

COMPLEXITY, EDUCATION, AND PLANETARY ETHICS: CHALLENGES FOR TEACHERS IN THE 21ST CENTURY

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ABSTRACT

The modern paradigm of school education, based on science and Enlightenment rationality, prioritizes discipline and the fragmentation of knowledge. While it has contributed to significant advancements, this approach faces contemporary criticisms, particularly regarding the ideas of Edgar Morin. He emphasizes the need for complex thinking that recognizes the interactivity between disciplines and promotes an integrated view of reality. Morin criticizes overspecialization and the simplification of knowledge,

which limit the understanding of human, social, and environmental complexity. Thus, transdisciplinarity is proposed as a way to overcome the fragmentation of knowledge and renew education. Teacher training should foster curiosity, ethics, and the ability to contextualize knowledge. This approach aims not only to train technics professionals but also to cultivate citizens who are aware of their interdependence with the planet and committed to an ethic of global responsibility.

KEYWORDS: Complexity; Education; Ethics; Training; Teachers.

COMPLEXIDADE, EDUCAÇÃO E ÉTICA PLANETÁRIA: DESAFIOS PARA A FORMAÇÃO DE PROFESSORES NO SÉCULO XXI

RESUMO

O paradigma moderno da educação escolar, que se baseia na ciência e racionalidade iluminista, prioriza a disciplina e a fragmentação do conhecimento. Apesar de ter contribuído para avanços significativos, essa abordagem enfrenta críticas atuais, sobretudo no que diz respeito às ideias de Edgar Morin. Ele salienta a necessidade de um pensamento complexo, que reconheça a interatividade entre as disciplinas e promova uma visão integrada da realidade. Morin critica a superespecialização e a simplificação do conhecimento, o

que limita a compreensão da complexidade humana, social e ambiental. Dessa forma, propõe-se a transdisciplinaridade como uma maneira de superar a fragmentação do conhecimento e renovar a educação. A formação docente deve estimular a curiosidade, a ética e a capacidade de contextualizar os saberes. Esta abordagem tem como objetivo não apenas formar profissionais técnicos, mas também cidadãos conscientes da sua interdependência com o planeta e comprometidos com uma ética de responsabilidade global.

PALAVRAS-CHAVE: Complexidade; Educação; Ética; Formação; Professores.

1 INTRODUCTION

The new scenario of the global climate crisis, with serious repercussions in Brazil, has brought to the fore the problem of the social and environmental crisis on a planetary scale. This article addresses, in the form of a reflective essay, the new challenges involved in the field of teacher training from the perspective of Edgar Morin's complexity paradigm. In particular, it asks: what knowledge is necessary and relevant to teaching in the context of the complexity paradigm, and to what extent does it allow us to rethink teacher training in Brazil in times of climate crisis?

The need for ecological thinking configured from the perspective of a complex epistemology requires us to think in a way that allows us to reconnect the various dimensions of reality that produce it. The contemporary condition expresses the existence of a global polycrisis, which involves politics, ethics, culture, the environment and thought. In this scenario, the assumptions of the complexity paradigm would be challenging us to rethink our way of thinking, and, consequently, our ways of life, implying changes in education and teacher training.

A new way of relating to knowledge and understanding could emerge in the context of school education based on the complex and ecological paradigm suggested by Edgar Morin. This implies a new way of training teachers, while valuing:

- a) ethical, political and aesthetic-expressive knowledge and skills, which allow for a general education, capable of providing a reflection on human, social and planetary destiny;
- b) pedagogical knowledge and skills, which enable reflection and understanding of the meanings of the act of educating, teaching and learning, taking into account a horizon of complexity to design the curriculum, planning, and pedagogical practice;
- c) epistemological knowledge and skills, which enable inter and transdisciplinary dialogue, allowing teachers to build research projects and incorporate cross-cutting themes, to qualify the learning of school subjects, while allowing students to decipher the complexity of the world based on the complex and articulated fabric of the multiple languages of knowledge.

To address this broader sense of the new reference frameworks that emerge from the paradigmatic approach to complexity, we will highlight three moments in the text. The first one signals the possibility of problematizing the pillars of the modern paradigm of science and its relationship with teaching knowledge. The second one opens up the question of how this notion of knowledge and scientific logic are present in schools and have a strong impact on what it means to be an educator and what knowledge needs to be taught. The third moment seeks some clues to help us think about the paradigmatic reform that could lead us to another moment in teacher training in Brazil.

