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CHAPTER 18

Cosmodern Education for a Sustainable Development: a Transdisciplinary and Biomimetic Approach from the Big History

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The objective of this chapter is to study the co-evolutionary processes that life has developed over billions of years in the context of “Big History”. The main intention is to identify their operational principles and strategies, in order to promote sustainable and bio-mimetic alternatives for the achievement of the “Sustainable Development Goals” (SDG). This is a qualitative, exploratory, descriptive, and analytical research that includes, unifies, and integrates the history of the universe, the solar system, Earth, and human being history. For the development of this “ecology of knowledge”, transdisciplinary methodology is combined with the Big History theoretical model. The most important observations show that all forms of life are developing sustainable co-evolutionary strategies in nature since life’s first appearance about 3,8 billion years ago. To help in the achievement of the SDG, the research also focuses on human training to reduce ecological and social footprint. As a result, emotional, spiritual, and ecological literacy is required to feel-think-act in harmony with nature. In conclusion, this biomimetic and transdisciplinary research proposes some recommendations to prevent future scenarios where the chronic shortage of natural resources impedes dignified human development and proliferation of life.

Keywords: Cosmodernity, biomimicry, transdisciplinary, big history, coevolution, complexity, spirituality, emotional intelligence, sustainable development goals.

18.1 Sustainable Development Goals: an Introduction

Sustainable development has gained momentum since the Member States of the United Nations committed to the Sustainable Development Goals (SDGs) for the year 2030. The final declaration signed by world leaders is known as “Transforming our World: The 2030 Agenda for Sustainable Development” (United Nations, 2015), and it includes climate change, conservation of terrestrial ecosystems, seas and oceans, as well as other systemic and global goals on health, gender, poverty, and education. In sum, the 17 SDGs and 169 targets recognize the socio-ecological problems that characterize the current global civilization beyond their national borders. Hence the need to transgress the current paradigm with the new approach that Big History gives us, because it represents an epistemic tool that conceived the interrelationships of the human condition in its cosmic and earthly context. This is a new transdisciplinary organization of knowledge that allows us to include natural ecosystems and human cultural systems in the same co-evolutionary historical process.

The Big History helps us to identify and recognize the sustainable strategies that work in nature to inspire us bio-mimetically in solving human problems (i.e. social, economic, technological, engineering, etc.). The continued exploitation of materials and energy resources of the Earth by the models of production and consumption has caused a great ecological and social footprint that has been disclosed as unsustainable. A society that walks towards a sustainable development must learn to reduce their ecological destruction, reusing and recycling materials already built. Sustainable development is a dynamic process that requires a “*glocal*” vision, because the global progress is an emergency of planetary system which thrives on multiple local progress advancing through systemic mechanics (synergies, feedbacks, etc.) that inter-retro-act with each other, influencing, conditioning, and modifying the different context of world citizenship. According to Robertson [1], the term “glocal” is a neologism where globalization does not imply an annulment of the local, but an inclusion, presence, and meeting of and with local cultures. We must focus our attention on the paradigmatic horizon of SDG in a planetary scale, engendering a world where “other worlds are possible”. This implies a transcultural recognition of cosmic structures and phenomena that paradigmatically transcend the human condition, aligned with the “*Cosmic Education*” of the pedagogical method of Maria Montessori [2].

18.2 Transdisciplinary Methodology: Linking Education with Sustainability

The idea of interconnection between human beings and other life forms leads us to revise the concept of development through transdisciplinary study. Life has developed co-evolutionary processes since their appearance on Earth some

3.8 billion years ago. The “cosmic miracle of life” is a transdisciplinary challenge we must integrate to safeguard all biodiversity that coevolves in Gaia¹. This essay has been written from the theoretical framework of the “Big History” coined by historian David Christian [3] and theoretically developed by Fred Spier [4], along the methodology proposed by nuclear physicist Basarab Nicolescu [5]: levels of reality, logic of the middle hidden, and complexity. This theoretical and methodological symbiosis represents an epistemological approach that understands the human beings as an integral part of autopoietic cosmic totality, housing the bioethical imperative to develop a culture of peace to meet the SDG [6]. In addition, this synergy also aims to produce both new biomimetic knowledge and technical innovations. According to the economist and educator Sue McGregor [7: 63], “transdisciplinary problem solving from a biomimicry perspective means recognizing organic patterns and natural connections, understanding the causes and effects of competing and interrelated components, and then making appropriate modifications.” The nature of sustainability from a biomimicry perspective reflects the very essence of transdisciplinary methodology and the Big History theoretical framework. The fit between those two approaches is elegant, ripe with hope and potentialities.

According to the “complex thinking” promoted by sociologist Edgar Morin in his book *The Seven Complex Lessons in Education for the Future*, - written in 1999 to promote UNESCO’s Transdisciplinary Project *Educating for a Sustainable Future*-, education is an essential epistemic tool to transform our world-society. In this visionary work, Morin affirms, “teaching the human condition means teaching the cosmic, physical, and earthly condition of the individual-society-species” [8: 21-23]. Since these intellectual horizons, all education pretending to be universal must take into account the different levels of epistemological and ontological reality that constitute the multidimensional identity of the individual-society-species: as *individual* in a local and specific community; as citizen of a determinate *society* belonging to a particular State/Nation; and as same cosmo-bio-genetic *species* in constant process of evolution. A human identity opened to the infinite diversity of global citizenship in its own unity as species. At the same way that own ontology structures the nature in different levels of Reality, humans have different strata, levels, and plans of gnoseological perception that structure and concretize their historical complexity in their cosmological context. Hence we can also add the identity in the Cyber-Space-Time: the virtual identity.

Thus, educational curricula must consider the complexity in all levels of identity that human race is shaped, without falling into reductionist, one-dimensional or homogenized logics. Higher education students must learn that our identity is composed by multiple dependencies with our social and natural environment. “Eco-bio-anthropo-social conceptual loop is a loop in which the thought of natural complexity should allow developing the thought of social and political complexity, [9: 120]. From this vision, our identity is a unique result of multiple relationships. Every culture is more or less hybrid,

¹Gaia is the primal goddess personifying the Earth in Greek mythology.

mixed, made of intersections, feedback loops... There are no finished or perfect cultures because each culture carries sufficiency, insufficiencies, functionalities, and dysfunctionalities.

Therefore, it is necessary to promote a mindset transformation that facilitates the development of a “complex thought” capable of building a new kind of identity for the emerging global citizenship [10]. Our planetary identity is based on the idea that humans are part of nature (governed by natural laws), whose historical approach addresses together the past of people, life, Earth, and the universe [6]. This integral view of cosmic, planetary, and human history is known as “Big History” by the scientific community [3, 4], and allows us to understand better the complexity of social relations with nature, where mankind is considered an important element of co-evolutionary processes.

18.3 A Brief Summary of the Big History: The Human Co-evolution in Gaia

While it is true that Big History framework does not directly affect the current situation, it gives us a bigger temporal perspective to transgress the commonly accepted concept of sustainable development. I aim to redefine sustainability as a process of integral co-evolution with Gaia. All assessments we conceive today, as an interconnected world society, will affect future life models of our children and grandchildren. That is why we must learn more about cosmic, physical, geological, and biological frameworks that we belong as a human species. This view is aligned with the biologist Stuart Kauffman thought [11: 4-5]: “what some are calling the new sciences of complexity may help us find anew our place in the universe, that through this new science, we may recover our sense of worth, our sense of the sacred.” For this reason, the recognition of the cosmic origins of the human condition we can learn to appreciate better the importance of fulfilling the SDG and safeguarding life on Earth. Altogether, the process of *mapping* the Big History is based on the scientific consensus reached by the international community in astronomy, cosmology, physics, geology, biology, chemistry, anthropology, paleontology, archeology, ecology, history, geography, sociology, demography, economy, and so on [3, 4].

According to the scientific consensus of Big History, the humanly known universe arose about 13.7 billion years before present (BP), with the explosion of the *Big Bang*. Earth formation occurred between 5 and 4.5 billion years BP, and the miracle of life appeared around 3.8 and 3.5 billion years BP. During the first half of this period, the forms of first-born life on Earth remained at very simple complexity levels (as archaeobacteria or eubacteria), but the appearance of free oxygen in the atmosphere originated the first complex cells (eukaryotics), some 2 billion years BP. The Cambrian explosion of metazoans took place about 1,5 billion years later, some 542 million years BP. Since then, the biological variety has increased rapidly, forming a wide range of multicellular organisms that are developing survival strategies with very unique energy

flows, such as the food chain.

While it seems that life arose in the depths of the oceans, it only managed to reach the mainland about 450 million years BP. Only 250 million years after reaching the Earth's surface came the first warm-blooded animals, where dinosaurs highlighted during the Jurassic period until they disappeared 66 million years ago by a supposed asteroid impact on Earth. As Christian [3: 162] noted, this circumstance gave rise to hegemonic period of mammals, from where emerged later the first bipedal hominids around 7 million years BP. Thanks to carbon-14 testing performed on fossil remains found to date, we can know in an approximate way the dating of first Australopithecus, which seem to be about 4 million years. *Homo Habilis* dates from 2.5 until 1.9 million years, those of *Homo erectus* are around 1.9 million years, and those of *Homo neardenthalis* and *Homo sapiens* point about 200,000 years ago. With the extinction of *Homo floresiensis* about 13,000 years ago, *Homo sapiens* is the only survivor of the human species that co-inhabits and coevolves on planet Earth with the rest of the animal biodiversity, plants, insects, bacteria, etc.

