

**CHALLENGES AND PERSPECTIVES FOR SCIENTIFIC AND TECHNOLOGICAL EDUCATION IN  
THE 21ST CENTURY: APPROXIMATIONS BETWEEN EDGAR MORIN AND HANS JONAS***DESAFIOS E PERSPECTIVAS PARA A EDUCAÇÃO CIENTÍFICA E TECNOLÓGICA  
NO SÉCULO XXI: APROXIMAÇÕES ENTRE EDGAR MORIN E HANS JONAS*

RAQUEL TUSI TAMIOSSO<sup>1</sup>  
ALINE GROHE SCHIRMER PIGATTO<sup>2</sup>  
MARCOS ALEXANDRE ALVES<sup>3</sup>

**ABSTRACT**

This paper analyzes the convergence between the epistemologies of Edgar Morin and Hans Jonas, and presents reflections and educational propositions related to science, technology, and life. Today's changes can quickly make knowledge and technologies obsolete, generate uncertainty about what is to come, and require ethical decision-making and action. Education is a resource to face uncertainties, in which students need to be encouraged to understand the complexity of the world and recognize themselves as part of nature, to avoid putting life on the planet at risk. In this sense, the text presents aspects of Morin's epistemology and Jonas's epistemology, as well as the convergences between them that contribute to facing the challenges of contemporary education. Finally, a conception of education that breaks with the strictly anthropocentric perspective and develops a bio-cosmocentric vision is sustained.

**Keywords:** science; citizenship; responsibility; ethics; complexity.

**RESUMO**

*O artigo analisa a convergência entre as epistemologias de Morin e Jonas, e apresenta reflexões e proposições educacionais referentes às ciências, tecnologia e vida. As mudanças hodiernas podem rapidamente tornar o conhecimento e as tecnologias obsoletos, gerar incertezas diante do que está por vir e exigir tomadas de decisões e ações éticas. A educação se constitui como recurso para enfrentar as incertezas, no qual o estudante precisa ser estimulado a compreender a complexidade do mundo e reconhecer-se como integrante da natureza, para não colocar em risco a vida no planeta. Nesse sentido, o texto apresenta aspectos sobre a epistemologia de Morin e sobre a epistemologia de Jonas, bem como as convergências entre elas que contribuem para o enfrentamento dos desafios da educação contemporânea. Enfim, sustenta-se uma concepção de educação que rompa com a óptica estritamente antropocêntrica e desenvolva uma visão bio-cosmocêntrica.*

**Palavras-chave:** ciência; cidadania; responsabilidade; ética; complexidade.

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1 Doutora em Ensino de Ciências e Matemática. Universidade Franciscana - UFN. E-mail: raquel.tamiosso@prof.ufn.edu.br. ORCID: <https://orcid.org/0000-0002-3137-4393>

2 Doutora em Ciências: Botânica. Universidade Franciscana - UFN. E-mail: alinepi@ufn.edu.br. ORCID: <https://orcid.org/0000-0003-1663-3817>

3 Doutor em Educação. Universidade Franciscana - UFN. E-mail: marcosalves@ufn.edu.br. ORCID: <https://orcid.org/0000-0002-5271-0624>

## INTRODUCTION

This paper aims to present a proposal for the approximation between the epistemologies of Edgar Morin and Hans Jonas, as these authors, with their respective theories, converge in many aspects. This convergence enables reflections, propositions, and arguments to be considered regarding issues involving education, teaching, science, technology, society, ecology, and life in all its essential dimensions.

Today's period is the fastest that has ever existed in the history of Western culture. Changes and transformations in all areas that permeate human existence, as well as the existence of other species, happen all the time. As a result, what is the object of knowledge and cognitive possession quickly becomes obsolete. What is "new" now soon becomes the "old" known and therefore obsolete.

The uncertainties and unpredictability in face of what is coming increase incessantly, and we are all supporting actors in this process. Either we adapt and make conscious decisions, or we will not know how to deal responsibly and prudently with the many changes that are still to come in the course of human existence.

In this sense, it becomes fundamental to openly present these issues to young people, alerting and teaching them how the world works. Here, one can consider education as the primary resource of humanity, concerning both the present and the future of all that is known today or that which is not yet known but may become known.

The ability to confront constant social, cultural, political, educational, and technological changes - that is, the new - with ethics, responsibility, and prudence needs to be cultivated. Students must be encouraged to comprehend the world and its phenomena in all their complexity, analyzing aspects related to the humanities, which are intertwined with the development of scientific and technological knowledge. In addition to these considerations, students must recognize themselves as integral parts of nature, understanding that they cannot exceed limits. Namely, they need to act with caution and prudence to avoid endangering the life of humanity and other living beings on the planet. Thus, distancing oneself from a strictly anthropocentric vision and moving closer to a bio-cosmocentric perspective is necessary.

In this context, the first section of this article presents aspects related to the epistemology of complexity, based on the thought of Edgar Morin (2003; 2011; 2015), as well as issues related to the uncertainties and unpredictability of the future and the need for a reconnection of humanistic and scientific knowledge. The second section addresses the thought of Hans Jonas (2004; 2006) regarding the principle of life, namely, the foundation of what could be called the Philosophy of Biology. In addition, it highlights the limits of traditional ethics in dealing with the new times and, above all, with the impacts of new technologies on the future of all living beings.

In addition to these aspects, the main characteristics and the role of education in the constitution of a new ethical consciousness will be presented, which involves the heuristic of fear and fosters decisions based on the principle of responsibility, translating them into prudent actions. In the third section, we seek to establish an approximation between the ideas of these two epistemologists. Based on this, we present some reflections on the challenges that contemporary education imposes, its implications and perspectives for teaching and learning, focused on the future and the new generations.

