions of those engaged in the learning process. This community acts as the curriculum, spontaneously shaping, constructing, and reconstructing itself and the subject of its learning" (p. 3). A rhizomatic learning experience can be realized as a process of constant adaptation, development and growth, despite the inevitable obstacles: "The rhizomatic flow develops in an unpredictable way and progressively takes shape while continuously avoiding the obstacles it meets. Robustness epitomizes the rhizome" (Bissola et al., 2017, p. 2). Brailas et al (2017), define rhizomatic pedagogy as an approach where "the learning of the

participants depends not so much on their individual action, as on being the coevolving parts of a self-organized whole." (p. 1) Bateson (1979) long before highlighted the importance of the interrelating pattern: "Break the pattern which connects the items of learning and you necessarily destroy all quality" (p. 8).

Autopoiesis, a concept initially developed by Varela & Maturana to describe biological systems and further developed by Luhman for social systems, provides a critical ground for understanding rhizomatic learning dynamics. Living systems are autopoietic, in the sense that "continually create, or recreate, themselves by transforming or replacing their components. They undergo continual structural changes while preserving their web-like patterns of organization." (Capra & Luisi, 2014, p. 316) Therefore, a learning rhizome, being as a whole a living dynamical system, would be able to produce or acquire the components it needs to sustain its development. Living systems need to be open to their environment to maintain their function. But at the same time, in order to maintain their boundaries, their own existence and organizational autonomy, this openness is not unconditional. Therefore, a learning rhizome should be *operationally closed* in the sense that "its self-production (autopoiesis) is a function of production rules and processes by which order and identity are maintained and which cannot be modified directly from outside." (Meyers, 2009, p. 7) A direct pedagogical consequence of the autopoietic nature of learning systems is that a teacher cannot actually "teach" anything to anyone; teachers can only *perturbate* the learning rhizomes of their students so as to catalyze and facilitate their development.

Capra & Luisi (2014) vividly describe this process of perturbation in autopoiesis:

Living systems, then, respond to disturbances from the environment autonomously with structural changes – that is, by rearranging their patterns of connectivity. According to Maturana and Varela, we can never direct a living system; we can only disturb it. More than that, the living system not only specifies its structural changes; it also specifies which disturbances from the environment trigger them. In other words, a living system has the autonomy to decide what to notice and what will disturb it. ... As a living organism goes through its individual pathway of structural changes, each of these changes corresponds to a cognitive act, which means that learning and development are merely two sides of the same coin. (p. 256)

In this direction, rhizomatic learning networks can be understood as *enabling constraints* in the sense that Davis et al (2015) define the term: "The phrase might at first sound like

an oxymoron, but it actually refers to a necessary condition for complex emergence. Complex unities are simultaneously rule-bound (constrained) and capable of flexible, unanticipated possibilities (enabled). That is, enabling constraints define a system's affordances." (p. 219)

### **Artificial intelligence, singularity, and a meta-learning ecology: The learning rhizome as an anotropic dissipative structure**

What is the relation between rhizomatic learning, artificial intelligence, and the modern networked techno-social spaces? Humans always developed technology to survive, adapt, and evolve in the natural world (Koletsis, 2022; Koskinas, 2018), this is not something new. Nevertheless, today there is a fundamental shift in the technological development. Artificial intelligence brings a brand-new feature: the ability to evolve and transform itself. According to many scholars and philosophers, we are approaching a critical threshold, the so-called *technological singularity* point. *Singularity* is a term used in Physics for describing black holes in space. Close enough to a black hole there is a point where gravity becomes infinite so as even the light itself cannot escape the gravitational force. Technological singularity usually refers to the scenario in which technological advances would ultimately lead to the rise of an infinite artificial intelligence through a chain-reaction of self-improvement cycles, a positive feedback loop that reinforces its output (Eden et al., 2012). Verner Vinge (1993) argues that "The acceleration of technological progress has been the central feature of this century. We are on the edge of change comparable to the rise of human life on Earth." Technological singularity right now is a thought experiment, a logical argument, a scenario that seems plausible:

An artificial intelligence that surpasses human intelligence will trigger the process of technological singularity. If human intelligence is capable of creating an artificial intelligence that surpasses its creators, then this intelligence would, in turn, be able to create an even superior next-generation intelligence. An inevitable positive feedback loop would lead to an exponential intelligence growth rate. (Brailas, 2019, p. 72)