Co-evolution is a term coined by biologist Paul Ehrlich and botanist-environmenta

list Peter Raven in 1964 [12]. In their joint work *Butterflies and Plants: A Study in Coevolution*, they approached the reciprocal evolutionary influences of plants and insects that feed on them: "an approach to what we would like to call coevolution is the examination of patterns of interaction between two major groups of organisms with a close and evident ecological relationship, such as plants and herbivores" [12: 586]. While the idea of co-evolution was not new and had already expressed in previous theories, the use made for Ehrlich and Raven allowed thinkers from other fields of application make new interpretations. In 1980, evolutionary ecologist Daniel Janzen was the first to define the concept of coevolution in his paper *When Is It Coevolution?* [13]. "Coevolution may be usefully defined as an evolutionary change in a trait of the individuals in one population in response to a trait of the individuals of a second population, followed by an evolutionary response by the second population to the change in the first", Janzen [13: 611] explain adding that "diffuse coevolution occurs when either or both populations in the above definition are represented by an array of populations that generate a selective pressure as a group." Thus, ecological interdependence requires three basic principles: 1) *specificity*, where the evolution of each specie is due to the selective pressures of the other; 2) *reciprocity*, when both species jointly evolve; 3) *simultaneity*, both species evolve simultaneously. So the co-evolutionary process has been used in a relatively restricted sense in the context of biological evolution.

But the sense of "coevolution" used in this research goes beyond to discuss in bioethics: including both the degree of mutual phylogenetic partnership as the degree of mutual change in the co-adaptation, but also global processes of macroevolution and specific processes of microevolution [14]. Coevolution is defined, then, as a reciprocal evolutionary change among species and their natural environment that, during the complex development of inter-retro-actions

with each other, mutually modify each other constantly. This view is used by researcher Rolf Zinkernagel [15] – Nobel Prize for Medicine in 1996- to explain how the immune system has co-evolved with microbes that cause infectious diseases, and also with the distinction between biological and social evolution introduced by historians Andrey Korotayev, Alexander Markov, and Leonid Grinin [16]. Coevolution is a feedback process very present in nature and has been basis for agricultural and industrial exploitation of human beings in their historical evolution on Earth. As explained by ecological economist Richard Norgaard [17: 39]: “with industrialization, social systems coevolved to facilitate development through the exploitation of coal and petroleum. Social systems no longer coevolved to interact more effectively with environmental systems.” With Industrial Revolution, began an era of hydrocarbons that drastically changed co-evolutionary processes of the prior agricultural stage of mankind. When social systems began to exert strong pressure on environmental systems, the stock of energetic and material resources decreased very quickly: starting an evolutionary period of planetary unsustainability.

The globalized society of 21st century must become aware, urgently, of socioeconomic unsustainability of “four-engine-of-globalization”: science, industry, capitalism, and technology [18: 104]. They are seriously jeopardizing both future human generations and the rest of natural ecosystems. It is necessary to organize transdisciplinary knowledge to understand that our specie evolution is intrinsically interlinked with constant co-evolution processes that different life forms are developing on our planet Earth from billions years ago. It is a multidimensional coevolution that unfolds through inter-retro-actions between different levels of cosmic, planetary, regional, national, and local reality, where an extensive network of universal interdependence is established with ecological, biophysics, social, political, cultural, economic, and technological phenomena. Hence the uncontrolled exploitation of natural resources for the manufacture of industrial products has become an issue of great concern in the international agenda, where different geopolitical actors study and analyze, for decades, cross-border phenomena that affect all life forms.

In this context, biomimicry emerges as a transdisciplinary science that deals with studying the complexity of inter-retro-actions developed between dynamic systems that make life (humans, animals, plants, etc.), within an environment which houses the ideal conditions for coevolution. Mankind is the unique species that participates in a cosmic dance starred by matter-energy phenomena whose symphony reminds us that we are active players in the coevolution of a common world shared with ecosystems of Gaia. “We now recognize the Earth as a single self-creative being who came to life in its rotating dance around the space” says biologist and futurist Elisabet Sahtouris [19: 25-26], adding that “as we gather the scientific details of the dance of life on our planet (...), the evolution of our species takes a new meaning in relation with the whole.” Hence the systematic degradation of nature makes us accomplices of a global ecocide, since the ecological footprint [20] is perpetuated by our active participation in consumerist dynamics and our bioethics passivity

before the destruction of life on our planet Earth, which is our sacred common good. “There are few more alarming indicators about the brutal climate imbalance that we have implemented, and the consequences will be terrible (ecocide and genocide, if you want to express in a synthetic formula),” argues the philosopher Jorge Riechmann [21: 333]. Our common future is built today and we cannot fail to future generations. With such imbalances, future generations will suffer the climatic consequences of global warning caused by our current consumer culture (chronic shortage of resources, ecosystem changes, loss of biodiversity, glacier melting, rising sea level, deforestation, pollution of soil, water and air, etc.). For all those reasons, biomimicry represents a paradigmatic shift in the epistemological construction of knowledge because its multi-referential epistemic frame goes beyond of traditional moral issues of human welfare to integrate new technological developments that radically altered the vital phenomena of own nature.

From this cosmodern vision, I propose that existing debate on SDG does not have to find solutions for the increasingly complex problems that arise in the current economical system of the world-society of the third millennium. SDG should promote the transformation of capitalism’s production system inspired by biomimicry approach. Affirming that economic growth is good for itself, postulating that human quality levels can be measured by GDP and GNP of a country, represent an intellectual fraud of danger consequences in the era of global ecological crisis. While it is true that capitalist system has brought enormous material benefits, its functionalist view subordinates everything to the maximum economic profit and the indiscriminate consumption at the expense of nature. It does not work to debate between communism, anarchism, socialism, capitalism or any other political theory of social organization derived from classical mechanics mental structures (where there is just one level of reality), but to mimic our own nature. “If we want to get along with Gaia, it is precisely how we must see ourselves, as one vote in a parliament of thirty (or perhaps even a hundred) million seats, a species among species” says biologist Benyus [22: 24]. Why the human species continues mortgaging the future of millions of species by its absurd logic of irrational consumption, which involves the exploitation of natural resources? Why do we believe in the epistemological illusion of unlimited economic growth when it has never existed any living species in nature, which grow endlessly to infinity?

18.4 Biomimicry: A Sustainable and Resilient Meta-Model

Human irrationality in patterns of consumption and production of the current capitalist system is unsustainable and are also causing serious consequences in the environment: climate change, desertification, destruction of natural resources, pollution of water and air, global warning, etc. In this sense, if the principle of biomimicry is reclaimed as meta-model (economy, engineer, archi-

itecture, design, urbanism, industry, technology, artistic, political, educational, energy, etc.) to achieve a perdurable sustainable development, it is necessary a small mention of some thinkers who have proposed to learn from nature to build a more just, democratic, and better integrated with the biosphere society. A good example is the biologist and ecologist Barry Commoner [23], with the formulation of the basic “laws” of ecology: 1) *everything is connected to everything else*. There is one ecosphere for all living organisms and what affects one, affects all. 2) *Everything must go somewhere*. There is no “waste” in nature and there is no “away” to which things can be thrown. 3) Nature knows best. Humankind has fashioned technology to improve upon nature, but such change in a natural system is likely to be detrimental to that system. 4) *There is no such thing as a free lunch*. Exploitation of nature will inevitably involve the conversion of resources from useful to useless forms. In his later book *Making Peace with the Planet*, Commoner [24: 15] notes that techno-sphere prevalent in industrialized societies “is in war” with the biosphere, causing global ecologic crises impossible to be hidden.

Those basic laws of ecology have a strong link with the notion of “ecoliteracy” or “ecological literacy” developed by physicist Fritjof Capra [25] to understand the five organizational principles of ecosystems to build sustainable human communities: 1) Interdependence. 2) Cyclical nature of ecological processes. 3) Tendency to associate, establish links and cooperate as essential characteristics of life. 4) Flexibility. 5) Diversity. In short, Capra [25: 20] argues that “understanding the life must be seen as the scientific vanguard of the paradigm shift, from a mechanistic world conception through an ecological conception”, postulating that human systems should be governed by the key criteria of a living system: a) *organizational pattern* or configuration of relationships that determinate the essential characteristics of the system; b) *structure* or physical embodiment of the organizational pattern of the system; c) *vital process* or involved activity in the continuous physical embodiment of the organizational pattern of the system [25: 175]. In other words, Capra believes reconnecting with the web of life means rebuilding and maintaining sustainable communities in which we can satisfy our needs and aspirations without diminishing the chances of future generations. For this task we can learn a lot from ecosystems, true sustainable communities of plants, animals, and microorganisms. To understand them, we must become ecologically literate. “Being ecologically literate, being *ecoliterate*, means understanding the organizing principles of ecological communities (ecosystems) and use these principles to build sustainable human communities. We need to revitalize our communities including education, business, and policies [25: 307].”