## EDGAR MORIN: FROM THE EPISTEMOLOGY OF COMPLEXITY TO THE KNOWLEDGE CONNECTION

Edgar Morin is an anthropologist, sociologist, philosopher, and the son of Spanish Jews. His parents migrated to France in the first decade of the 20th century. During his adolescence, he was always a great reader and had a restless, intrigued, and active personality. Morin's restless position was reflected "[...] in a dynamic production that was attentive to the phenomena of his time, and, especially, always open to dialogue, namely, capable of incorporating the complexity of facts and elements of the living world" (SANTOS; HAMMERSCHMIDT, 2012, p. 562, our translation).

Initially, some categories of Edgar Morin's thought are presented, especially those related to the epistemology of complexity, the separation of the human sciences from scientific knowledge, and the uncertainties and unpredictability of the future.

According to Morin (2015), we live within the dominion of the principles of separation, reduction, and abstraction, contributing to what the author refers to as the "paradigm of simplification". The author argues that Descartes formulated this paradigm, by distinguishing between the thinking subject (*ego cogitans*) and the object of understanding (*res extensa*), essentially dividing science and philosophy. He also posited that "clear and distinct" ideas, which embody disjunctive thought, serve as the foundation of truth. Morin (2015) says that this paradigm, which has guided the trajectory of Western thought since the seventeenth century, has undoubtedly facilitated significant advancements in scientific knowledge and philosophical inquiry. However, its ultimately detrimental effects have only begun to surface in the twentieth century.

In Morin's point of view, Descartes and the heirs of his thought (Cartesians) separated the subject from the object, philosophy and reflective research from science and objective research, the soul from the body, the spirit from the matter, and feeling from reason.

[...] The simplifying paradigm is a paradigm that puts order in the universe and expels disorder from it. Order is reduced to a law, to a principle. Simplicity sees the one, or the multiple, but it fails to see that the one can be at the same time multiple. Either the principle of simplicity separates what is connected (disjunction), or it unifies what is diverse (reduction) (MORIN, 2015, p. 59, our translation).

According to Morin, the simplifying paradigm dominates today's culture, even though reactions against its dominance have already begun. Estrada (2009) points out that this paradigm, which met the parameters of modern science, has been losing its explanatory capacity nowadays. In this sense, Morin includes the notions of plurality and complexity of physical, anthropo-sociological, and biological systems, which require a new paradigm: the paradigm of complexity (ESTRADA, 2009). He attributes the construction of this new paradigm to a gradual, evolutionary, and complex process, saying that this complex paradigm will result from a set of new visions, new conceptions, new discoveries, and new reflections that will be reunited. Morin (2015) concludes by saying that the principle of complexity will be based on the predominance of the complex conjunction.

In this context, Morin addresses the issues of complexity and defends the idea that it is not possible to fragment knowledge into disciplines since to understand the complex, it is necessary to see the whole, and not just its parts.

There is an increasingly broad, deep, and serious inadequacy between separated, fragmented, compartmentalized knowledge between disciplines, and, on the other hand, realities or problems that are increasingly polydisciplinary, transversal, multi-dimensional, transactional, global, planetary (MORIN, 2003, p. 13, our translation).

In this regard, Morin argues that the following aspects become invisible: “complex sets; the interactions and feedback between part and whole; multidimensional entities; the essential problems” (2003, p. 13). The author considers global problems as essential problems, and states that these cannot be split. They need to be thought of in a broad way and the context must always be taken into account.

Morin introduces the concept of the term “complex”, which means “what is woven together” (2003, p. 14). Namely, he states that the shredding of the disciplines makes it impossible to understand the complex. This is because each discipline tries to explain a certain subject related to a specific phenomenon, fragmenting the aspects of this phenomenon to better explain it. Sometimes, the strict division of knowledge into distinct disciplines can hinder effective communication, creating a situation where it appears that the information fails to convey the intended problem or phenomenon initially meant to be studied. The vision of the whole is threatened, weakening the understanding of the subject.

Morin (2003) also argues that the challenge of globality is also the challenge of complexity. He explains it by saying that complexity arises when the various components that make up a whole - such as economic, political, sociological, psychological, affective, and mythological elements - are inseparable. There exists an interdependent, interactive, and inter-retroactive relationship between the parts and the whole, as well as the other way around. According to the author, the advancements of the current century and our planetary era increasingly and inevitably bring us face to face with the challenges posed by this complexity.

Complexity, according to Morin, refers to the multiple components that permeate a phenomenon, a problem, a situation, or an object of study. There is no way to look at just one aspect and hope to truly understand the referred phenomenon. It is necessary to have a dense and complex study that addresses the several factors involved in order to achieve a total understanding.

In this sense, Morin argues that education should promote the “[...] general intelligence that is able to refer to the complex, to the context, in a multidimensional way and within the global conception” (2011, p. 36, our translation). The general intelligence to which the author refers is responsible for operating and organizing the mobilization of general knowledge based on each particular case.

In his book entitled “The Well-Made Head”, Morin takes up the thought of Montaigne, who says the following: “a well-made head is worth more than a well-filled one”. The author explains the meaning of this phrase, in which a well-filled head represents an accumulation of knowledge piled up, without an organization that provides it meaning. On the other hand, a well-made head has a general aptitude for dealing with problems and an organization that provides connection and meaning to knowledge. Still according to Morin (2015), complexity is always linked to chance, since the complex also includes aspects such as uncertainties and random phenomena; namely, it is not reduced only to what is quantifiable.

For the author, we are not yet ready for the unexpected, despite the evidence regarding the irremediable uncertainty of human history. The future is inherently unpredictable and uncertain. There is no way to predict what will come, and that is the reason why it is emphasized that we must be ready to face the uncertainties. “A great achievement of intelligence would be to be able, finally, to be free

from the illusion of predicting human destiny. The future remains open and unpredictable” (MORIN, 2011, p. 69, our translation).