2 THE PILLARS OF THE MODERN SCIENCE PARADIGM AND TEACHING KNOWLEDGE

The challenge of thinking about the knowledge necessary for teaching in the context of the civilizational and climate crisis we are experiencing places us not only in the task of characterizing our time, but above all, of problematizing the paradigm that governs our thinking. According to Morin (2000, p. 26), “the paradigm plays a role that is both subterranean and sovereign in any theory, doctrine or ideology”. According to him, “the paradigm is unconscious, but it irrigates conscious thought, controls it and, in this sense, is also supraconscious” (ibid.). Morin (2000, p. 26) warns us that the paradigm “establishes primordial relationships that constitute axioms, determines concepts, commands discourses and/or theories”, and in this regard “organizes their organization and generates generation or regeneration” (Morin, 2000, p. 26).

A paradigm is a type of logical relationship (inclusion, conjunction, disjunction, exclusion) between a certain number of notions or master categories. A paradigm privileges certain logical relationships over others and that is why a paradigm controls the logic of discourse (Morin, 2003, p. 162).

In Morin's interpretation, the striking characteristics of the modern paradigm of science, which had been imposed on planetary civilization by the “unfolding of European history”, had been introduced by Descartes in the 17th century (2000, p. 26).

Descartes, in proposing the problem of knowledge, determines two totally separate, totally distinct fields of knowledge. On the one hand, the problem of the Subject, of the *ego cogitans*, of the man who, so to speak, reflects on himself, and this problem will be, must be, that of philosophy. On the other hand, the problem of what he calls *res extensa*, that is, of the objects that are found in a space, and the universe of the extension of space is that offered to scientific knowledge (Morin, 2000, p. 27).

It can be observed, based on this understanding by Morin (2000), that the total disjunctions of these two areas of knowledge, philosophical and scientific, are striking characteristics of this period that marks the modern era. And, in contemporary times, it will be responsible for the lack of awareness and reflexivity within science, as well as the relevance of scientific knowledge within philosophy. According to Moraes (2021, p. 80), the problem of thinking from disjunctions reinforces that “the paradigm privileges some relationships to the detriment of others, which makes it control the logic of discourse”. On the other hand, we need to think about paradigms from a broader approach in which both theories, the dominant and the rival ones, complement each other, coexist with each other and establish good communication.

In this sense, based on the principles of *separation and disjunction*, cultures of knowledge have developed that have been exclusively concerned with either explaining reality or understanding it, without worrying about the problem of reciprocal foundation and communication. This dualism within the modern debate on knowledge and science causes an overvaluation of technical-scientific (objective) or even explanatory knowledge, linked to teaching, and relegates to a secondary position the dimension of knowledge related to reflexivity, Philosophy, Human Sciences and Arts (subjective), or even comprehensive knowledge.

According to Morin (2000), from this perspective, Western thought takes as fundamental and constitutive assumptions of any epistemological relationship that aims to be objective (and meets the monological and one-dimensional logic of science) the need to use the principles of decomposition and isolation. Under this confluence, epistemic relationships emerge in modernity, marked by the dualism of the subject-object relationship, characterized by centralizing the possibilities and limits of knowledge in the mind of the subject and in the certainty of the method. The fundamental dogmas of this knowledge are situated in the perspective of understanding that “the role of knowledge, as Jean Perrin said, consists in explaining the complex visible by the simple invisible” (Morin, 2000, p. 45). The notion of teaching knowledge derived from this epistemological perspective validates as central dimensions, for didactic action, the mastery of technical and disciplinary knowledge, in such a way that everything that involves more complex dimensions, such as pedagogical, ethical-political and aesthetic-expressive dimensions, are disregarded in the field of teacher training.

According to Morin (2000, p. 95), classical science, until the 20th century, when it entered into crisis, was based on four pillars of certainty that have the cause and effect of dissolving complexity through simplicity: the principle of order, the principle of separation, the principle of reduction, and the absolute nature of deductive-identity logic. The sense of knowledge and understanding that will become constitutive of the modern paradigm, therefore, will influence and determine the identity core of what constitutes the activity and knowledge of teachers and professors within modern institutions.