The biomimetic approach is one of the most innovative responses in recent years to protect the environment and improve the quality of life through new sustainable habits of consumption and production. The term *biomimicry* comes from the ancient Greek *bios* (life), and *mīmēsis* (imitation). In the nineties, the term biomimicry would be used in disciplinary fields of material sciences, cosmetic research, and robotics, until the American science writer

Janine M. Benyus popularized it with her book *Biomimicry: Innovation Inspired by Nature*. Since then, biomimicry emerged as a new science that considers and values of nature as model, measure, and mentor: looking for the inspiration and imitation of the natural process to be applied into social systems, and thus find innovative solutions to complex problems (such as SDG). “Biomimicry uses an ecological standard to judge the correctness of our innovations. After 3.8 billion years of evolution, nature has discovered what works, what is appropriate, and what endures,” notes Benyus [22: 13], affirming that biomimicry “begins an era based not on what we can extract from the natural world, but what it can teach us.” Biomimicry represents a theoretical-pragmatic symbiosis between citizens from the North and the South, and also a fundamental tool to face the climate change. In this line of thought, Benyus recognized nine basic operational principles of Life in the Nature that can be used as example of beneficial model for human behavior:

1. *Nature runs on natural sunlight*: the energy absorbed by almost all natural communities comes from the nuclear fusion that sun makes at 150 million kilometers. “The solar, wind and tidal energies, as well as biodiesel, all derive from the current sunlight” [22: 321]. When we burn fossil as oil, natural gas or coal, we are using the old sunlight, which remained trapped (compressed in an environment without oxygen) in the bodies of animals and plants of the Carboniferous period. When the combustion is made, we are completing “the decomposition process suddenly, pouring the coal stored into the atmosphere in large quantities, ignoring the ecosystem precept of no *big flows* [22: 321].” Taking into account that our biosphere is almost a closed and autopoietic system [26], this attitude would be equivalent to burn the furniture inside our home with the windows closed. Unfortunately, fossil fuels are too cheap and the current consumer society, addicted to energy, goes to full exploitation of these natural resources. A good example would be the leaves, which perform photosynthesis (biochemical decomposition of solar energy in nutrients) with amazing 95% of quantum efficiency, four times more efficiency than solar panels built by human.
2. *Nature uses only energy and resources that it needs*: While it is true that second law of thermodynamics converts energy into heat, and a portion of energy is no longer usable, nature knows how to get energy efficiently through different ecosystem connections. In order to make an optimum use of limited habitat, each organism has found a niche and only uses what it needs to survive and evolve. Thus, the lessons of natural systems can guide us to establish new uses for energy. We must consider what we are maximizing (production) and focus more on optimization, as natural systems do when they invest their energy in maximizing diversity to become more efficient in the process of recycling organic nutrients and minerals [22: 322].
3. *Nature fits form to function*: nature is a highly cooperative system made

by dense interactions between its components. The whole ecosystem network has been built in the limits of available resources and as a result, the entire ecosystem has reached an internal coherence of intricate organic patterns which form is adapted to the function. The nature optimizes rather than maximizing. On the contrary, our industrial ecosystems “continue betting on higher rates of productivity and growth, for a maximum flow of material extracted from Earth and converted into shiny new items. 85% of manufactured goods quickly become waste” [22: 323]. Indeed, the current globalization economy defines its success by fast growth and creates the illusion to measure progress and human development by indicators such as GDP and GNP. By contrast, organisms co-evolving in nature adapting themselves into the changes of others because their structure play several functions in its environment. “The lesson is that we have to delay the material manufacturing and put the emphasis on quality and not quantity of new items [22: 323].”

4. *Nature recycles and finds uses for everything:* “One of the key lessons of ecology systems is that when a system accumulates biomass (total weight of living matter), it needs more recycling to avoid collapse” [22: 312]. The existence of trophic chains in ecosystems has a circular organizational scheme where producers, consumers, and decomposers have evolved together in a closed loop to prevent the loss of resources: “all waste is food, and everyone is reincarnated into the body of other” [22: 313]. The problem of human culture of production and consumption is that it continues accumulating biomass without a network of closed loops. In this sense, Benyus explains several examples of “zero waste economy” in European Nordic countries (especially Denmark) where there are small trophic networks of industrial ecology with closed loops, where the exchange of information and the mutual wish to utilize the waste causes that all manufactured products coming from market, re-entering into the production system through legislation recovery and reimbursement systems.
5. *Nature rewards cooperation:* in mature ecosystems the cooperative strategies among organisms are as important as competition. According to the endosymbiosis hypothesis of Lynn Margulis [27], the symbiosis between two species is a fundamental element of evolutionary progress from billions of years ago. Natural ecosystems operate in a complex symbiotic network of mutually beneficial relationships and when they grouped a large number, they make up organs and organisms. In fact, the endosymbiotic theory postulates that our body is actually a combination of unicellular organisms that have conformed a huge pluricellular organism. Translated into the human production system, the Japanese industrial ecologist Michiyuki Uenohara notes that “we have plenty arteries (main tracts where flow products from the industrial heart to the body of economy), but we also need veins, return tracts of used products to purify and reuse their materials” [22: 318]. The lesson learned, there-

fore, is to build an economy where the arteries and the veins have the same importance, what would imply the imitation of ecological systems of closed loops that reuses the resources. According to Benyus [22: 319], an example of pre-competitive cooperation is constituted by the American brands Chrysler, Ford, and General Motors, developing partnerships for the manufacture of standard material that allow them to reuse parts of each other.

6. *Nature depends on and develops diversity*: the enormous development of diversity in nature is due to their experience of billions of years in “trial and error”. Nature is characterized, in consequence, by the multi-referential approach that randomness produced by the entropy (rupture of the order) has enabled with its flexible opening to new anomalies. This eco-biological flexibility has enabled a large variety of animals and plants over billions of years around the entire habitat of planet Earth. Therefore, the lesson we learn from nature is that our industrial system must be flexible to be adapted to the emerging needs of global citizenship, and be as diverse as its own environment to respect regional, cultural, and material uniqueness of the place.
7. *Nature requires expertise and resources*: generally, natural ecosystems are connected in a relatively closed manner in the space-time. There is a rich biodiversity in the local ecosystems where many local species co-evolve together to be adapted to the changes. Unfortunately, the current capitalist trend is a global economy without frontiers where manufactured goods are produced in far countries geographically separated. In this sense, we must learn from the local knowledge and experience that indigenous people have, because “the idea of an adapting economy to the land and take advantage of its local attributes would bring us closer to the organisms that have evolved until become local experts [22: 339].
8. *Nature avoids internal excesses*: “The biosphere (the layer of air, land, and water that sustains life) is a closed system, meaning it is not imported or exported materials (apart from the naughty meteorites)” [22: 332]. The autopoietic character of the biosphere get that life maintains the necessary conditions to regulate itself through a constant exchange between organisms (photosynthesis, respiration, growth, mineralization, decomposition, etc.). Unfortunately, the global industrial system is an opened system where “nutrients” become “waste”, without any significant recycling process. This exploitation dynamic of natural resources and pollution is changing drastically the natural process because they cannot recycle the huge amounts of CO₂ emitted into the atmosphere (currently 355 of each million of molecules). The only answer is an industrial ecosystem that can be integrated in the biosphere without harming it.
9. *Nature taps into the power of limits*: nature has learned that living with finite resources is a powerful resource of creativity. In nature there are

internal feedback mechanisms that optimize the use of resources of the environment in constant balance, with moderation and without devastating it. That means not mortgaging the future because, otherwise, it would die. The lesson is that our current production system cannot continue to push the limits of the planet. Nature teaches us to flourish within biological limits, without being in continuous predatory expansion. On the contrary, we must “*adapt human systems to ecosystems (biomimicry), managing greater efficiencies (eco-efficiency) and act on the demand with self-containment measures (generalized demand management)*” [21: 28].

In short, the nine principles of life from nature that Benyus [22] identifies are incompatible with the current capitalist socio-economic order. “It could even be said that capitalism is the metaphorical antithesis of the natural process of life: in it prevails exclusion, squander, deregulation, what we call today as *relocations*, as well as unaware speculative flows to real production of goods and services” notes the natural philosopher Luciano Espinosa [28: 66] compared to natural systems of the biosphere where “operate inclusive circuits of all member of the network, which are attached to the ground, tied to the satisfaction of the basic needs and the constant recycling of matter and energy” (ibid). This comparison seeks to understand the complexity of life. A bioethics understanding that should be promoted by the SDG to face the global techno-economic dynamics that are destroying life on Earth. SDG should aim to establish itself as the political, educational, and epistemological tool able to modify the socio-ecologic metabolism through new symbiosis between natural ecosystems and human cultures systems of production. To do this, Riechmann [21: 171] claims to address the principle of biomimicry in a broader sense, “to understand the operating principles of life in its different levels (particularly the eco-systemic level) with the goal to *rebuild human systems in order to fit them in the natural systems harmoniously.*” In this way, Riechmann [21: 211] also suggests six basic principles for the ecological reconstruction of economy from the biomimetic perspective: 1) Homeostasis or “steady state” in biophysical terms. 2) Living from the sun as energy source. 3) Close material cycles. 4) Do not carry too far the materials. 5) Avoid xenobiotics like POPs (persistent organic pollutants), GMO (genetically modified organisms), etc. 6) Respect diversity. Together, we must *rebuild our human systems* failing to grow economically to focus more on the qualitative development. The economy is a subsystem of nature. Then, we must learn to consume the only necessary natural resources for a sustainable human development.

With this ecological vision, learning-teaching processes of the educational system should promote a biomimetic dialogue that fosters a planetary critical consciousness through global solidarity reflections and, ultimately, the emergence of new social organization networks to compliance with the SDG [14]. Metaphorically speaking, education is a living organic structure in a constant process of adaptation and co-evolution with the environment. For this reason, Education for Sustainable Development (ESD) program should not only

think about how to integrate the biomimetic principles in local and national educational curricula. ESD should also think about how to apply them as networks in an interconnected world. Since the scholarly microcosm embodies the macrocosm of social structures, the common future of humanity among the planet Earth requires a true political, epistemological, and educational transformation that implies the emergence of a cosmodern paradigm characterized by the change of hierarchies to networks in the social organization field. The conceptual notion of “cosmodern paradigm” is aligned with the idea of “Cosmodernity” proposed by Nicolescu [5] and with the “*cosmodernism*” of Moraru [29]. In the thoughts of both authors, there is an important bioethics fundament of responsibility with world problems, an epistemological call to overtake binary and reductionist knowledge, and a contextual relationship between human beings and the cosmos.

18.5 Cosmodern Education for a Sustainable Development

Education is the main key to achieving a sustainable development in Gaia: being the seed that we must cultivate for our present and future flourishing. We need to develop an integral view that includes the human being within co-evolutionary processes of Big History to achieve the SDG. “Sustainability is not just a problem between us the humans,” explains environmental educator Maria Novo [30: 368], “it is also a serious problem of our relationships with the biosphere, the way we appropriate resources, exploit nature, manage the commons, and how we consider the limits of ecosystems.” For this reason, it is urgent to transform models of predatory behavior that human species exercise over Gaia, as well as the unequal distribution of wealth that only benefit a minority. In this regard, the identification of operational principles and strategies that life is developing in nature represent biomimetic models that help us to live in Cosmodernity: where human beings co-evolves in sustainable and resilient harmony with all the ecosystems of our planet.