Events such as the First World War, the Communist Revolution, the Second World War, Hitler’s rise to power, the Cold War, the Gulf War, among others, are examples of events that no one could predict beforehand! Morin points out, therefore, that “The future is called uncertainty” (2011, p. 71, our translation). Because of this, he emphasizes the emergence of a new consciousness: learning to face uncertainties. He justifies it by saying that we live in a time of changes in which values are ambivalent and everything is connected, so it is necessary to face uncertainty. Additionally, he argues that the education of the future must focus on the uncertainties linked to knowledge (MORIN, 2011).

The truth, according to Morin, is: “[...] knowledge is navigating in an ocean of uncertainties, among archipelagos of certainties” (2011, p. 75, our translation). Morin alerts that to deal with the uncertainties and unpredictability of the future, it should be noted that the response to the uncertainties of action involves making a deliberate decision, being aware of the associated risks, and developing a strategy that considers the inherent complexities of the objectives. This strategy may need to be adjusted during the course of action in response to unforeseen events, new information, and changes in context. Additionally, it must account for the possibility that the action could be undermined, potentially leading to harmful outcomes (MORIN, 2011). It is necessary, therefore, to reflect on the decisions, to know the complexity of the situation, to develop strategies in a way that they can be reviewed in cases of more unforeseen events.

From this same perspective, Morin emphasizes the cultural challenge, which corresponds to the separation between the culture of the humanities and the scientific culture, which began in the nineteenth century and was worsened in the twentieth century. The perception is that the culture of the humanities has been confined to scientific discoveries, failing to encompass them in its reflections and inquiries. Similarly, it is believed that scientific culture has been deprived of reflections on global issues, hindering consideration of the implications of its discoveries and the human and social problems it brings with it (MORIN, 2003).

Concerning philosophy, the author suggests that it should contribute to the development of the students’ problem-solving spirit. In this regard, he highlights that Philosophy is a force of questioning and reflection, directed towards the great problems of knowledge and the human condition. He says that Philosophy, nowadays, is a discipline almost closed in itself. However, Morin argues that Philosophy should join the scientific dilemmas by contributing with the reflection and solving problems. He highlights that Philosophy teachers, in the conduction of their teaching, should also extend their power of reflection to scientific knowledge, as well as to literature and poetry, feeding on science and literature at the same time (MORIN, 2003).

In this sense, the importance of bringing Philosophy and the Human Sciences in general closer to the scientific knowledge produced is emphasized. This approach allows for a reflection on what is being discovered in the technical-scientific sphere, enabling a thoughtful and reflective analysis. Another challenge Morin highlights is what he calls civic challenge. He points out that the diminishing of a global perspective results in a reduced sense of responsibility, where individuals tend to feel accountable only for their specialized tasks. This also leads to a decline in solidarity, as people no longer maintain their organic connection with their community and fellow citizens (MORIN, 2011).

The role of people as citizens of the place where they live and even of the world becomes diminished when they think only of themselves. A global understanding of the world’s situations and problems fosters greater responsibility and solidarity with what belongs to everyone, not just the private



sector. It is as if each individual solely attends to their own home and private property, overlooking the fact that beyond their walls, some spaces are also collectively shared. Therefore, there is a crucial need to value and preserve what belongs to all living beings.

Specialized knowledge is a particular form of abstraction. Specialization “ab-traits,” in other words, extracts an object from its context and its whole; rejects ties and intercommunications with its environment; introduces the object into the abstract conceptual sector, which is that of the compartmentalized discipline, whose boundaries arbitrarily fragment the systemicity (relation of the part to the whole) and the multidimensionality of phenomena [...] (MORIN, 2011, p. 38, our translation)

Edgar Morin, therefore, covers the following ideas discussed: he suggests a change in the simplifying paradigm so that the complexity of the phenomena is taken into account; he considers that there is no way to separate what is complex (woven together); for a faithful understanding of reality, we must consider the complex, the context, the global and the multidimensional factors; the separation between the humanities and scientific knowledge is a cultural challenge, which must be addressed for these sciences to walk together again; there is no way to predict the future, and therefore it is necessary to develop the ability to face the uncertainties and unpredictability of what is coming.

## **HANS JONAS: FROM THE BEGINNING OF LIFE TO THE PRINCIPLE OF RESPONSIBILITY FOR THE FUTURE LIFE**

Born in 1903 in Mönchengladback, Germany, Hans Jonas is of Jewish origin. He was a militant of Zionism (TME), a political movement that defends the self-determination of the Jewish people and the existence of an independent Jewish state. When he was 18 years old, he was a disciple of Edmund Husserl and Martin Heidegger. He suffered greatly under Adolf Hitler and the Nazism implemented in his country. With the rise of Hitler, he decided to leave Germany, migrating to London and other European cities (JONAS, 2006). Hans Jonas experienced the persecution and injustices committed against the Jewish people, which contributed to the development of his epistemology.

His first book, “The Phenomenon of Life: Toward a Philosophical Biology,” published in 1966, deals with the ontological interpretation of biological phenomena. A philosophical reinterpretation of the biological as a possibility to reclaim the inner dimension, facilitating the understanding of what is organic and thus restoring the psychophysical unity, previously separated by Descartes into mental and material, is defended. (JONAS, 2004, p. 7).

The dualistic motto defended by Descartes and his followers fragments the conception of man and nature, the spirit of nature, and the civilization of nature. The moderns understood man as a superior being separated from nature, and therefore they used to consider their interests as the only important ones, without concerns for other living beings and the factors enabling life on the planet. Viana (2010, p. 108, our translation) points out that, in modernity, “[...] the potentiation of the Subject implied the devaluation of Nature”. On the other hand, according to Oliveira (2010), the modern tradition already connected necessity to nature, but freedom was related only to the realm of rationality, that is, solely to human beings.