The pillar of “*order*” postulates that the universe is governed by imperative laws. Its absolute character comes from the origin of absolute monarchy, human and/or divine. Until Newton, it was divine perfection that guaranteed the perfection of the Laws of Nature. Later, with the return of God to technological unemployment by 19th century science, Order is based on itself, or rather, it is the world conceived as a perfect machine, which acquires the absolutism torn from God. [...] The second pillar, that of the *principle of separability*, is constituted by the principle according to which to solve a problem it is necessary to break it down into simple elements. According to the rule of the Discourse on Method: ‘Divide each of the difficulties that I would examine equally into parts that could and would be convenient to better solve them’. [...] The third pillar, that of the *principle of reduction*, is based on the idea that knowledge of the basic elements of the physical and biological world is fundamental, while knowledge of its sets, changes and diverse aspects is secondary. This principle strengthens the principle of separability, which strengthens the principle of reduction. [...] The fourth pillar is that of *inductive-deductive identity logic* identified with Reason. Induction, deduction and Aristotle’s three identity axioms ensure the formal validity of theories and reasoning. Our classical logic was born in Greece four centuries before our era; it concerns concepts, propositions, inferences, judgments and reasoning; its foundations were proposed in Aristotle’s *Organon* (Morin, 2000, p. 95-97).

Morin (2000) interprets that these pillars were being used to construct safe, metaphysical paths to build scientific knowledge capable of building a new civilization - modern - centered on the idea of a rational, conscious subject, endowed with the ability to look at the world and explain it through the rules of the method. This conception refers to a growing belief, at least in the scientific community, that there were possibilities of unveiling the world through increasingly

rigorous scientific methods, imagining, however, that there was an ultimate foundation and that everything could be done technically. The mechanistic configuration of the world itself, instituted by the paradigm of natural sciences, would become the hegemonic representation, which would influence not only education, but also the very idea of politics.

In modern times, politics, taken as a technique, as a political technique, becomes the basis for constituting the State. Practical philosophy thus follows the cognitive ideal of the natural sciences, since it seems the most reliable. Politics, in this way, not only starts from ethics but also becomes scientifically rationalized. Practice, in the general sense, also follows the technical-scientific model (Milovic, 2002, p. 25).

Philosophy, the arts and religion, from the perspective of this scientific paradigm, are relegated to a secondary level as they do not correspond to and are unable to achieve the levels of objectivity required by the new contexts. In general, knowledge, under the terminology of subjective (practical) reason, capable of guiding and illuminating the most diverse spheres of daily life, then becomes the difference between modern philosophy and science in relation to medieval philosophy. A different mentality (from the medieval era) on the cultural and social plane gradually begins to be constructed under the prism of the rise of the power of reason and science in constructing values to standardize the context of social life. But what did this imply in the process of constitution and organization of the human sciences, such as psychology, sociology and history? And how did it influence teacher training and the idea of what knowledge would be necessary for teaching?

According to Morin, the human sciences suffered the invasion of the model originating from classical physics, and everything that resisted this model seemed retrograde. The author also emphasizes that it is necessary to note that these sciences suffered, since their birth, the mark of the great disjunction that separated them from the natural sciences, which inhibited any possibility of considering the bioanthropological complex that constitutes human reality (Morin, 2000, p. 129).

[...] the invasion of the principles of classical science inflicted on the psychosocial-historical complex that is specifically human the cuts and divisions into compartments, abstract and arbitrary. Sociology, claiming to be scientific, emptied itself of all history and all psychology, objective behaviorist psychology emptied every human being of his subjective, cultural and historical part. It even reached the structuralist paradox that liquidates the notion of man and evidently that of subject (Morin, 2000, p. 129).

In fact, it can be intuited from these characteristics that there is, in modern thought associated with the idea of growing development and achievement of science, of the myth of an authentic rationality capable of revealing the truth about the world, and of promoting its progress and ordering, an also growing dependence on other spheres of knowledge which, under the need to organize themselves, even questioning this simplifying logic, end up suffering its influence, manifested primarily in the fragmentation and compartmentalization of reality (Morin, 2003, p. 42).

This theoretical-methodological matrix originating from Cartesian thought, which privileges fragmentation and separation, to the detriment of distinction and union, ends up becoming in modernity a correct way of knowing, interpreting and understanding the world, in order to detect its regularities, orders and laws (Morin, 2001a).

It is clear, in the meantime, that the notion of explanation that enters the field of knowledge and organizes it has become tied to the problem of causal techniques arising from the natural sciences, following the classical principles of science, which postulated that “the apparent complexity of phenomena could be explained based on a few simple principles, that the astonishing diversity of beings and things could be explained based on a few simple elements” (Morin, 2001, p. 27). In this context, the classical principles of explanation operate and are rooted in the Cartesian assumptions of separation and reduction. The “linear” transposition of these principles to the humanities, according to Morin (2000), results in a “simplifying” way of thinking. Against this background, it is important to state that the application of simplifying thinking to human phenomena leads to the crudest ideas. As Wittgenstein pointed out, “explanations of (supposed) primitive uses are much cruder than these uses are” (Morin, 2000, p. 100).