Back in 2003, an era characterized by the rise of social media, Ilya Prigogine argued that "The Internet gives us a lot of information and it leads probably to a new form of society but we don't know what kind of society it will be." (p. 72) According to Prigogine, we were

facing a critical tipping point. Modern humans have already acquired cybernetic cognitive extensions in the form of “always carrying with me” smartphones (Brailas & Tsekeris, 2014; Vakali & Brailas, 2018). If we combine the cybernetic-enhanced biological self with the networked society and the development of ubiquitous artificial intelligent actors, would it be possible for this unprecedented combination to trigger the emergence of a complex techno-social distributed intelligence? Can we think of the techno-social rhizome as a new kind of brain? After all, human brain is itself a vast network of interconnected neurons that is always in the becoming (neuronal plasticity), a kind of a neuronal rhizome, an acentric multiplicity where the sense of consciousness as an emergent property.

In the middle of the 20<sup>th</sup> century, Pierre Teilhard de Chardin (a paleontologist, theologian, philosopher, and catholic priest) placed a strong emphasis on the co-evolution and the transformative interrelation between the biosphere and the human culture. He introduced the concept of the *Omega point*, an ultimate state of biocultural development for the whole universe, a state of maximum evolutionary complexity and consciousness (Teilhard de Chardin, 1947). In a symbolic interpretation of the term used, Omega is the last letter in the Greek alphabet and also appears in a phrase at the book of revelation to describe the God: “I am the Alpha and the Omega”. So, the concept of Omega point bears a profound teleological weight. Teilhard is credited of having anticipated the development of the internet, the network society, the Anthropocene and the Gaia theory (Brailas, 2019; Zwart, 2022). Teilhard's put an emphasis on the combination of the technological and biocultural evolution. He identified computers and networks as the two key ingredients for developing a kind of a rhizomatic network that finally took the form of the Internet (Vidal, 2021). Teilhard further developed Vladimir Vernadsky's concept of the *noosphere*, and connect it with his teleological concept of the omega point. Teilhard viewed the ultimate rise of the noosphere as a kind of a superorganism, the inevitable result of the accelerating human techno-cultural development (Vidal, 2021). Teilhard's noosphere can be understood today as the ultimate phase of development of the global techno-bio-cultural rhizome, a superorganism in the sense of being an evolving networked whole with emergent properties.

Isn't bizarre how in just two decades we gained a new extension to ourselves, an object with which we have more skin-to-skin contact than anything or anyone else in our lives? And what will happen in the next two decades or more? Will we acquire more such extensions and become complete cyborgs,

or is there another direction to go in? I already noticed that our senses are gradually being altered by technological developments. Take our sense of distance, for example; it is obvious that the physical location of our body is no longer a barrier to communicating and interacting with people from other parts of the world. Considering the speed with which the enhancement of our bodily functions is taking place, it may well lead to the complete replacement of our senses by new and advanced ones in the near future. (Vishnevskiaia, 2018)

In the introduction of this article, we defined *rhizomatic learning networks* as spontaneous and self-organized collectives able to demonstrate emergent properties like novelty and innovation. We argued that in a networking conception of learning, learners can be understood as autonomous, while interdependent, nomads creating and traversing their personal learning networks in their own ways in the context of a community of co-learners and in the context of a chaotic external environment of available learning resources and potential pathways. We also argued that the role of the educator in a rhizomatic ecology of learning is to perturbate rather, instead of directing, participants in order to create alternative connections, new (sub)networks of thinking, and new patterns of relating with each other, and with other available human or *non-human nodes*, and learning resources in an empowering confluence, *a co-evolutionary dance*. We continued suggesting that by developing learning rhizomes, self-organizing *confluences of human and non-human* in the becoming, we participate in anotropic performative dances which help us unfold our full living potential.