Hans Jonas argues that the moderns were not concerned with questions related to origin and the past of the history of nature did not belong to the scientific program. In this sense, Jonas (2004, p. 49, our translation) emphasizes that

The mechanistic model of nature, which took shape in the 17th century, was primarily concerned with ready-made structures - the solar system or animal bodies, for example - without tying the thinker to the questions inherent to their origin. Each structure, as found, was regarded as a functioning mechanism, and the analysis should explain through the elementary components of matter and motion its actual functioning according to an uniform model.

The moderns said that animals, for example, did not feel pain or pleasure, but humans believed otherwise since they related certain bodily expressions of animals to the feelings they usually feel. Jonas said that after separating the “body” from any connection with the spirit and allowing the science of the body to operate independently of spiritual phenomena, Descartes and his followers were able to treat the organism as merely another instance of *res extensa* (extended thing, body, matter) without any concerns (JONAS, 2004).

In contrast to modern thought, Jonas states that “the animal being is essentially a passionate being” (JONAS, 2004, p. 130, our translation). It is argued that if freedom and interiority are present in human beings, it means that they are present throughout the organic world, even in its simplest forms.

The great contradictions that the human being encounters in himself - freedom and necessity, autonomy and dependence, the self and the world, relations and isolation, creative activity and mortal condition - are already germinally prefigured in the most primitive manifestations of life, each of them maintaining a precarious balance between being and non-being, always already carrying within itself a horizon of “transcendence” (JONAS, 2004, p. 7, our translation).

Jonas justifies the presence of these characteristics throughout the organic world by drawing on Charles Darwin’s Theory of Evolution. According to this theory (scientifically considered the most accepted), all existing living beings have genealogical relationships with each other, that is, they are related by common descent with different degrees of kinship. Individuals gradually changed and differentiated into species. The point that Jonas draws attention to is that, if human beings are related to other living beings, it means that other living beings also have this relationship with human beings. Therefore, if human beings possess “freedom”, it means that it is also present in the most primitive forms of life. This is also valid for questions of interiority, ignored by the moderns, who analyzed only external aspects (OLIVEIRA, 2010).

Like any broader theory, the current theory of evolution and genetics is a complex network, where established facts, hypotheses, and deductions are intertwined. Evolution as such belongs to the number of established facts, which also includes the fact that species change, that they have grown in a series of modifications from ancestral forms, and that in their totality they constitute a branching system of families with a common origin, where the simple precedes the complex and the transitions are gradual. Another established fact is the occurrence of mutations, but not their nature or cause (JONAS, 2004, p. 55, our translation).

Jonas comments on mutations that happen randomly and are also dependent on the external environment to which the organisms are exposed. Random because they are unpredictable; no one can predict them. He also emphasizes in his book that amoebas, for example, do not have thought, opposable thumbs, or spine, but that each of these structures has developed into other organisms over time, in an unpredictable way (JONAS, 2004). Even so, humans, endowed with thought, opposable thumbs, and spine have a common ancestor with amoebas.

Jonas (2004) discusses that if humans are similar to animals, then animals are also similar to humans and, to varying extents, possess an interiority that humans, as the most advanced species, are aware of. Following the limitations imposed by Christian faith in transcendence and Cartesian dualism, the concept of the “soul” - with its attributes of feeling, striving, suffering, and enjoying - would, according to the principle of constant gradation, once again encompass the entire realm of life, extending from humans to all living beings (JONAS, 2004).

Metabolism, according to Jonas, already carries the characteristic of freedom. Among organisms, the human being is considered to have attained the highest degree of freedom, precisely because of his ability to think, reason, and understand himself. According to Oliveira (2010), freedom emerges in the attempt to disconnect life from inert matter, from the inorganic. In Jonas’s conception, the greater the freedom, the greater the risks and dangers, and a greater degree of responsibility is required. However, no matter how free the organism is, it will always need the inorganic, such as water.

The human being, therefore, is endowed with a transanimality, as an animal linked to the world, but in a different way. According to Chiarello, “the recognition of a common essence between men and animals does not, however, prevent Hans Jonas from discerning in man what he designates by his transanimal character, that is, his own essence, without thereby denying what is animal in him” (2016, p. 175, our translation).

Man possesses a greater capacity for success in life and for self-understanding. For these reasons, he is the agent of greatest responsibility among all living beings. He additionally possesses his own characteristics, such as skills in building tools and developing techniques, recognizing images and producing art, and burying the dead people in tombs.

The concept of transanimality, therefore, evokes the perspective of man’s reconnection in the evolutionary process of life and at the same time does not dispense with his own characteristics, by which he enjoys in the name of the great freedom and also has the greatest risk (the risk of destruction of his own life and the lives of other living beings), a fact that imposes on him the greatest of responsibilities (OLIVEIRA, 2010, p. 96, our translation).

Jona’s perspective of philosophical biology provides the following interpretations: man is a being belonging to nature, and is not distinct from it as modern dualism claimed; aspects such as interiority, freedom, and need are present in human beings, and therefore are also present in other living beings; Charles Darwin’s Theory of Evolution supports the previous two interpretations; the human being has a transanimal characteristic since he has reached the apex of freedom, acquiring the capacity for self-understanding; consequently, he is also the being that carries the greatest responsibility.

These facts reveal the awareness that human beings belong to nature and are related to other living beings. It is the understanding that men, no matter how free they may be, still depend on and need nature and the abiotic factors it provides, such as water, sun, wind, and soil. That is, the notion



that the human species has evolved but that in its origin it has a common ancestor to all other living beings, and, therefore, all are equally important is perceived. In this sense, Alves (2016) points out that the concept of responsibility is defined by freedom. The author suggests that being free requires humans to act prudently and respect other forms of life, as their existence is directly linked to the continuity of humanity. This endeavor is uniquely human, and the future relies heavily on the power of decision-making.