In fact, it is known that, paradoxically, associated with the progress of science and knowledge, as we have previously argued, humanity lived, during the 20th century, in the social field, a profound state of misery. We witnessed two great wars, genocides and ethnocides of all kinds, totalitarianism, concentration of wealth, gradual destruction of natural resources, exclusion and silencing of cultures, individuals and minority groups. Heidegger characterized this period as the “crisis of humanism”, from which he understands the intimate connection between the destruction of metaphysics and the advent of science and modern technology to the detriment of humanist ideals.

Technique appears as the cause of a general process of dehumanization, which includes both the obscuring of the humanist ideals of culture in favor of a formation centered on sciences and rationally directed productive skills, and in the plan of social and political organization, a process of accentuated rationalization that allows us to glimpse the characteristics of the society of total organization, described and criticized by Adorno (Vattimo, 1996, p. 20).

For Morin (2002), today we are experiencing the decline of a type of idea of the future, and this idea is associated with a deterministic, optimistic conception that believes in progress and has been fed back by technoscience and modern thought.

There was uncritical belief in technology, science and the beneficial, necessarily emancipatory effects of Reason. In the nations of real socialism or in the capitalist world, with the same intensity, people bet on a radiant future. The crisis is not only due to the fall of communism, but also to a general upheaval of civilization. Economic instability is global. Until thirty years ago, intellectuals allowed themselves to be blinded by the promise of futurism. We have discovered, however, that science can also produce ignorance, because knowledge is confined to specialization. Industry manufactures useful objects and also threats to the universe, such as pollution. Finally, the very foundation of the radiant future no longer holds: no one knows what will happen tomorrow. There is no way to make reliable predictions (Morin, 2002, p. 10).

According to him, under this closed logic, “our future is more than ever animated by the dual dynamics of the development of science and the development of technology, which feed off each other” (Morin, 2002, p. 88). This dynamic propels industrial development and civilizational development across the globe, which in turn stimulate it. Thus, technoscience has been leading the world for a century. It is its developments and expansions that operate the developments and expansions of communications, interdependencies, solidarities, reorganizations, and homogenizations that drive the planetary era forward. But it is also these developments and expansions that provoke, “by retroactive effects, the balkanizations, heterogenizations, disorganizations, and crises of today” (Morin, 2002, p. 88).

In this way, the links of the crisis in science find their counterparts in the civilizational crisis in which it participates, more particularly, from the interludes of the entry of the logic of the artificial techno-scientific machine into the world of life of developed societies. For Morin, technoscience “is not only the locomotive of the planetary era”, but also the nucleus and engine of the planetary agony” (2002, p. 88).

[...] Technoscience... has invaded all the fabrics of developed societies, implanting in an organizing way the logic of the artificial machine even in everyday life, expelling citizens from democratic competence in favor of experts and specialists. It has created fractures in thought by imposing disjunctions and reductions (Morin, 2002, p. 88).

In this sense, although it is superficially perceived that the contribution of science to the contemporary social world has been considerably significant (positive) in the dimension of the production of technique and technology, its implications in other contexts of the world of life have not necessarily been so and, therefore, raise a series of ethical, political and cultural questions. These are of significant interest in the process of reforming thought and resizing the meanings and purposes of education and school teaching from a less mutilating perspective.

In complexity, there is no longer a single or ultimate foundation for knowledge, nor a sovereign order in a universe where chaos, disorder, and eventualities compel us to negotiate with uncertainty. There is no relevant knowledge about closed, isolated objects, but rather a need to contextualize all particular knowledge and, if possible, to introduce it into the whole or global system of which it is a moment or part (Porto & Fortunato, 2024, p. 23).

The problem of teaching knowledge, under this prelude, finds an echo in the reform of thought and in the critique of modern instrumental and simplifying rationality. In a similar sense, the teacher training project for the 21st century would need to consider the ways in which the modern paradigm helped to constitute and consolidate a logic of knowledge and curricular organization, or even a meaning and purpose for the school. Overcoming the modern paradigm, through complexity, will allow us not only to establish other programmatic principles for knowledge, but also for the scope of teacher training, which include, above all, epistemological, pedagogical, ethical-political and aesthetic-expressive dimensions.