Teilhard (1960) noted that evolution is the “general condition to which all other theories, all hypotheses, all systems must bow and which they must satisfy henceforward if they are to be thinkable and true. Evolution is a light illuminating all facts, a curve that all lines must follow.” (p. 219). What would be the effect of artificial intelligence agents entering this kind of evolutionary dance? Self-organization and the evolution of life itself seems to be an oxymoron in the context of an ever entropic universe condemned to disorganization, deterioration, a thermodynamic death. Teilhard de Chardin passed away in 1955 being “exiled” by the official church in China and prohibited from publishing his work. After his death, the publication of his works inspired the world scientific community, especially in the fields of cybernetics, complex systems, information theory, and internet studies (Kreisberg, 1995). A few years later in 1977, Ilya Prigogine, a physics and chemist

scientist, became a Nobel laureate for his work on dissipative structures, far from the equilibrium dynamic systems, and the irreversibility of chemical processes. Later, Prigogine developed an epistemology for complex living systems, demonstrating how life is possible in an entropic context. Living organisms sustain their structure and further develop by being open enough to dissipate their excessive entropy in the environment and taking in information that allows them to self-organize and evolve (Prigogine & Stengers, 1997). "There is something special about life in general and human existence in particular ... whereas the general movement in the universe is towards entropy and dissipation, life evolves in a juxtaposed direction, ascending towards complexity: life as 'negative entropy'" (Zwart, 2022, p. 215).

*Anotropy*, literally meaning in Greek moving (tropi) upward (ano), was a term introduced by George Vassileiou back in the the 1970s to refer to negentropy, avoiding the double negative connotation in the term (Polemi-Todoulou, 2018; Vassiliou & Vassiliou, 1985). Anotropy refers to the inherent ability of living systems to self-organization and develop toward more complex forms, against entropy and the second law of thermodynamics (Brailas, 2020c). What Teilhard brought in philosophy of science, among others, was a teleological belief to a better, more anotropic (aka negentropic) future. Teilhard argued that the ultimate evolutionary goal "is not the attainment of maximum entropy as assumed by physical science, but the attainment of maximum consciousness. Chardin maintains that the increase in entropy is just necessary payment to achieve this goal." (Gowan, 2014) In the context of the work of Teilhard de Chardin and Ilya Prigogine, learning rhizomes can be realized as social dissipative structures able to demonstrate self-organization amid an entropic, always degrading (at least in energy terms), environment. Would the introduction of artificial agents in learning rhizomes will catalyze further their developmental process, and toward what direction? Prigogine answers, who knows? The future is not given (Prigogine, 2003). We already live in a world where technology, artificial intelligence, society and culture create a brand new technosocial space, a unique generative combination of elements (Brailas & Tsekeris, 2014). Nevertheless, "through the prism of complex systems epistemology, life is not a mechanical automaton, and the future is not a given. Artificial intelligence and humans form a bio-techno-social system, and the evolution of the participating actors in this complex super-organism depends upon their individual action, as well as upon each actor being a coevolving part of a self-organized whole." (Brailas, 2019, p. 75) Ivan Illich (1970) suggests that "technology is available to develop either independence and learning or bureaucracy and teaching." (p.

77) As Aldous Huxley points out, Teilhard "is able to envisage the whole of knowable reality not as a static mechanism but as a process." (Teilhard de Chardin, 1960, p. 11) In the terms of the present work, we try to envisage education not as an attempt to convey a static body of knowledge, but as catalyzing the process of developing learning rhizomes, anotropic islands in an entropic sea, performative wholes that are always in the becoming and evolving. This is about facilitating the development of learning webs in the words of Ivan Illich, learning rhizomes that allow the generation of new forms, constantly reaching out for creativity and novelty (Capra & Luisi, 2014). We build generative, meaningful processes of relating and co-creating by improvising from within the enabling relational space of a learning community (Bava, 2020).

### **The call for a new pedagogy for the 21st century**

John Dewey (1938), in his work *Experience & Education*, contrast traditional to progressive education. In traditional education Dewey argues, "The subject-matter of education consists of bodies of information and of skills that have been worked out in the past; therefore, the chief business of the school is to transmit them to the new generation." (p. 17) As Ivan Illich (1970/2022) points out in *Deschooling Society* "Everywhere the hidden curriculum of schooling initiates the citizen to the myth that bureaucracies guided by scientific knowledge are efficient and benevolent. Everywhere this same curriculum instills in the pupil the myth that increased production will provide a better life." (p. 74). This *more is better, faster is better, and me first* mentality (Capra, 2003) lies behind the ecological and cultural crises of the modern world: "we are faced with an unprecedented set of challenges that cannot be addressed by any of us individually. Climate change, the overexploitation of environmental resources, financial crises, war, violence, poverty, and affronts to basic human rights and needs raise calls to action." (Brailas, Koskinas, et al., 2017, p. 1). Today we are faced with the so-called *wicked problems* which are any social, cultural, ecological or other complex challenges that are difficult to cope with and find a sustainable solutions by linear, symptoms-oriented, thinking (Brailas, 2021).