According to Oliveira (2010), the concept of transanimality presented by Jonas serves as a guiding thread for the Responsibility Principle. Now, if man is related to other living beings, if he depends on nature, he cannot be considered as a superior or even selfish being and thinking only of himself and his own interests.

In 1979, Jonas published the work "The Imperative of Responsibility: In Search of an Ethics for the Technological Age". Here, Jonas discusses the need for a new ethic that supports the great technological advances that man has achieved. Basically, this new ethic must prevent men from becoming, through technology, a threat to themselves.

Alves Neto (2010) argues that the technique, according to the Greeks, was an extension of the body; it was inseparable from the human body. They did not use sciences such as mathematics and physics to build their instruments. They relied on the sun, for example, to count the hours of the day (ALVES NETO, 2010).

On the other hand, modern technological thought, according to Alves Neto (2010), with the scientific revolution of the seventeenth century, made use of sciences such as mathematics and physics to develop technological tools. The moderns effectively carried out the scientific rationality that penetrated and transformed the devices and instruments into precision devices. To have a notion of time, moderns developed technologies such as the clock or the stopwatch.

These advances involving technique and technology aroused deep concern in Jonas, because the ethic of tradition that used to exist in the modern era no longer keeps pace with technological progress. According to the author, the ethics inherited from tradition is essentially anthropocentric, that is, it takes into account only the interests of the human being. In addition, it is an ethic that is concerned with the present moment, ignoring aspects related to the future. According to Alves (2016, p. 62, our translation), "in the traditional perspective, ethical action was limited to the relationship between man and man and all changes in domain took place in the human sphere of the present".

This classical conception of ethics, according to Jonas, gains body and practicality through Kant's categorical imperative, which is summarized in the following maxim: "act only in accordance with that maxim through which you can at the same time will that it become a universal law" (JONAS, 2006, p. 47). Therefore, Jonas states that a suitable imperative for the new kind of human action should be the following:

Act in such a way that the effects of your action are compatible with the permanence of authentic human life on earth; or, expressed negatively: Act in such a way that the effects of your action are not destructive to the future possibility of such a life; or, simply: Do not endanger the conditions necessary for the indefinite conservation of humanity on earth; or, in a positive use again: Include in your present choice the future integrity of man as one of the objects of your will (JONAS, 2006, p. 47-48, our translation).

Thus, it is argued that the ethics of tradition is no longer sufficient to support technological advances, and it is necessary to implement a new ethics that possesses the aforementioned imperatives. Replacing the anthropocentric ethics, Jonas proposes a bio-cosmocentric ethics, which privileges the sense of being and life in face of the future (ALVES; PES, 2018, p. 191). From this perspective, the following ethic is required:

[...] By means of voluntary restraints, prevent the power of men from becoming a disgrace to themselves... the promise of modern technology has become a threat, or the latter has become indissolubly associated with it. It goes beyond the realization of the physical threat [...] No traditional ethics, therefore, instructs us about the norms of "good" and "evil" (JONAS, 2006, p. 21, our translation).

This new ethic must be concerned with all living beings on the planet and with the maintenance of the conditions necessary for the permanence of life, and not only with the well-being of the human being. The new ethic also advocates a deep concern for the future, for what is to come and, in particular, for future generations to be born. According to Jonas, it is not possible to wager something that does not belong to us. He argues that the fundamental ethical principle assumes that the existence or essence of man cannot be transformed into stakes of action. In this sense, the mere possibility of such a situation must be understood as an unacceptable risk under any circumstances (JONAS, 2006).

We cannot put life on the planet at risk. Jonas points out that the new imperative allows us to risk our own lives, but not the life of humanity in general. He exemplifies this by quoting Aquiles, a man who had the right of choosing for himself a short life full of glorious deeds instead of a long and safe life without glory. Aquiles had the right to choose it for himself, not for the entire population. In this context, Jonas (2006) argues that we do not have the right to choose non-existence or to risk the existence of future generations.

It does not mean that technological advances are harmful, pessimistic, or negative, but the problems that arise concern the real power of destruction that this technology carries with it. According to Alves and Mentges (2017), technique is a good thing as a human cognitive faculty, and Hans Jonas agrees with this assertion. However, the worrying aspect behind technique is how to use it safely, without generating bad consequences for humanity. The progress itself is important, but it is necessary to reflect on its consequences as well (ALVES; MENTGES, 2017).

From this perspective, Jonas highlights the need for an ethic of responsibility in order to use new technologies prudently. Santos (2010) points out that Jonas fears the "success" of technique, as this performance puts the future of humanity and the planet at stake. If there are risks to future life, we should not use that specific technology, or ways should be found to make its use safe.

One way for people to realize the risk they are taking when using a certain technique is through the heuristic of fear. Jonas seeks to trigger people's reflection based on a feeling: fear. The author states that "We need the threat to the human image - and very specific types of threat - to affirm an authentic human image with the dread generated [...] We only know what is at stake when we know that this or that is at stake" (JONAS, 2006, p. 71, our translation). Hans Jonas exemplifies this idea:

Just as we would not know about the sacredness of life if there were no murder and the commandment "Thou shalt not kill" did not reveal that sacredness, and we would not know the value of truth if there were no lie, nor that of freedom without

its absence, and so on - so, too, in our case, in the pursuit of an ethic of long-term responsibility, whose presence is not yet detected on the real plane, helps us first of all to predict a deformation of man, which reveals to us what we want to preserve in the concept of man (JONAS, 2006, p. 70, our translation).

In this sense, he argues that “it is necessary to pay more attention to the prophecy of doom than to the prophecy of salvation” (JONAS, 2006, p. 77, our translation). “To be faithful to the truth, heuristics revere a prudential appeal, namely, the delineation of scientific theories in the sense of studying and examining the future effects of their propositions” (PIZZI, 2010, p. 110, our translation).