3 KNOWLEDGE AND SCHOOL EDUCATION IN THE MODERN PARADIGM

The traditional organization of teaching and education at school level, *broadly speaking*, is centered on the logic of the organization of modern society, under the roof of the structuring concepts that stem from the scientific and philosophical paradigm developed since the beginning of the 16th century, with the Renaissance, and which reached its peak in the 18th century, with the Enlightenment. In effect, this perception is articulated in the sense of the social relevance that the educational project assumes in the constitution of modern forms of social participation (democratic), as well as the role of knowledge, school/university and scientific rationality in the construction of modern subjectivity.¹

In this context, the school/university acquires centrality in the human social project of modernity from the possibility of breaking, through science and rationality, with the archaic mentality of the medieval paradigm of knowledge. These initial perspectives, which are beginning to be outlined, necessarily allow us to demonstrate that an understanding of contemporary education, and its possibilities for paradigmatic change, cannot be separated from a reflection on the relevance of science in the social context, and, particularly, accompanied by a reflection on the very notion of science and knowledge that has become hegemonic in Western thought.

The inability to recognize, treat and think about complexity is a result of our educational system. It teaches us to validate every perception, every description, every explanation through clarity and distinction. It inculcates in us a mode of knowledge that comes from the organization of sciences and techniques of the 19th century, which is disseminated throughout all social, political and human activities (Morin, 2000, p. 90).

This seems to be the indicator that brings us closer to Edgar Morin's intellectual production in relation to education, that is, the possibility of thinking about the restructuring of school education in the face of the resizing that has been taking place at the heart of contemporary science and philosophy itself, which, incidentally, also has a close connection with the crisis of the constitutive paradigm of modern civilization.

It can be said, in these terms, that Morin's path of criticism of the modern paradigm of science is oriented, among other aspects, towards "denouncing" the growing "hyperspecialization" and "compartmentalization" of modern science. And, in this sense, he demonstrates with great clarity and consistency the fragmentation resulting within science itself, as well as the social significance of this process in the constitution of modern man and education. The relevance of his reflection is not limited to an "obscurantist criticism" that, in the face of the "crisis of humanity", rejects the richness of science, rationality, or even reason itself.

On the contrary, it fundamentally demonstrates an appreciation for the entire tradition of knowledge, while also including the relevance and need for new principles of knowledge capable

¹According to Morin (2002, p. 26) "in the 18th century, the humanism of the Enlightenment attributed to every human being a spirit capable of reason and granted him equal rights. The ideas of the French Revolution, when they became widespread, internationalized the principles of human rights and the rights of peoples".

not only of recognizing the complexity of reality, knowledge, man, society, and life, but, fundamentally, of fighting in epistemic terms against any attempt to mutilate it. The reform of thought, of new principles for thought, seems to be the imperative issue that arises in different forms in scientific, ethical, political, artistic, and philosophical contexts as we enter the 21st century.

The links of a reform of thought, in this perspective of complexity, emerge not only as a specific need to transform education or science, faced with a state of crisis, but fundamentally, as a broad and profound need to restructure the very conditions of human thought in the most distinct dimensions of human life in society.

Our thought must invest the unthought that commands and controls it. We use our thought structure to think. We will also need to use our thought to rethink our thought structure. Our thought must return to its source in the form of an interrogative and critical circuit. Otherwise, the dead structure will continue to hold petrifying thoughts (Morin, 2002, p. 35).

In the face of this onslaught, the educational and school project of modernity has been heavily criticized, since it was based on an exclusively disciplinary and encyclopedic conception of science, as well as presupposing its supposed absolute sovereignty in relation to other areas of knowledge. The very notions of man, cosmos, nature and society addressed in traditional theoretical approaches have disregarded the multiplicity of anthropo-socio-biological issues that involve the human condition on the planet. Marques (2002, p. 108) warns of the importance of understanding the process of constitution of sciences as a way of thinking about teacher training:

It is not possible to adequately think about pedagogical science without thinking about the pedagogy of sciences, that is, it is not possible to think about the teaching of sciences except in a way that is linked to the movement of their constitution. If the practice of science is already a pedagogical practice in a discontinuous process and through ruptures, the teaching of sciences can, however, acquire finished and dogmatic formulas, thus distancing itself from the process of reconstructing them, always in successive approximations. Educators need to be alert against these epistemic relapses.

The principles of Morin's theory of complex dialogism ², to the detriment of the principles of classical logic, would be allowing a fruitful discussion on the theme of trans/inter/disciplinarity in school education, and its relevance to thinking about teaching knowledge, dissolving old fixed, rigid and static relationships between the different areas of knowledge. This allows educators to think differently about disciplinary boundaries, giving them the challenge of carrying out, through the complex method, a practice of dialogue and communication between them, while at the same time not erasing the differences and hiding their ambiguities.

² "The dialogic principle can be defined as the complex association (complementary/competing/antagonistic) of instances necessary together for the existence, functioning and development of an organized phenomenon" (Morin, 1999, p. 110).