Educate to live in the paradigm Cosmodernity means introducing transdisciplinary and biomimetic approaches at all levels of formal education, but also in non-formal and informal areas to develop the full potential of the human condition. The oldest example is found in many native and indigenous peoples who are still training individuals through a “bio-literacy look” that persist for thousands of years. Human training of indigenous and aboriginal peoples is focused on strengthening linkages and relations between human beings and nature. This vision is far from educating people who are submissive workers in a globalizing economic system that tends toward homogenization of cultural diversity and ends with a large portion of the biodiversity on Earth. For this reason, the *United Nations Declaration on the Rights of Indigenous Peoples* recognizes “that respect for indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and

proper management of the environment” [31: 2]. All worldviews of indigenous peoples are a good example for a resilient and sustainable development because they have been developing excellent socio-ecological practices during thousand of years. While we cannot fall into the romantic idealization of the indigenous community, all their rich epistemic multi-referentiality is in full harmony with the co-evolutionary limits and margins that ecosystems set in a self-organizational way.

In 2009, General Assembly of the United Nations proclaimed April 22 as the “International Day of Mother Earth” to pursue this harmony with nature. Since then, the General Secretariat of the UN has published annually a resolution on Harmony with Nature to recognize the Earth and its ecosystems as our common home. The aim is the Member States achieve a fair balance between economic, social, and environmental needs of present and future generations. For this reason, we must face the paradigmatic crossroads of climate change from an “ecology of knowledge” [32] to develop and improve all human dimensions through a transdisciplinary organization of knowledge that combines scientific reason with other epistemic, spiritual, religious, emotional, political, rhetorical, poetic, artistic, and philosophical aspects. Undoubtedly, dialoguing with indigenous and aboriginal wisdom enable us to develop more resilient epistemological horizons. When this multi-referential and transdisciplinary perspective is adopted, education becomes an epistemic tool that searches individual development of people within a vast network of relationships with other human beings, but also with nature and the cosmos. That is why all theoretical models that reduce sustainable development to just three dimensions (economic, social, and environmental) are failing to address the inherent complexity of the interdependent network of systems that are interconnected at various levels of ontological reality. This is the epistemic point of departure to create a holistic and transdimensional education to strengthen ties with sustainability to achieve the SDG in 2030. The potential development of global citizenship represents the genesis of a cultural metamorphosis that reinvents our relationship with the sacred: moving from the exploitation of nature to create new biomimetic models to learn from it in order to achieve a lasting sustainable development.

Educate to live in Cosmodernity requires, therefore, a civilizational mindset that transforms the core of the paradigmatic collective imagination that Modernity began in the West in the seventeenth century. It was established worldwide through computerization of economic globalization. If we want to achieve the SDG it is essential to reflect on the historical origins of our educational systems. Education can be both a way to aggravate the socio-ecological problems, but also an instrument of change that helps us to solve them. From a historical point of view, ideological discourse created by the power groups during Modernity has used educational knowledge to establish a set of behaviors, norms, and actions that have served to structure hierarchically Western modern societies. For this reason, education becomes a fundamental key to change historical civilizational direction and walk towards sustainability. Cosmodern

education promotes a transdimensional understanding where the human being is seen as a unique species that co-evolving in a shared ecosystem with more than ten million other species. We must learn to respect, preserve, and regenerate them. We cannot extinguish the infinite wisdom accumulated over billions of years of planetary biodiversity. It is urgent to transform mankind's domination approach to nature, into an approach of stewardship. The processes of domestication (about 10,000 years ago with Agricultural Revolution) and industrialization (about 250 years ago with Industrial Revolution) have accelerated exponentially ecological degradation. Now it is the time to learn to co-evolve as a sub-system within the biophysical limits of Gaia: our Earth-Homeland [33].

From this co-evolutionary vision that integrates the human being in his earthly and cosmic context, the concept of sustainable development gain a new sidereal dimension to see how all living forms that co-inhabit in Gaia represent an exceptional miracle in the universe. This type of "Cosmic Education" was formulated in 1935 by the biologist, medical doctor, psychiatrist, anthropologist, philosopher, educator, and pedagogue Maria Montessori. As shown in Figure 18.1, the Montessori method is a set of knowledge, practices, and recommendations characterized by the emphasis on the interdependence of all natural elements. This method seeks to create conditions for children 6 to 12 years – future global citizens- to strengthen their feelings of cooperation, respect, and love in relations with the own nature and the cosmos. "Life is a cosmic agent. How shall this truth be presented to the children so as to strike their imagination?" Maria Montessori questioned [2: 32]. Aligned with Big History, Cosmic Education is based on giving children freedom to explore, study, and learn about the early universe, the origin of life, human evolution, language development, and the history of mathematics. They learn to appreciate how diverse cosmic forces operate and interact according to the complex laws and co-evolutionary strategies of nature: "another – and stronger- factor in evolutionary processes is concerned with the cosmic function of each living being, and even of inanimate natural objects, working in collaboration for the fulfillment of the Purpose of Life" [2: 42]. This cosmic vision in pedagogy is an essential seed to achieving the blossoming of a conscious global citizenship ready to comply with the SGS [14].

In sum, Montessori's Cosmic Education promotes a sustainable human development where students feel creative, deeply, and self-aware about how the whole and the parts are interrelated. The epistemological core of this pedagogical approach is aligned with the thought of indian educator Jiddu Krishnamurti [34: 26]: "to learn the mind must remain highly sensitive, and learn implies we see every problem, not as an isolated event, but as a fact related to others." Hence Krishnamurti [34: 185] says, "We need, internally, a great revolution. And to have the possibility make this great psychological and mental revolution we must go beyond the limits of our own mind." For this reason, self-awareness and management of our emotional intelligence are essential elements that all models of education must include in their pedagogical

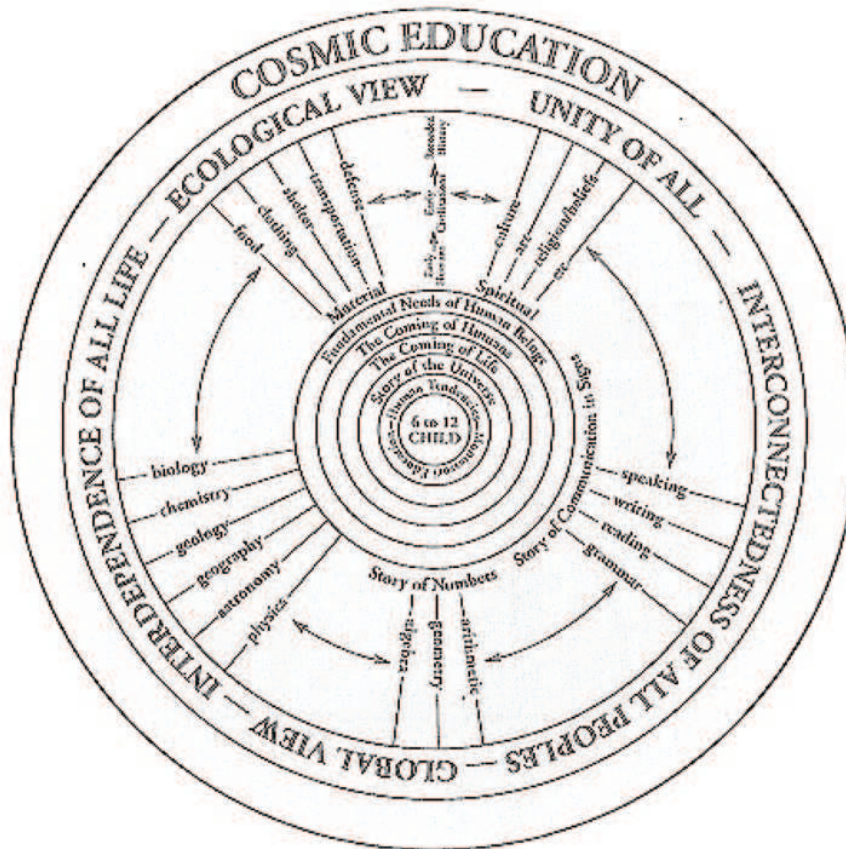


Figure 18.1: Maria Montessori's Cosmic Education method. Resource: Omni Montessori School.

praxis to emancipate human beings in Cosmodernity.

In this sense, combining the thoughts of Montessori and Krishnamurti is a good way to understand that sustainability is a complex and transdimensional process, which is at the same time inside and outside of the human beings. This cosmodern approach constitutes an epistemological openness that seeks to integrate and combine multiple cosmic, physical, ethical, emotional, affective, cultural, and artistic dimensions of a human being who constantly co-evolves in systemic and interdependent processes of energy, matter, and information [35]. Herein lies the need to reintroduce all these dimensions in the teaching & learning processes of formal, non-formal, and informal education, because they are human dimensions directly linked to imbalances of the current world. "The

psychological transformation is more important than outer change. The outer fundamental changes are not possible unless there is a radical transformation, a true revolution in the psyche”, explains Krishnamurti [34: 192], “outer changes and reforms are necessary, but they are always destroyed by our inner state of confusion, disorder, and violence.” Therefore, it is clear that governments are failing in their educational reforms because they are trying to face complex problems of the current globalized world by making the same mistakes of the past. In this process, they are alienating millions of young adults in higher education who do not see any use in university attendance, especially in the West. In order to face the dangers of the future, with the collective aim to meet the SDGs by 2030, we will need a holistic, systemic, and transversal reflection on the appearance of human beings in the Big History, without forgetting the epistemic worldviews and cultural traditions of each particular context.