The risks associated with using technologies should be very clear to everyone. From that understanding, the decision to take those risks or not should be made. It is important to be aware of the dangers so that decisions will be prudent. Therefore, the ability to predict is highlighted.

In short, Jonas uses a philosophical biology perspective to argue that human beings belong to nature and share a common origin with other living beings. Thus, he argues that what differentiates us and guarantees our transanimal condition is the awareness of thought, our actions, and reflections, which grant us greater freedom. This freedom comes with greater responsibility, requiring a new ethic to guide our actions. Technically speaking, we can create life in a laboratory, destroy the entire world with atomic bombs, or even exterminate entire species for the sake of our interests. However, Jonas points out that human actions must be guided by this new ethics and responsibility, so as not to jeopardize the possibility of future life.

This reflection refers to the need to think before acting, to analyze the causes that lead us to a certain action, the benefits that this action can provide us, and, above all, to analyze the consequences that the action can bring and its harms. Consequently, the new ethic aims to prevent man from becoming a threat to himself. Nothing that endangers, that is, that compromises the existence of life on the planet should be done, according to Jonas’ new ethics.

## **REFLECTIONS AND PROPOSITIONS: FROM CONTEMPORARY EDUCATION TO NEW PERSPECTIVES FOR SCIENTIFIC AND TECHNOLOGICAL EDUCATION**

At this point, we seek to present an approximation between the main ideas developed by Edgar Morin and Hans Jonas to highlight some reflections and propositions for scientific and technological education. Each reflection and proposition emerges from previous discussions, based on aspects related to the epistemologies of these two authors, with a view toward education. Initially, reflections and discussions on contemporary education will be presented and, in the end, perspectives for future education will be pointed out.

### **Reflection and proposition 1**

Morin’s conceptions of complexity are very pertinent for thinking about education and, particularly, teaching. The author argues that to truly understand a phenomenon and everything that involves it, it is necessary to know the complexity (woven together) of this phenomenon. It is not enough to look at only one aspect or another; but a general understanding is essential. In school, this is often reflected in the division of subjects, which are usually studied separately and without connection to each other. As stated by Morin (2003, p. 15, our translation)

In primary school we are taught to isolate objects (from their environment), to separate disciplines (instead of recognizing their correlations), to dissociate problems instead of bringing them together and integrating them. They force us to reduce the complex to the simple, that is, to separate what is connected; to decompose, not to recompose; and to eliminate everything that causes disorders or contradictions in our understanding.

One of the problems that Morin identifies in this regard is that fragmenting the complex of the world into pieces atrophies the possibilities of understanding and reflecting, compromising appropriate judgments or long-term vision. Therefore, students must acquire skills to understand and reflect on phenomena, situations, problems, or objects of study that belong to the world. This is possible when we analyze the complex, the whole, and not just the parts in a fragmented way. In addition, it is necessary to develop the ability to contextualize these issues. "An intelligence incapable of perceiving the context and the planetary complex becomes blind, unconscious, and irresponsible" (MORIN, 2003, p. 15, our translation).

Understanding the complex and contextualizing situations and problems enables a more accurate and careful analysis of the world's phenomena, situations, and problems. This way, students will be better prepared to make future decisions and exercise their duties as citizens. Morin (2003) argues that education must contribute to the self-formation of the person, teaching about the human condition and how to live, as well as how to become a citizen. By citizen, Morin refers to the definition of citizen in a democracy, which implies being responsible and showing solidarity towards one's homeland (MORIN, 2003).

This argument is strongly related to Jonas' principle of responsibility, where the author emphasizes the necessity of acting ethically to ensure the permanence of life on the planet. The ability to analyze the world's problem situations in a broad and complex manner aids in responsible decision-making. It is impossible to make a prudent decision on a given subject without knowing its complexity.

For example, consider the theme of radiation and radioactivity. From the specific perspective of physics, radioactivity is a phenomenon that can be very useful in the production of energy through nuclear power. Current technology enables the construction of numerous nuclear power plants, primarily aimed at generating increasing amounts of energy. However, when viewed from the perspective of biology, it becomes apparent that the radiations emitted along with the generated energy can harm humans and other living beings. This radiation can cause mutations, leading to problems in the short, medium, and long term, depending on the exposure dose.

Because of this, nuclear power plants have safety systems designed to prevent the emission of radiation into the environment. However, meticulous care is essential in the installation, maintenance, and control of these stations, as accidents can occur. An example of such an accident is the Chernobyl disaster in 1986. It resulted from several factors, including human error. Consequently, thousands of people were exposed to radiation, the site had to be evacuated, and it remains isolated to this day. Therefore, the installation of a nuclear power station requires a lot of responsibility from those who manage it.

In addition, another important factor to be analyzed from a biological perspective is the impact on ecosystems. The installation of a nuclear power station implies the modification of the local ecosystem, as it must be located near a water reservoir, which serves as a habitat for aquatic life.

The operation of the station involves heating the water, thereby altering the natural habitat of many organisms living in the area.

The question that arises is the following: if the focus were solely on the perspectives of energy production and economics, perhaps we would not act with such prudence and responsibility. A broader understanding is necessary to truly grasp all aspects of this phenomenon - the benefits, harms, causes, and possible consequences. In the context of education, students need to comprehend this situation to form responsible and ethical opinions.

Still discussing the theme of radiation and radioactivity, we can consider the issues related to atomic bombs. History shows us that the United States of America, during World War II, produced and dropped two atomic bombs on the Japanese cities of Hiroshima and Nagasaki. This action was neither ethical nor responsible, given the numerous biological consequences that living beings exposed to the radiation suffered in both the short and long term. The question is: did the leaders responsible for dropping the bombs consider these consequences? Did they analyze the complexity of the situation before causing? Perhaps they thought only of power, winning the war, and political and economic issues. Once again, students must understand the complexity of such situations to develop responsible opinions and make informed decisions when necessary.