Thus, the paradigm of complexity, even though it questions the mutilating and simplifying conditions of disciplinary thinking, typical of the modern paradigm of science, does not reject the discipline itself. It does not condemn the teacher/specialist either, but imposes on him the need to contextualize it in a web of relationships and overlaps with others. It does not question the simplicity, the relevance of a specific, local, contingent approach, but incites it to the challenge of situating itself in a general, global, structural contextuality. As Ardoino (2002, p. 558) describes:

[...] without causing harm to disciplinary knowledge, which is always necessary, teachers need, in order to fulfill their task, to have increasingly solid ethical, epistemological and political curiosities and skills, in light of the missions entrusted to them by society and due to the challenges posed by the contradictions and antagonisms experienced today by our universe.

Thus, from the perspective of the disciplinarity/trans/inter/disciplinarity relationship, it is described that the challenges of complex thinking in education are articulated and brought together in a perspective that allows us to overcome the exclusively disciplinary model characteristic of school education in modern times, opening gaps for a paradigmatic approach of a transdisciplinary nature regarding the indispensable teaching knowledge in times of climate crisis. Knowing how to contextualize and globalize, at the same time, become relevant conditions for intervention in the classroom. According to Moraes, "the very etymology of the word *trans-disciplinary* already reveals a little of its nature, it is that which transcends the disciplinary, recognizing the intrinsic dynamism that occurs at another phenomenological level, in another linguistic domain, in another reality" (2015, p. 76). And what is beyond the curricular components is the human being himself immersed in his complex reality to be continually explored.

From this, it can be seen that the logic of the organization of teaching and education, as well as the fundamental knowledge to be developed by educators in the school environment, can be guided by a new matrix that considers inter/trans/disciplinarity as the backdrop for the intercomplementarity of knowledge. This condition becomes one of the possible ways, in this work, to understand the current relevance and importance of complexity theory for pedagogy and education.

Beyond a specific content, a key to open all doors and a single answer to the ills of civilization, Morin's thinking regarding the reform of education and the construction of a well-rounded mind in today's world should be understood as a necessary challenge for educators, who need to make full use of their intelligence and their thinking. In other words, this would mean a necessary undertaking on the part of educators to understand the need for the emergence of a new scientific spirit, capable of fostering general intelligence, the ability to problematize and connect knowledge. According to Morin:

[...] to this new scientific spirit, it will be necessary to add the renewal of the spirit of the culture of the humanities. Let us not forget that the culture of the humanities favors the ability to open up to all major problems, to meditate on knowledge and to integrate it into one's own life, in order to better explain, correlatively, one's own conduct and self-knowledge (Morin, 2001, p. 33).

In addition to taking these statements in isolation, separated from their context, in order to understand the breadth of the questions that are posed to school education, it is important to understand together the situation of crisis in which modern thought finds itself, in its own constitutive epistemology. Morin's writings on the current condition of knowledge, more especially on the crisis of the foundations in philosophy and science, would also become the condition for rethinking, in the face of these circumstances, the conditions of possibility of new meanings and purposes for education, regenerating our way of thinking about the knowledge necessary and indispensable for teaching.

4 THE REFORM OF THOUGHT IN SCHOOL EDUCATION: THE PRINCIPLES OF THE COMPLEX METHOD AND TEACHING KNOWLEDGE

This topic aims to address the conditions that lead us to seek to overcome the paradigmatic logic that designed teacher training in modern times, and to seek, with this, to think about the teaching knowledge necessary for the 21st century, based on the principles of the complex method. The split between philosophical and scientific cultures, the devaluation of the humanities, the compartmentalization and specialization of technoscientific knowledge, have led to an increasingly prominent presence of simplifying principles in people's daily lives. In school education, this presence is evident through the quantitative logic of knowledge, the requirement to accumulate and memorize, the disregard for the arts, body expression, playfulness, and reflection/thought. It is also evident in the disciplinary organization of knowledge, in the distance from the reality of students, in the difficulty of communicating with everyday knowledge, and, fundamentally, in the construction of the meanings and purposes of education.

In addition to the need to understand the importance of our complex human condition and the need for effective communication between knowledge, it is necessary to reinforce that humanity has its identity as an earthly being, that is, we must recognize and understand our deep connection with planet Earth. Morin (2003) argues that all human beings, despite their cultural, ethnic, linguistic and religious differences, share a common heritage and destiny linked to the Earth. Teaching this "earthly identity" is, therefore, a way of promoting awareness that we are all inhabitants of the same planet and that both our past and our future are deeply interconnected.