In the paradigm of Cosmodernity, scientific knowledge of an external physical universe converges with the spiritual knowledge of an inner emotional universe. “Our transdisciplinary education experience for sustainability includes the spiritual dimension as a core for creating relevant knowledge within our societies, at local and global levels,” explains anthropologist and economist Cristina Núñez [36: 109]. This means that educational success cannot be reduced to a simple quantification carried out by standardized tests of reading, science or mathematics, as happens with PISA² tests developed by the OECD. The real educational success lies in understanding that students have spiritual, emotional, and psychosomatic experiences with the intention to develop deep connections with other people, with life, with nature, and with the cosmos. Theory and practice belong together in the paradigm of Cosmodernity, as ideas and sensorial experimentation converge to develop a meaningful learning in all educational levels. This educational vision of human training is defended by neurologist Antonio Damasio [in 37: 34], who considers: “it is necessary that political and educational leaders come to understand how important is the knowledge about emotion and feeling because many of the reactions we consider pathological have to do with emotions, mainly with social emotions, and with the ease that social conflicts are triggered.” This kind of emotional education seems to be a fertile and prosperous path that leads us to the heart of an education that prepares us to achieve sustainable development.

Educating is a transcendental act in the lives of people that forces us to recognize problems outside the classroom. It is necessary to challenge our own educational paradigm to encourage a culture of peace and sustainability that promotes social and democratic transformation. “This is not another reform, but a real structural transformation in the mindset, raise, implement, and management basic education”, argues educator Moacir Gadotti [38: 47], who claimed the need to create a “pedagogy of the Earth” or “eco-pedagogy”

²The Program for International Student Assessment (PISA) report is a worldwide study by the Organization for Economic Co-operation and Development (OECD) in member and non-member nations of 15-years-old school pupils’ scholastic performance on mathematics, science, and reading.

that goes beyond the school logic and reach the entire society. For Gadotti [38: 93], eco-pedagogy “is concerned with the ‘promotion of life’, relational content, experiences, attitudes, and values”, so education should not be confused with the formal and institutionalized schooling processes. While the

schooling logic is focused in the speech, educational logic is focused on the process. “Founded on the principle of competitiveness, selection, and sorting, traditional pedagogies do not help in the development of citizens who needs to be more cooperative and active” [38: 87]. On the contrary, most educational organizations that do not behave like an isolated island in their social environment which develop formal, non-formal, and informal networks ,are already fostering a sustainable mindset. A good example is the formal education system of Finland, where secondary schools train students in an interdisciplinary way through complex concepts such as sustainability, climate change, globalization, etc.

In this line of transdisciplinary human training, psychologist and education scientist Gaston Pineau [39] and medical and anthropologist Patrick Paul [40] have proposed different models. In both theoretical models of human training, it seeks to think in complex ways to understand the interrelationships of the whole with the parts and vice-versa. Consequently, knowledge and human learning imply the development of self-regulating, self-organizing, and self-transforming processes that involving different dimensions of human complexity. According to the “Tripolar Theory on Training” postulated by Pineau [39], where the methodology explores life stories and various formulations that subjects give to their training paths, there are three essential processes in the human training: personalization, socialization, and ecologization. This theoretical perspective led him to formulate three concepts of human training: the “*self-training*” in relation to oneself; the “*hetero-training*” in relation to the others; and “*eco-training*” in relation with the world. Pineau [39: 130] explains that term “*self-training*” came before the other two and favored the development of research on “empowerment of the actors for the appropriation of their power of training.” The concept “*hetero-training*” refers to the social dimension of education and train action in relation with other people and the term “*eco-training*” means training processes with respect material environment [39: 132]. In turn, Pineau highlights that none of these training dimensions should be prioritized over another, and that is why he suggests the term “*co-training*” to describe certain educational processes focused on the interrelations of actors, where nonhierarchical inter-retro-actions occur.

It is here that Paul [40] advocates for an articulation of all these human dimensions postulated by Pineau to develop a fourth dimension that he calls “onto-formation.” According to his “Anthropoformation Theory”, Paul [40: 28] argues that human training is the “global and general process (at the same time particular and unique, but also social and collective) that articulates the interactive relations between eco-formation, hetero-formation, self-formation, and onto-formation.” In addition to increasing a new dimension, Paul [40] also proposes a detailed modeling of the different levels of educational reality of the

transdisciplinary subject, which is summarized in the following figure made by Sommerman [41: 808]:

As Sommerman [41] summarized in Figure 18.2, the model proposed by Paul [40] is composed of four dimensions of human training: ontoformation (L0), self-formation (L1), heteroformation (L2), and ecoformation (L3). According to Paul [40: 531-535], the level of reality N0 is unitive and corresponds to the onto-formative dimension, where a unary logic is necessary to understand virtuality and potentiality that goes beyond of all form and image of this level. L1 is a non-dual level corresponding to self-formative dimension, where all potentialities contained in L0 are manifested, for whose understanding is required the logic of the included middle. The L2 level concerns to dual interactions of hetero-formative dimension, whose binary logic runs about life and death, the subjective and the objective, the individual and the collective, etc. Finally, L3 is the fusion level corresponding to an eco-formative dimension where the symbiosis is the functional basis of living systems of nature. In turn, these four dimensions are epistemologically crossed by the transdisciplinary subject through different stages: moving from eco-formation (L3) to hetero-formation (L2) constitutes the psychogenetic path of human training; moving from hetero-formation (L2) to self-formation (L1) is the imaginary path, and the passage from self-formation (L1) to onto-formation (L0) is the theophanic path of a human being's overall training [40: 541]. As a whole, multidimensional modeling proposed by Paul and Pineau [42] for human being training represents a new transdisciplinary approach that helps us to face planetary challenges that humanity has to meet the SDG. Therefore, educating to live in Cosmodernity means developing the potential of these four dimensions for a transdisciplinary training of a complex human being in constant material, energetic, and informational co-evolution.

This *anthropo-formative* vision is complemented for a complex model of emotional training that we cannot forget in Cosmodernity: the called emotional education. This educational approach is a phychedagogical innovation focused on the endogenous development of people to shape their interiority inside a universe of emotions. Emotional education is supported by the scientific foundations provided by social psychology, neuroscience and psychoneuroimmunology, and it seeks to meet social needs that are not met by traditional academic subjects. So emotional education is within the latest movements of pedagogical renewal and regeneration. This emotional perspective redefines the "Theory of Multiple Intelligences" and potentiates the *self-, hetero-, eco-, and onto-formation* because it provides meaningful learning of cosmodern human training. In short, emotional feelings, spirituality, and interiority are important facets to achieve mental, social, and environmental balance needed to improve the human welfare in a resilient and sustainable manner with all ecosystems of the Earth. What is the role of emotions to manage sustainability? How can emotions help us to achieve the SDG? Is it possible to speak about *eco-emotional education*?

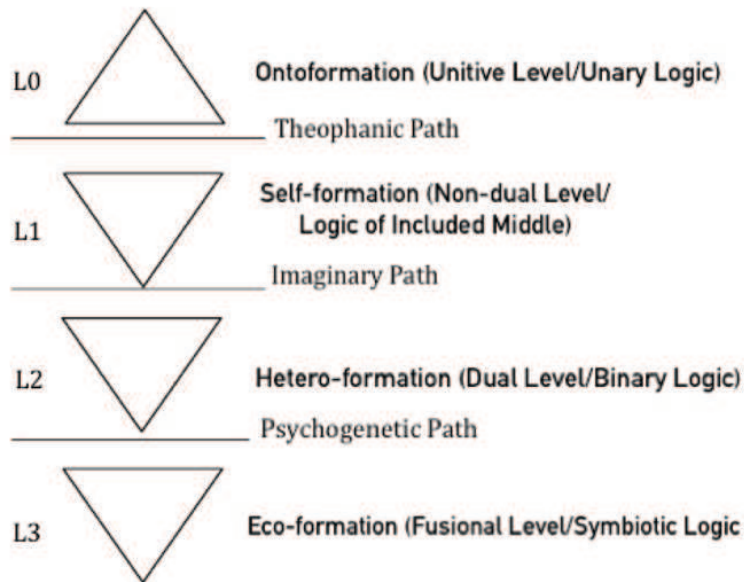


Figure 18.2: Modeling the Anthropoformative Theory of Paul [40]. Epistemological levels of consciousness in different levels. Resource: Sommerman [41: 808].

18.6 Inner Education in a Universe of Emotions

From a historical point of view, human emotions have been little studied by modern scientific psychology, but in recent decades more attention went to this fundamental human dimension. According to the specialized literature, Michael Beldoch first used the term “emotional intelligence” in his book *The Communication of Emotional Meaning* in 1964. In early 1990, social psychologists Peter Salovey and John Mayer [43: 189] proposed the “Theory of Emotional Intelligence,” defining emotional intelligence “as the subset of social intelligence that involves the ability to monitor one’s own and others’ feelings and emotions, to discriminate among them and to use this information to guide one’s thinking and actions.” However, the term was popularized in 1995 with the publication of the book *Emotional Intelligence* written by psychologist and science journalist Daniel Goleman [44, 55-56], who reports five basic domains: 1) Knowing ones emotions (self-awareness); 2) Managing emotions (resilience/mood management); 3) Motivating oneself (self motivation); 4) Recognizing emotions in others (empathy); 5) Handling relationships (social competence).” Since then, there have been different theoretical models but they have never been exempt from criticism alleging lack of indicators or gauges of this type of

intelligence. But, how could we measure emotions and feelings? How to measure our passions and affects? According to scientific agreement, it is clear that emotional intelligence cannot be measurable today, at least with intelligence tests that have been applied since the 1910s to predict school performance of children. The educator Ken Robinson [45] states that most intelligence quotient (IQ) tests only reflect a measure of linguistic, logical (mathematical), and spatial skills, but do not consider other intellectual dimensions such as creativity. Hence the controversy between the scientific communities to assess what types of intelligence exist.