Another issue to consider is the use of radiation and radioactivity in the health sector, both for diagnostic tests and therapies. Professionals dealing with this phenomenon need to have comprehensive knowledge. They must control safe doses for each test and therapy, ensuring neither patients nor themselves are overly exposed. Additionally, they need to understand the physics of the equipment, the chemistry of radiation, the molecules that make up our bodies (such as DNA), and the biology of living beings (whether human or animal patients). Thus, complex knowledge is essential to take prudent, ethical, and responsible actions.

Students pursuing careers in fields like engineering, management, politics, medicine, or dentistry must be aware of the complexities and applications of radioactivity in various contexts. However, even those not directly involved with radioactivity in their professional lives need this knowledge simply because they are citizens of the world. As informed citizens, they need to form opinions, make decisions, discern what is right or wrong, identify imminent risks to life, understand what can harm living beings and the planet, and address other critical aspects.

According to Jonas, education has an “[...] end determined as content: the autonomy of the individual, which essentially encompasses the ability to take responsibility” (JONAS, 2006, p. 189, our translation). Thus, the first reflection and proposition for scientific and technological education is emphasized: understanding the complexity of phenomena favors responsible and ethical decision-making. An integrated education on topics such as radiation and radioactivity allows students to perceive and understand the various aspects of the subject, enabling them to form opinions in a responsible, prudent, and ethical manner.

## Reflection and proposition 2

From the three situations involving the theme of radiation and radioactivity, aspects related to the Human Sciences can be addressed. In the first situation, we can reflect on the risks of accidents at power stations and the destruction and modification of ecosystems at these sites. In the second situation, there are reflections to be made about the consequences of atomic bombs, including the traumas caused to the people and living beings in the areas where the bombs were dropped, among



other aspects. In the latter situation, we consider the effects of radiation and its applications in medicine. The same radiation that helps diagnose exams or cure diseases can also cause injuries, mutations, and harms to living beings, depending on the dose used. There are several reflections involving the Human Sciences that can be made on these themes.

Edgar Morin considers the separation between the humanities and scientific knowledge to be a cultural challenge. He argues that the culture of the humanities has been restricted to scientific discoveries, without incorporating these discoveries into its reflections. Conversely, scientific culture has been deprived of reflections on global problems, hindering the consideration of its discoveries and the human and social issues they entail (MORIN, 2003).

Hans Jonas also elucidates the need to articulate the human sciences with scientific knowledge to foster greater reflections on knowledge and discoveries, leading to ethical and responsible actions (ALVES; PES, 2018). In this sense, Jonas serves as a powerful reference for discussing the potential integration of bioethics, philosophy, and education. According to Alves, “the ethical principle of responsibility imposes itself as a new revolution for scientific thought and even more so for human behavior. It re-establishes the dialogue between ethics and science, reflecting on human conduct about life” (ALVES, 2016, p. 17, our translation).

Corroborating this idea, Santos argues that

That is why there is a demand for interdisciplinary scientific work that goes beyond the restricted scope of philosophical ethics, calling all the sciences to collaborate in the establishment of a new level of relations, of a new position on technical-scientific problems. If Jonas is right, then contemporary philosophy can no longer shirk this task because it is not in a position to solve it alone (SANTOS, 2010, p. 288, our translation).

It is also the responsibility of disciplines such as Philosophy and Sociology to engage with other sciences in discussing the problem situations that permeate the current world. Students need to see these connections and be stimulated to reflect on scientific knowledge while contemplating human and existential aspects. Alves and Ferigolo (2019, p. 62, our translation) point out that “in an era marked by technical-scientific progress, there is a need for a more humanistic consideration of relationships so that, in the future, there will be a society characterized by respect for the essence of the human being”. Morin and Jonas advocate against purely disciplinary teaching, suggesting a more integrated approach to education.

Therefore, the second reflection and proposition for scientific and technological education is highlighted: to articulate, whenever possible, the dialogue between the human sciences and the scientific knowledge addressed in the classroom, to stimulate reflections and questions on the subjects. This reflection and proposition are supported by the idea that those involved in the educational endeavor should go beyond merely informing about technical-scientific innovations. Instead, they should provide training that is based on developing the ethical dimension of knowledge and science (ALVES, 2016).

### **Reflection and proposition 3**

Concerning this, another reflection can be made. Hans Jonas uses a philosophical biology perspective to argue that human beings belong to nature and share a common origin with other living

beings. In this sense, it is argued that what differentiates and guarantees the transanimal condition of humans is their awareness of thought, actions, and reflections. This awareness endows human beings with greater freedom and, consequently, greater responsibility.

In this sense, students must understand this interpretation to recognize that they belong to nature and are related to other living beings. They need to grasp that just as we are important and deserve life, so do other living beings, which also deserve life in the same way. Our ability to think and reflect on this makes us the ones most responsible for ensuring that living conditions remain viable. Therefore, we cannot act in a way that jeopardizes the possibility of future life. According to Morin (2003, p. 73, our translation),

The awareness and sense of belonging to Earth and our earthly identity are vital today. It is the progression and rootedness of this awareness of belonging to our earthly homeland that will allow the development, through multiple channels and in different regions of the globe, of a feeling of reconnection and intersolidarity, essential to civilize human relations (NGOs, Survival International, Amnesty International, Greenpeace, etc. are pioneers of earthly citizenship). It will be the heart and soul of the second globalization, an antagonistic product of the first, that will make it possible to humanize this globalization.

Morin (2003) argues that human beings must be aware of their belonging to Earth. He attributes to them distinctive characteristics such as culture, spirit, and consciousness. Morin states that we are simultaneously outside and inside nature.

Thus, due to the ability to think, reflect, and predict, it is necessary to consider the lives of future human generations and other living beings. We must ensure the conditions for life on the planet. The third reflection and proposition emphasizes the importance of preserving and guaranteeing the life of human beings and other living beings in both the present and future.