Its biological identity is fully terrestrial, since life emerged on land from terrestrial chemical mixtures in turbulent waters and under stormy skies. And this terrestrial physicochemical identity, inherent to all living organizations, contains within itself a cosmic pluri-identity, since the carbon atoms necessary for terrestrial life were formed in the furious forge of suns before ours, and billions and billions of particles that constitute our body were born 15 billion years ago in the radiant beginnings of our universe (Morin, 2003, p. 56).

According to Lacerda and Pedroso (2024, p. 13), "Educating for this awareness requires that we embrace complexity in teacher training. Education cannot be limited to the knowledge of isolated facts, but must promote an integrated understanding of the world, which recognizes the connections between different fields of knowledge". And all of these relationships include and

relate to broader ethical, political, aesthetic, cultural, and social issues. By cultivating this integrated understanding of reality in our educators and students, we can promote an ethics of responsibility that recognizes our interconnection with the world and our obligation to care for it.

School knowledge based on the idea of disruptions in knowledge does not favor self-knowledge, it does not allow man to situate himself in the cosmos, understand the construction of his identity, his myths and his insertion in an earthly/cosmic society/community. Technoscientific knowledge increasingly makes it possible, for example, to understand the parts of the human body, allowing fabulous discoveries at the biochemical, biophysical, physiological, genetic, morphofunctional levels, but it makes it impossible, due to the reductionist perspectives that it considers valid, to consider this body as a living body/organism that is inserted in a natural, cultural, affective, political, historical, social ecosystem.

Knowledge under this methodological logic also disregards the human subject and underestimates his or her creative and inventive capacities to connect, relate and interconnect knowledge, and therefore does not favor the ability to think and organize one's own knowledge. The overvaluation of the analytical, simplistic perspective does not favor the subject's insertion into the object he or she is knowing, to problematize his or her own thinking, nor does it require the historical and geographical contextualization of the object itself. As a result, the conditions of multidimensionality that surround the phenomena are lost, and their links and unity are also hidden, which contributes to the development of fragmentary knowledge that does not account for the increasingly complex and multifaceted human mundane and existential problems in the context of the current phase of globalization. Morin (2002, p. 17) states:

Intelligence that only knows how to separate breaks the complex nature of the world into disunited fragments, fragments problems and makes the multidimensional one-dimensional. It is an intelligence that is increasingly short-sighted, color-blind and cross-eyed; it ends up being blind most of the time, because it destroys all possibilities of understanding and reflection, eliminating at the root the possibilities of critical judgment and also the opportunities for correct judgment or long-term vision.

Morin (2002) believes that the way of thinking we use to find solutions to the most serious problems of our planetary era constitutes one of the most serious problems we must face. According to him, "the more multidimensional the problems become, the greater the inability to think about their multidimensionality; the more the crisis progresses, the more the inability to think about it progresses; the more global the problems become, the more unthinkable they become". Thus, "blind intelligence becomes unconscious and irresponsible, incapable of facing the planetary context and complex" (Morin, 2002, p. 17). For Morin (2003, p. 38), "educating based on complex thinking should help us escape the state of disarticulation and fragmentation of contemporary knowledge and social and political thinking, whose simplifying approaches have produced an excessive and painful effect on humanity". Lacerda & Pedroso (2024, p. 15), in a similar sense, highlight that:

Systematized knowledge, whether technical, scientific or popular, when interrelated, enables a more complex and complete view of reality. This leads us to realize the importance of distancing ourselves from reductionist simplifications and moving towards an approach that values plurality and interconnection. This perspective, which transcends the mere accumulation of knowledge, demands a new type of training, especially in the field of education. In this context, teacher training must go beyond the transmission of content and technical skills and embrace human development in its entirety, incorporating ethical and emotional aspects.

From these considerations, a fundamental requirement for school education and for educators emerges, which can be summarized in the fundamental need to rethink reform - to reform thought. This emergency brought about by complex thought cannot be deduced, obviously, from a certain, permanent method; nor can it be considered from a mechanical and deterministic perspective. In other words, the reform of thought requires not only a new method, but also a new conception of method. In a different way from Descartes, who considers method as a “program that has certain and permanent rules”, Morin adopts a perspective of method as a “strategy of a thinking subject”, which “emerges during experience” (Morin, 2003, p. 18). Morin (2003, p. 18-20) interprets it as follows:

[...] if we are certain that reality changes and transforms, then a conception of the method as a program is more than insufficient, because, faced with changing and uncertain situations, programs are of little use and, on the other hand, the presence of a thinking and strategic subject is necessary. [...] the method does not precede the experience, the method emerges during the experience and presents itself at the end, perhaps for a new journey.