In 1983, the “Theory of Multiple Intelligences”, created by neuropsychologist Howard Gardner, became a pioneering model that opened the debate to redefine intelligence. Since then, numerous authors have been proposing and criticizing models focused on the study of intelligence. While the traditional definition of intelligence was rather reductionist and focused on cognitive aspects, Gardner’s theory [46] focused more on the multiple ways in which we think and learn. Despite the great academic controversy, many schools of thought are using this model to understand the multidimensional nature of human intelligence. For Gardner and his team, there are eight types of intelligence and each person develops some more than others depending on their personal skills and paradigmatic social influence: 1) verbal-linguistic intelligence, 2) logical-mathematical intelligence, 3) visual-spatial intelligence, 4) musical-rhythmic and harmonic intelligence, 5) bodily-kinesthetic intelligence, 6) intrapersonal intelligence, 7) interpersonal intelligence, and 8) naturalistic intelligence. Extending these ideas about intelligence, Gardner and Hatch [47] suggest that interpersonal intelligence recognizes and responds to the moods, temperaments, motivations and desires of others; while intrapersonal intelligence focuses on self-knowledge and access to one’s feelings. Currently, they are also investigating the existence of the ninth multiple intelligence: the “existential intelligence.” Therefore, a theoretical and conceptual model of multiple forms of intelligence is very close to the “Theory of Emotional Intelligences” [43]. This suggests that emotional intelligence plays an important role in internalizing the resilient and sustainable behavior necessary for the compliance of the SDG because this biological phenomenon goes beyond of our cultural constructions..

From a phylogenetic evolutionary standpoint, the human species has developed the ability to combine reason with an inner universe of emotions and feelings that have accompanied it for thousands of years during its evolution. Emotions have been passed down from generation to generation and are a feature and indispensable part of our human nature. Without them, we would be psychopaths with antisocial personality disorders. “As we all know from experience when it comes to shaping our decisions and our actions, feeling counts every bit as much – and often more- than thought” argues Goleman [44: 18], adding that “each emotion offers a distinctive readiness to act; each point us in a direction that has worked well to handle the recurring challenges of human life.” According to some sociobiologists, these automatic reactions

of *emotion-action* were recorded in some form in our nervous system and were crucial to surviving during the long period of human prehistory. Here it is important the specification introduced by the neurologist Antonio Damasio [48: 110]: “while emotions are actions accompanied by ideas and certain modes of thinking, emotional feelings are mostly perceptions of what our bodies do during the emoting, along with perceptions of our state of mind during that same period of time.” Thus, neuroscience affirms that emotional feelings “color” our life from beginning to end, regardless of our nationality, ethnicity, culture, race or religion.

In this sense, it is curious that most international events I have participated always talk about “universal values” and not about “universal emotional feelings.” In my opinion, this is a transcendental epistemic mistake we must correct if we want to achieve the SDG. When we try to identify the universal values that are present in all cultures of the world, we run the serious risk of homogenizing the rich and complex cultural diversity of peoples [10]. According to the estimation made by the philosopher Kenneth Shoulder [49], there are currently around 4,200 religions worldwide. In turn, the research project *Ethnologue* reckoned there were around 7,102 living languages for a population of 7.1 billion people in 2015. After colonization and imperialism, it is clear that epistemic approaches that “universalize” values almost always have a strong Western imprint, as happened with the Universal Declaration of Human Rights. On the contrary, by focusing the discourse of sustainability using a transcultural biological phenomenon, such as human emotional feelings, education gain a new epistemological perspective of *feeling-thinking* to build “another world is possible.”

18.7 Spiritual and Religious Dimension of the Human Condition

In addition to emotional dimension, the book *The Tao of Liberation: Exploring the Ecology of Transformation* written by the ecologist Mark Hathaway and theologian Leonardo Boff [50: 376] also advocate for the spiritual dimension: “The spirituality of each person is in some sense unique, and our own spirituality may draw on a variety of religious or philosophical traditions, as well as our own personal experience.” However, they also warn “most of humanity draws on religious traditions as a key source of spiritual insight. It is nearly impossible to consider spirituality without also considering the influence – both potentially positive and negative- of religion” [50: 376]. Therefore it is necessary to differentiate spirituality from the historical interests that have prevailed and continue to occur within religions. To this end, the work, *Why Religion Matters*, written by Huston Smith [51] is a good study that helps us to establish an interreligious dialogue of most practiced and influential beliefs today: Christianity (33% of the world population), Islam (21%), Hinduism (14%), Buddhism (6%), traditional Chinese religion (6%), and Ju-

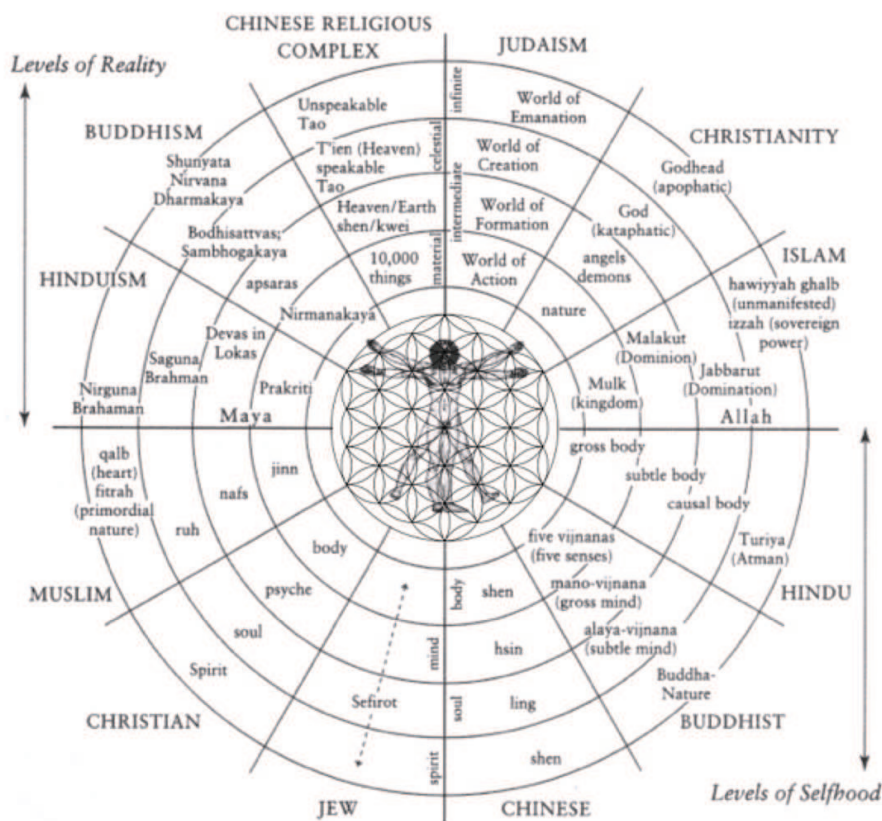


Figure 18.3: Levels of Reality and Levels of Selfhood in the most influential religious beliefs (flower of life added by author). Resource: Smith [51: 224].

daism (0.25%) [49].

As shown in Figure 18.3, the diagram has a form of the mandala with the flower of life in the center representing the common wisdom of native indigenous peoples. The mandala addresses the interpretations that the main religious beliefs have about the relationship between reality and selfhood. At the top, the levels of reality are reflected in the levels of selfhood of the bottom through four circles of different intensity. This figure depicts the many similarities between of the six most influential religions practiced today by approximately 80.25% of current world population. If we also note that 16% of world citizenship is secular, not religious, agnostic and atheist, it means that only 4% of the world population, about 275 million people, practice the other 4,195 religious worldviews identified by Shouler [49]. Thus, the mandala serves us to recognize ourselves in the mirror of the other, of the infinite otherness,

since there are numerous bridges between these great religious dimensions.

Throughout mankind history, religion has constituted a risk factor for all the wars that took place, especially in the Middle East . This is an area of great instability due to a complex network of ethnic, racial, political, and economic factors that arise by the coexistence of three monotheistic religions: Judaism, Christianity, and Islam. Currently, inter-religious conflicts are suffered in countries such as Nigeria (Christians and Muslims), Israel (Jewish and Muslim), Thailand (Buddhists and Muslims), Sudan (Muslims and non-Muslims), Afghanistan (fundamentalist Muslims and non-Muslims radicals), and in Bosnia and Kosovo (Catholics, Muslims, and Orthodox). At the same time, intra-religious conflicts are giving more visibility within Islam, between Shiites and Sunnis, in suppressed countries as Syria, Lebanon or Iraq. In these countries, the so-called “Islamic State” is emerging and threatening the world through terrorism practiced by its followers in the “holy war” against the West.

All these confrontations seem to indicate that we have developed a wrong way to seek our spirituality. Instead of cultivating and researching the mind and our relation with the sacred, we have preferred to maintain dogmatic beliefs: mistaking them with religion and spiritual growth. For this reason, all liberating education must transgress these epistemic paradigms to promote an investigative mind that questions and find out for itself, rather than reproduce and imitate contents of a certain “holy book” written thousands of years ago. In line with this, the Indian theosophist Padmanabhan Krishna [52: 27] marks that “Jesus did not become Christ through a church or a belief, but through his own understanding and his own research. Buddha attained enlightenment and understanding through his own meditation, his own research. We must understand this and correct the situation in our educational system.” The pedagogy of freedom must guide at each individual of global citizenship in their own intellectual, emotional, and spiritual research, questioning the epistemic paradigms where they live in. What is my identity? Why is this my nationality? Why should I follow this particular religion? What are my responsibilities with nature given my human condition and ability for reflection? Only by researching and having our own *insights* we will learn to give these answers. Repeating the answers of Jesus, Buddha, Mohammed or other spiritual leaders we will not be cultivating our own conscience to safeguard life on Earth. Each response is unique and non-transferable.