Despite the ineffectiveness of linear interventions and ad-hoc solutions that address only the symptoms avoiding to cope with the complicity of the modern challenges, "schools are designed on the assumption that there is a secret to everything in life; that the quality of life depends on knowing that secret; that secrets can be known only in orderly successions; and that only teachers can properly reveal these secrets." (Illich, 1970/2002, p. 76). This is about an utopic wishful thinking that "technology and science alone, like a

new Deus ex machina, would ultimately save us from any problematic situation we would ever face, and from any possible catastrophe we would ever confront, proved to be unrealistic.” (Brailas, 2021, p. 1) Unfortunately, traditional educational systems promote a ‘thinking inside the box’ mentality: students are expected to know and provide the right answers for already known problems. As von Foerster (1972) explains, “Tests are devices to establish a measure of trivialization. A perfect score in a test is indicative of perfect trivialization: the student is completely predictable and thus can be admitted into society. He will cause neither any surprises nor any trouble.” (von Foerster, 1972, p. 41)

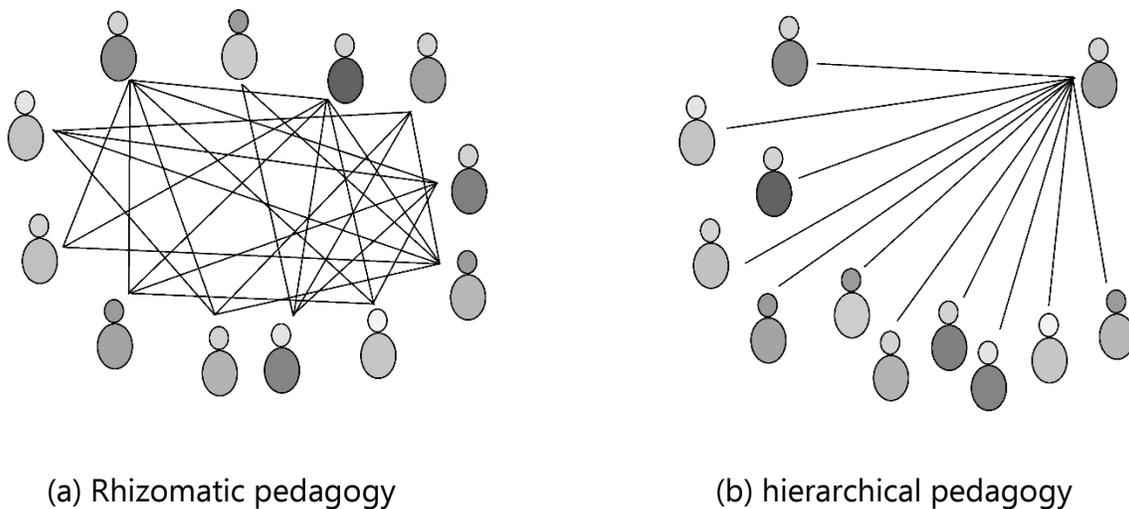


Figure 4. *Rhizomatic vs Hierarchical Pedagogy. The potential number of relations nurtured is  $n(n-1)/2$  vs  $n-1$  in a hierarchical learning approach. For example, in a peer learning community with 10 members (where all participants are treated as active actors able to contribute in the knowledge production), all the horizontal possible connections are 45 (vs 9 if one of the members assume the absolute authority to deliver knowledge production and the rest nine assume a passive/consumer role).*

How to prepare them to cope with unprecedented challenges? How to prepare students to address wicked problems? How to educate for sustainability and well-being? Nothing can be done for the students without the students (Hoskins, 2020). In a rhizomatic learning approach, resilience, sustainability and innovation are not qualities of individuals but emerge through their synergies and emerge as qualities of an entire learning community: “We are social beings. We live and learn in the company of others. Outside schools, the ability to work with others is critical to the strength of communities and to meeting the

challenges we collectively face. Yet, in many schools, young people largely work on their own; they learn in groups but not as groups." (Robinson, 2011, p. 138)