In this context, the reform of education, the reform of thought, which makes it possible to transform education, will only occur from the educators themselves and their ability to reconstruct their knowledge and understanding in the context of their experiences. The demand for new thinking in/about/with/for education involves educators, brings them together, invites them, makes them accomplices in the arduous task/historical mission of reconstructing knowledge and human actions. The method of complexity, as a path that one tries to follow, is a method that dissolves in the journey. As Rodríguez and Fortunato (2024, p. 2) stated that complexity...

... is not confused with the teaching provided in schools, with the objective of pre-paring students for large-scale external evaluations; What happens in schools is the practice of stuffing people's heads. Our wish is that this changes and that we have another education, that of heads on straight, as we saw in the complexity of Morin.

Complexity, then, is a method-path that considers the experience of educators, that considers not only the spirit, but the whole being, “not only to achieve what is possible, but also to sense what is impossible” (Zambrano apud Morin, 2003, p. 20). In this regard, “it is necessary to abandon programs, it is necessary to invent strategies to get out of the crisis, or even, “it is often necessary to abandon the solutions that remedied old crises and develop new solutions” (Morin, 2003, p. 20).

5 FINAL REMARKS

The blind and unidirectional perspective of techno-scientific development, associated with a fragmented and fragmented science, contributed to the construction of educational and social ideals that disregarded the social, identity, ethical and political complexity of the human being. They also relegated to the background the self-eco-organizational dynamics contained within living organisms and ecosystems. In doing so, they favored the development of processes of domination and exploitation, where they rightly believed they were contributing to emancipation and liberation. The project of training teachers to act under a paradigmatic emphasis on complexity does not have closed and monological paths, but takes on the challenge of overcoming the modern and simplifying paradigm, while preserving its potential aspects.

By contrasting simplifying theoretical perspectives, which have been unable to perceive the paradoxicality, ambiguity and contradiction that exist in all the dynamics of the universe and the living world of man and of societies and cultures, complex thinking reinserts educators into the possibility of thinking of a new meaning and purpose for education in the 21st century, which is neither apocalyptic nor pessimistic. Instead of affirming an inescapable certainty, of a blind belief in revolution and faith in progress, Morin's perspective of complexity prefers to maintain (as a challenge to all who wish to contribute to the *humanization of man*) the permanent questions: Who are we? Where do we come from? What is our condition on the planet?; and in this sense it takes up again the questions already posed by Kant two centuries ago: 'What can I know? What must I do? What am I allowed to hope for?' (2002, p. 93). For Morin (1986, p. 168): "Awareness of the limits of knowledge opens up the universe of knowledge to us instead of closing it. True knowledge is that which recognizes, within itself, the presence of uncertainty and ignorance".

In these meanders, the centrality of the issue for thinking about the connections between the cosmos, society, man and education assumes a shift in the concern for educational transformation from the programmatic plane to the plane of knowledge, that is, to the paradigmatic plane; a process that encompasses a questioning of the modern paradigm of knowledge itself. This means, in other words, the need to problematize the legacy inherited from the modern tradition in terms of the very principles that articulate thinking and knowledge that have become characteristic.

In this sense, the condition of problematizing education and teaching in order to understand the possibilities and needs of their transformation in contemporary times involves, above all, a profound rethinking of the very logical structures that we use to think about life, society, nature, the cosmos, and humanity. It also encompasses an epistemological rethinking of the founding notions of science and philosophy, which, in turn, have unfolded into guiding approaches to social and educational discourses and theories that are still clearly ongoing and that have served as a reference for training teachers.

Our ability to think and understand what is relevant in teacher training, in this regard, presupposes a hermeneutic and complex capacity, which goes beyond the technical and instrumental sphere, and feeds the relevance of a comprehensive training, which includes the

centrality of Pedagogy, as a science of educators, which dialogues on the one hand with the very movement of the constitution of sciences, and on the other with the social and historical world, with a view to human emancipation. Teaching knowledge, in these terms, would need to be increasingly related to the disciplinary fields, to which each area of activity refers, and in this sense, it requires disciplinary depth, at the same time, it needs to be increasingly inter and transdisciplinary, encompassing expanded meanings about knowledge, education, school, the world, and sciences. Training educators capable of reconnecting knowledge and understanding, and interpreting the world in an ecosystemic way, becomes increasingly relevant in times of climate and civilizational crisis. The emergence of a planetary civilization requires an ethics and a civilizational policy that allows us to understand our human condition in a globalized and interdependent world.

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