Critical thinking and self-knowledge is one of the most important skills that students must learn to become spiritually literate. For this reason, it is important to reinvent the sacred from our own individual hermeneutic, which involves learning to dialogue in an intra-religious form. According to the philosopher, theophysicist, and expert in religious comparisons, Raimon Panikkar [53: 74]: “If interreligious dialogue is to be a real dialogue, an intrareligious dialogue must accompany it, i.e., it must begin with my questioning myself and the relativity of my beliefs.” The thought of Panikkar is a meeting point between East and West, his his works is an ongoing intercultural and interreligious dialogue that leads to mutual fertilization between cultures

and civilizations: where everyone learned from everyone. “Each language is a world of its own (...) each culture is a galaxy with its own criteria of goodness, beauty, and truth” [54: 29]. The truth is pluralistic and this means no one has all the elements for the judgment of other cultures. Pluralism makes us aware of our contingency and our limits to judge, showing how to coexist with a cultural diversity that implies galaxies of worldviews with own criteria of reality. According to Panikkar [55], every culture and civilization have three ontonomic orders (myth, logos, and mystery) and an interrelated cosmotheandric dimension. This means that Human History, Cosmic Existence, and Divine Destiny are inseparable. Thus, Panikkar [55] unifies and reconciles the physical cosmology and the religious cosmology, giving a new philosophical and spiritual sense to the *ontology of science*. This is the pure essence of the Cosmodernity paradigm [56]. In sum, the pluralistic consciousness reminds us that every culture or religion are intrinsically opened to be fertilized by others since the understanding of our human identity/condition in the universe requires comprehensive solidarity among all beings to bring us to the knowledge of the ontological structure of reality. Therefore, we must develop a comprehensive look at the teaching and learning processes that take place in the institutions of the educational system. But, how to educate to live in the paradigm of Cosmodernity?

18.8 Educating to Live in the Paradigm of Cosmodernity

Educating to live in the paradigm of Cosmodernity means developing new processes of meaningful learning by exploring different types of human intelligence (rational, spiritual, social, emotional, ethical, etc.) that help us to *feel-think-act* in response to our current emergency situation. Thus, Cosmodern Education cultivates the emotional, spiritual, and ecological literacy as its foundation to develop a sustainability mindset where science, culture, and spirituality are interlinked in the cosmos for a resilient and sustainable human development on Earth. This triple literacy helps students to develop a cosmodern consciousness. Emotional feelings, thoughts, and actions are part of the same phenomenon of inseparable interconnections that form the basis of our socio-ecological relations. In this sense, emotional education helps us to potentiate the meta-cognition pursued by anthropocentric and ecocentric approaches promoted in values education, global citizenship education, education for gender equality, environmental education, education for sustainable development, etc. Emotional education emerges, therefore, as a parallel psychopedagogical dimension that complements transcendently self-formation, heteroformation, ecoformation, and ontoformation. Cosmodern Education cannot be an act of transmitting values and knowledge, but a creative, constructive and transformative act. Students must learn to develop a continuous self-conscious dialogue to *feel-think-act* with their emotional feelings, thoughts, and actions.

According to educators Maria Candida Moraes and Saturnino de la Torre [57: 41-42], “humans act as a whole, where thought and feeling are in holomovement conjugating themselves, so it is difficult to know which one prevails over the other.” What this comparison of the two basic movements of retraction and expansion that physicist David Bohm [58] created in his “Theory of Holomovement”, Moraes and Torre argue that feeling-thinking is a flow of relational and dynamic emotions that interact with the mind, body, and action of individuals to transform their environment. Recognizing that emotions are the foundation of reason, as asserted by biologist Humberto Maturana [59], education is perceived as a holistic phenomenon with multidimensional implications affecting all dimensions of the human condition - mind, body, and spirit. Without those dimensions, an alienation process takes place and the individual and social senses are lost. Therefore, emotions define the type and quality of human actions during their social and relational coexistence. For this reason, it is important to work the emotional education in all areas of formal, non-formal, and informal education. Emotional feelings, thoughts, and bodily actions are part of the same phenomenon of inseparable interconnections that form the basis of our socio-ecological relations. If we want to meet the SDG we have to overcome the fragmentation of positivist culture of the twentieth century to understand that all human knowledge is linked to an infinite universe of emotions that shapes our interiority.

In this line of thought, the psychotherapist Claude Steiner postulated the term “emotional literacy” in 1997 to describes the ability to know the emotions, the ability to empathize with the emotions of others, and the art of learning to manage our emotions to solve emotional problems resulting from the interaction with others. According to this view, emotional literacy helps us understand our inner emotional universe with the intention to facilitate relations of social coexistence. We assume the responsibility for our actions by putting emphasis on emotional training of individuals and seeking to improve interpersonal relationships. “An open heart is the foundation of emotional literacy and a prerequisite for the next two stages of emotional literacy training: Surveying the Emotional Landscape and Taking Responsibility” argues Steiner [60: 57], “that is why the training starts here, by learning how to give and take affection – or in plain English, by learning to love.” Educating for emotional literacy is a dual process of personal development and collective activity, i.e., self-development and community building where the sense of welfare grows along with others in a common and shared environment. In that way, emotional education broadens epistemic horizons of ESD to achieve the SDG’ targets, since it seeks to transform entire global citizenship from the root: making them affectively responsible for current ecological and civilizational crisis.

In a school environment, there are different philosophical and pedagogical movements that seek to develop a social emotional learning to train mankind integrally. A good example is the “Waldorf education” postulated by the philosopher Rudolf Steiner in the early twentieth century, which promotes the

physical, spiritual, emotional, intellectual, and artistic development of students with the aim of developing free, socially competent, and morally responsible individuals. Steiner's theosophical training led him to join anthroposophy to education, applying the process of reincarnation in pedagogy to expand the material world into the spiritual world. From this epistemological perspective, Steiner [61: 5-6] explains that "anthroposophy is therefore the knowledge of spiritual man, and that knowledge is not confined to man but is a knowledge of everything which spiritual man can perceive in the spiritual world, just as the physical man observes physical things in the world. (...) The knowledge which he acquires may likewise be called 'spiritual science.'" Thus, the material world merges with the spiritual world in addressing the integrity of the human being. This endogenous development is also present in the perspective of spiritual evolution and material reincarnation of Indian philosopher Sri Aurobindo. "If evolution is a truth and is not only a physical evolution of species, but an evolution of consciousness, it must be a spiritual and not only a physical fact" points Aurobindo [62: 343] while explains "if there is the evolution of a conscious individual, then there must be rebirth. Rebirth is a logical necessity and a spiritual fact of which we can have the experience." According to Aurobindo [62: 35], "through intensity of emotion that the psychic being awakes and there is an opening of the inner doors to the Divine," which means that soul grows during its experience in the evolution of life by experimenting emotions with the purpose to develop its own nature.

Based on these ideas, physicists and philosophers Danah Zohar and Ian Marshall [63: 9] created the concept of "Spiritual Intelligence" (SQ) to refer to the *soul of intelligence*: "SQ is the intelligence that rests in that deep part of the self that is connected to wisdom from beyond the ego, or conscious mind, it is the intelligence with which we not only recognize existing values, but with which we creatively discover new values." For Zohar and Marshall [63], SQ is not culture-dependent or value-dependent - it creates the very possibility of having values in our cultures. Influenced by the Vedanta philosophy of Swami Vivekananda and Mahatma Gandhi, Zohar and Marshall [63: 263] put forward seven practical steps to improve our spiritual intelligence: 1) become aware of where I am now, 2) feel strongly what I want to change, 3) reflect on what my own center is and on my deepest motivations, 4) discover and dissolve obstacles, 5) explore many possibilities to go forward, 6) commit myself to a path, 7) remain aware there are many paths. Taken together, these steps are aimed at making the "spiritual being" be connected to the whole, having the feeling of integrity. In a similar way, the specialist psychologist in interiority, spirituality, and emotional education, Luis López González [64: 47] considers that "interiority is the human *capacity* that allows developing the consciousness of one's self and the environment, giving sense and meaning to the own existence." For this reason, many authors seem to agree that emotional education is a parallel and complementary path to spiritual education and the education of our interiority in the complex processes of human development.

From this multi-referential perspective of our inner universe, it seems clear

that global citizenship cannot meet the SDG without proper training focused on the meaningful learning of emotions, spirituality, and interiority. They all are dimensions of our human condition that must be potentiated to generate sustainable actions. When neuroscience points out that our actions are preceded by neuronal electrochemical impulses caused by emotional feelings and thoughts that arise from our interiority, it can be concluded that we externalize what it is inside of us, and vice-versa, because we also internalize what happens *outside*. This complex process of constant inter-retro-actions between subjects and the environment is an important feature in the co-evolution of living systems. Nonlinear understanding of this emotional order-disorder of our inside-outside universe is essential for those who work with sustainable development. It implies recognizing sustainability as the result reached by global citizenship – a complex adaptive system- in intermediate conditions of order and disorder. Sustainability also is, therefore, an emotional and spiritual issue. So the contributions of emotional and spiritual education are essential for sustainable development and Gaia's care. According to educators Angela Antunes and Moacir Gadotti [65: 143]: “our first education is an emotional education which places us before the mystery of the universe, in close contact with it, creating in us the feeling of being part of this sacred and living creature that is constantly evolving.” In this context of cosmic evolution, Antunes and Gadotti [65] propose eco-pedagogy as the proper pedagogy for the process of the Earth Charter, where it is promoted the emotional feeling of belonging to one common and shared home at the universe: Earth-Homeland.