Despite today's technological advances in communication technologies and the increased technological literacy of people, especially during the pandemic years, "we confront a world in which the world's peoples are both closer together and further apart than ever before." (Gergen, 2020, p. 12) Education can be a starting point for initiating a change. Schools should be relational communities that create optimal conditions for learning, by supporting, facilitating, and encouraging participants in their inquiry toward personal and collective flourishing and well-being (Lewis, 2020). In an appreciative relational community, participants develop a rich set of social-emotional skills, learn to recognize diverse perspectives, and experience how different, and often competing, ideas may be turned into a process of co-creation (Brailas, 2020b). To design thriving learning communities, we first need to understand how nature sustains and promotes life. Studying the long history of human evolution, we realize that sustainability is not an individual attribute but an element of a whole web of relationships, as it always includes an entire community. This is the deepest lesson we are called to receive from nature. The way to sustain life is to build and support communities (Capra, 2003). The principles for designing our future educational institutions must be in line with the organizational principles that nature evolved in order to develop and maintain the fabric of life.

Social constructionism argues that knowledge cannot exist outside of a web of relationships and, therefore, knowledge production in a classroom is a community achievement: "learning no longer takes place in the mind of the individual learner; it is the result of relationships between teachers and learners, between learners themselves and between the classroom and its community" (Dragonas, 2020, p. 314). Consequently, education's primary goal should be to facilitate the development of learning communities where students can engage in meaningful relational activities with their peers and the world outside (Brailas et al., 2015). Education is the process of creating opportunity webs (Illich, 1970/2002), networks and rhizomes. Ivan Illich proposed back in 1974 a kind of rhizomatic learning pedagogy "where networks replace hierarchies, where interaction displaces centralized control, where the agency of learners is balanced with the expertise teachers, where complementary knowledge of peers is brought to bear, and where knowledge emerges from differentiated and distributed sources." (Cope & Kalantzis, 2022, p. 25) In such a view, the goal of a learning community should be to facilitate collaborative

learning processes where gradually the students themselves, as learning nomads, lead their learning and co-create knowledge within their networks (Brailas, Avani, et al., 2017; Dole, 2020).



Figure 5. *The Rhizome as a multicolor Dialogue. Collective in-class drawing of a rhizome by students participating in the course Systems Theory, Psychology and Social Media, Panteion University, 2021-22 cohort (Image used with permission). If we observe carefully, we can identify living forms as they emerge from this colorful rhizome. Nevertheless, there is an underline rhizome that give "life" and interconnect those forms.*

As regarding the role of the teacher in such rhizomatic learning ecology, we can illuminate it through the gardener metaphor. A gardener has to take care of a living ecosystem. A gardener cannot secure the flourishing of their garden, but careful gardening is usually followed by a flourishing garden. We can't control the process, but we can attempt to create the optimal conditions for something beautiful to emerge. And this is a helpful metaphor for the teacher's role in an anotropic pedagogy "knowledge democracies require continuous and ongoing effort to bring about what is possible in the present moment while maintaining what is vibrant and desired." (Lewis, 2020, p. 322) Nevertheless,

this is about a mutual development process, a coevolution of both the gardener and their plants. The teacher and their student form the learning rhizome of the class. Education has the potential to transform the world, to create a future that is different and better than the one we were given. When educators begin teaching for the first time, they quickly realize that themselves change and evolve along with their students.

In an era of increased screen time, immersion in virtual reality, and a sedentary way of living and being (Kohorst et al., 2018), nomadic pedagogy should be an embodied pedagogy of moving and relating, an experiential learning process that locate the students and their teachers in a web of enabling relationships with each other in the context of a networked reality. We can learn things only by being embodied nomads developing and traversing our own and unique learning rhizomes (Brailas, 2020a), “we can understand things only by handling them, by moving them, by moving our own body” (Clarke & Hansen, 2009, p. 31), and equilibrium exists only in action, according to Simone Weil (Sharp, 1984). At the end, is there any form of learning that is not actually rhizomatic? Life, from the very beginning, did not take this planet by compact but by synergies (Capra, 2010), and the other is necessary for the survival of me, and for sustaining everyone (Lugo, 2020). Learning is always rhizomatic, life in any form is an ongoing rhizomatic dialogue (Figure 5). However, there is something you can see, understand, and take advantage of, only if you look at it as a rhizome, and this is something educators should take advantage of.

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