## Reflection and proposition 4

The final reflection and proposition presented here is related to concerns about the uncertainties and unpredictability of the future. In this context, Morin argues that

Everyone must be fully aware that his own life is an adventure, even when he imagines himself enclosed in a bureaucratic security; Every human destiny implies an irreducible uncertainty, even in the absolute certainty, which is that of death, because we do not know the date. Each one must be fully aware of participating in the adventure of humanity, which has launched itself into the unknown at a speed, from now on, accelerated” (MORIN, 2003, p. 63, our translation).

In this sense, Morin (2003) states that in the past, people believed that world events were cyclical, repeating themselves from time to time. However, there is now an awareness that the future is uncertain and that new situations arise, requiring us to deal with them in the best way possible. You do not always have previous experiences to rely on, so it is necessary to manage unpredictability.

Jonas considers the heuristic of fear a good way to analyze situations with prudence: “[...] in make a decision, we should treat as certain what is doubtful, although possible, as long as we are

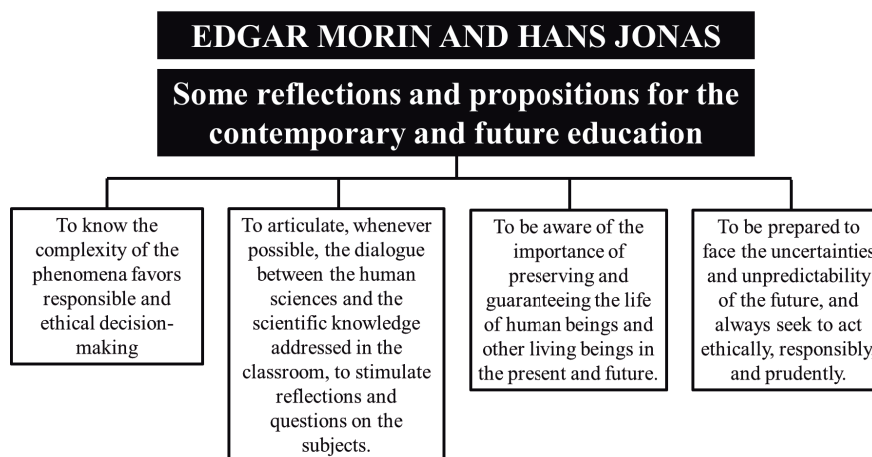
dealing with a certain type of consequence” (JONAS, 2006, p.7, our translation). For each situation that presents itself to human beings, it is essential to analyze it carefully and verify the possible consequences that it can bring. Based on this, it is possible to decide which attitude is the most ethically coherent. Consequently, Jonas argues that “it is necessary to give more attention to the prophecy of doom than to the prophecy of salvation” (JONAS, 2006, p. 77, our translation).

Morin (2011) states that it is certainly possible to calculate the effects of human actions in the short term, but their long-term effects are unpredictable. This requires, according to Jonas’ conception, a great deal of caution, responsibility, and ethics in decisions. Especially because of the unpredictability of what is coming, of what awaits us, there is a need to take care of the choices that are and will be made. According to Jonas, a person does not have the right to bet something that is not personal or his/her own. Therefore, under no circumstances should the life of humanity be endangered, nor the permanence of life of all beings on planet Earth. Pizzi (2010) points out that the heuristic reveals a prudential appeal in the sense that preconizes the study and examination of scientific theories in terms of their future effects as well.

Therefore, students must be aware of the unpredictability that awaits them in the future and the uncertainties that may arise during their lives. They need to be conscious of this to deal effectively with upcoming situations. Regardless of the situation that arises, they need to remember to act responsibly and ethically, considering future human lives and other living beings. Thus, the fourth reflection and proposition is: being prepared to face the uncertainties and unpredictability of the future and always striving to act ethically, responsibly, and prudently.

Finally, a summary of the reflections and propositions for considering education from the approximation between the epistemologies of Edgar Morin and Hans Jonas is presented below (Figure 1).

**Figure 1** - Approximation between the epistemologies of Edgar Morin and Hans Jonas.



Source: elaborated by the authors.

## FINAL THOUGHTS

This article aimed to demonstrate that educating for responsibility, particularly in the context of the technological age, is not only a necessity but an urgent requirement. The reflections encouraged

throughout the educational processes challenge individuals to reconsider their relationships with themselves, others, and nature, fostering the assumption of collective responsibility for the continuity of life and the common good. These reflections, grounded in the epistemologies of Edgar Morin and Hans Jonas, can serve as a foundation for understanding scientific and technological education and for exploring future teaching perspectives. The goal is to qualify individuals to become responsible global citizens.

It is considered that Edgar Morin and Hans Jonas present epistemologies that align in several aspects, promoting a mutual collaboration that can serve as a foundation for the advancement of certain fields, such as education. This article sought to bridge their epistemologies with a reflective perspective on scientific and technological education, proposing an integrative and ethical dimension for teaching aimed at future generations.

The approximation allowed us to discuss and list some useful reflections for thinking scientific and technological education and future teaching: understanding the complexity of phenomena, which favors ethical and responsible decision-making; promoting, when possible, dialogue between the human sciences and scientific knowledge addressed in the classroom to stimulate reflections and questions on the subjects; being aware of the importance of preserving and guaranteeing the life of human beings and other living beings in the present and future; and being prepared to face the uncertainties and unpredictability of the future, always seeking to act ethically, responsibly and prudently.

Finally, it is believed that these reflections and perspectives, based on the epistemologies of Morin and Jonas, can aid education professionals who work in the teaching and training of students both in the contemporary period and in the future. These are basic and essential aspects for students to be able to understand the world, act ethically and responsibly, and, consequently, ensure the permanence of life on the planet and face what is to come.

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