From a similar pedagogical worldview, educational psychologist Rafael Bisquerra [37] is inspired in the ontological structure of the outer universe to organize the *universe of emotions* of our interiority. In his book *Universe of Emotions* there is a strong *cosmo-mimetic* creativity with rich theoretical contributions to emotional education. While the universe is formed by galaxies, the universe of emotions is composed by families of emotions that Bisquerra [37] metaphorically referred to as galaxies of emotions. They are massive clusters of affective phenomena and the largest structures in which emotions are agglutinated. “It is estimated around 100,000 million galaxies in the universe. Emotions are processed in the brain, where there are estimated about 100,000 million neurons,” explains Bisquerra [37: 21] while arguing “this curious numerical coincidence is another excuse to propose a parallel between the cosmic universe and the universe of emotions processed in the brain.” Analogous to the “wheel of basic emotions” designed by medical doctor Robert Plutchik in his “Theory of Psychoevolution” or the “Circumplex model of Affects” proposed by psychologist James Russell, the “universe of emotions” also represents a didactic, psychopedagogical and psychotherapeutic resource. The universe of emotions is based on knowledge and scientific theories, but Bisquerra [37] recognizes that its configuration is opened to different interpretations due to the intangibility of emotions. In its original sense, astronomy is the science that studies the celestial bodies of the universe (galaxies, stars, planets, satellites, etc.) and is divided into four main branches of knowledge: positional

astronomy, celestial mechanics, astrophysics, and cosmology. In his emotional model, Bisquerra argues that:

Positional Astronomy aims to locate the stars in the celestial sphere. It describes the movement of the stars, planets, satellites, and phenomena such as eclipses. The application into the universe of emotions is determining the position of various emotions in space. *Celestial mechanics* aims to interpret the movements of positional astronomy. It studies the movement of the Moon, the planets around the Sun, their satellites and calculates the orbits of comets and asteroids. Its application into the universe of emotions is to analyze the movement to cross from one emotion to another. *Astrophysics* studies the stars as physical bodies, analyzing their composition, structure and evolution. Its application into emotions is to analyze the intrinsic traits of each one of them. *Cosmology* studies the origins, structure and evolution of the universe as a whole (...). Its application to the emotions is to study their origin and primitive functions and their evolution [37: 19-20] (own translation).

With this cosmomimetic vision, Bisquerra [37] defines the epistemological model to create his vision of the emotional universe. The complex universe of emotions is structured in galaxies of emotions that, having similar features and nuances, they are grouped in the same family group. The large spiral galaxies are formed at the top by joy, love, and happiness; while the galaxies of fear, anger, and sadness are in the bottom. The surprise appears as a barred spiral galaxy because it is an ambiguous emotion. Social emotions and aesthetic emotions are elliptical galaxies. In turn, disgust and anxiety are irregular galaxies. Collectively, galaxies form a central prism symbolizing the connection between positive (above) and negative (below) emotions. Emotions belonging to one galaxy are divided into four levels measuring their intensity. “We must make it clear that all emotions are good. The problem is what we do with them. The way we manage them determines the effects they will have on our welfare and on the others,” says Bisquerra [37: 47] adding: “while all emotions have value, some make us feel good and other make us feel bad. Hence some are called positives and other negatives depending on whether or not provide welfare.” While the constellations of positive emotions (joy, love, and happiness) are represented at the top, the constellations of negative emotions (fear, anger, and sadness) are at the bottom. The existence of these two constellations represents our emotional polarity: joy-sadness, love-have, etc. In the emotional intergalactic space are located the values and attitudes for their implication in the affective states that embody our actions. Here lies the importance to understand how “universal values” emerge from the emotional feelings of our inner universe. If a human being did not have the ability to feel emotions would be a psychopathic species incapable of understanding the planetary emergency of current unsustainability. In fact, this is what happens with large corporations at the transnational level [50]. They are entities with-

out conscience or emotional feelings that are guiding the course of humanity towards climate catastrophe in their insatiable desire for economic profit. For this reason, sustainability must be conceived as a complex and interdependent process that spans multiple cosmic, ecological, political, economic, epistemic, emotional, and spiritual dimensions.

From this perspective of sustainability, it is so important to know the cosmic universe as well as our inner emotional universe. While the knowledge of a cosmic universe allows us to assess the emergence of life in the Big History as an exceptional event that we must preserve and conserve at all costs; the emotional knowledge or our inner universe allows us to improve the quality of our relations with other people and with nature. Therefore, walking towards sustainability means setting the emotional course for our mental, social, and environmental welfare. We cannot let the markets of economic globalization continue managing the civilizing course because it has a huge negative impact on our personal health and the planet's health. The great transition to "other possible worlds" is a twofold process of internal and external transformation of our human condition that requires new transdisciplinary educational models aimed to create strong links between emotions and the environment. This symbiosis represents the ideal mindset for the emergence of a cosmodern education that allows us to improve our human ability to learn how to co-evolve in harmony with all ecosystems of nature.

Emotional learning has a key paper to respect the *Pachamama* (our Mother Earth according to the indigenous cultures of the Andes) and to achieve the SDG. When the emotional and socio-ecological pedagogical practices are integrated, it is possible to plant the seed of sustainability in every human being: stimulating their self-esteem to improve their social skills and develop healthy lifestyles for our planet. As demonstrated by neuroscience, emotional feelings precede our actions, which means that before learning to inter-retro-acting sustainably we must learn to feel in harmony with nature. It is for this reason that sustainable development can not be reduced to just three dimensions (social, economic, and environmental), as happens in almost all statements of the UN system. This reductionist view does not allow us to internalize the complex phenomena that are inter-retro-acting constantly in the *continuum* of life during its co-evolution with the environment. As it has been demonstrated in this study, our emotions, spirituality, and interiority are a fundamental dimension for the achievement of the SDG through a comprehensive and sustainable human development. For this reason, "before a child learn the alphabet and some notions about the world, should learn what is the soul, truth and love, and what forces are sleep in the soul," explains pacifist activist Mahatma Gandhi [66: 100], arguing that "an even more essential part of education should teaching child to win the battle of life to conquer hatred with love, falsehood with truth, and violence with his own suffering." In the educational philosophy of *Gandhiji* (as he is popularly known in India), love is a feeling that fights against violence to be a law of truth and life. What is the role of love in the future we want?

18.9 Final Conclusions for the Future We Want

SDG have an important role in Big History because the human race has had a profound impact on the climate and environment of the Earth. They represent our last opportunity to avoid ecological extinction and points of no return in the new geological era we have entered – the Anthropocene. This period is characterized for the great human footprint on Earth, causing a huge extinction and dramatic environmental degradation. Reflecting on challenges concerning the SDG carries many questions and approaches. Therefore, the transdisciplinary and biomimetic contribution of this study has to be understood as a proposal to raise the consciousness in evolution, opened for new reinterpretations, additions, and considerations. I believe that emerging global citizenship must learn to contextualize human history, life history, history of Earth, and the history of the universe from transdisciplinary methodological approaches. This involves examining the multidimensional identity of the emerging planetary citizenship through a cosmodern approach that views the complexity of the human condition as an *individual-society-species*: contextualizing cosmo-biologically the human *species* to understand we all are ontologically equal beings (with the same molecular composition of DNA); with a rich cultural and spiritual diversity that characterizes every *society* in terms of their phenomenological and hermeneutical historical context; and with interests, motivations, and dreams radically different between *individuals*. A human condition is, moreover, interconnected in the *cyber-space-time* through mobile devices in its virtual identity condition. This cosmodern vision that contextualizes our human condition in a multidimensional way supposes a true educational transformative tool to promote a new mindset where we all are ready to *feel-think-act* in harmony with nature. In short, this cosmodern philosophy is the epistemic training of authentic *worldlists*, an expression created by the Argentine writer Ernesto Sábato to argue the great need of our planetary civilization to have people who are taking care of the most urgent and global problems of the world. In this sense, love is the most powerful energy to transform our world-society.

For this reason, we have to implement this transdisciplinary and biomimetic vision in all pedagogical contexts of schools and universities to strengthen the links between education and sustainability. This cosmodern mindset promotes the creation of new socio-economic models with planetary character to feel-think-act in harmony with co-evolutionary processes of nature. Biomimicry is a meeting point between the societies called “primitive” and the so-called “hyper-technological” because it has a spiritual and ecological corpus playing the symbiogenetic role between nature and human culture. Thus, the past and the future are present in the spiritual and scientific research process, complementing a common reality shaped by the undivided wholeness of consciousness, matter, and energy [67]. “Just like transdisciplinarity, biomimicry-inspired problem solving, with a deep emphasis on how humans from all walks of life can learn from nature, focuses on the processes and energy flows inherent in

deep, complex interactions among people's internal world and their external world, mediated by such factors as culture, art, religion, and spirituality", said McGregor [7: 63]. Transdisciplinary refer to the latter as the Hidden Third, the place full of potential where people's experiences, interpretations, descriptions, representations, images, and formulas meet. Then, we have to combine a framework of convergence between scientific knowledge that our outer physical universe offers us, with the spiritual wisdom of the inner emotional universe of mankind [68]. According to Núñez [36], the ancient philosophical traditions of indigenous peoples show us that psychosomatic experiences between the body and the mind help us to establish and develop sacred connections between Nature and Life – promoting sustainable human habits with the environment. A good contemporary example that seeks to rescue such millenary knowledge and wisdom of the Aboriginal peoples of Australia is the permaculture created by the scientist David Holmgren [69].

In current context, SDG educational strategies of Action Framework for 2030 should seriously reflect on the possibility to build a great human family through a cosmopolitan consciousness that identifies our human condition within co-evolutionary processes of Big History. In abstract, it is necessary to foresee the future to be ready when it arrives, because there are not doubts that nanotechnology, quantum computers, artificial intelligence, contact lenses with internet access, genetic mutation of DNA, and space travels will radically change our human habits in a short period of time. That is why we must train global citizenship for the emerging Cosmopolitan paradigm [70: 105]. It has come the time to walk together to the challenges of this new civilizational paradigm following the African proverb that says, "If you want to go fast, go alone. If you want to go far, go together." Are you ready? I invite all readers to move forward with any thought inspired by the transdisciplinary and biomimetic ideas of this work for the fulfillment of the Sustainable Development Goals.

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