



Exploring Complexity: Morin's Influence on Environmental Education Research

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ABSTRACT

The initial and continuing education of environmental educators has a history marked by the fragmentation of knowledge and the influence of scientific determinism. The Complexity Theory, proposed by Edgar Morin, presents itself as a challenge of differentiated thinking, bringing relevant implications in the training of environmental educators. In this context, the objective of this study is to deepen Environmental Education (EE) on Complexity, reinforcing the intrinsic connection between social and environmental issues since their origin, and how these interactions materialize in a concrete way, as proposed by Morin. The article in question conducts a systematic review, exploring the contribution of studies in Complexity to EE research, analyzing five works published between 2017 and 2022 in the EArTE Project (State of the Art of Research in Environmental Education), including the Bank of Brazilian Theses and Dissertations in Environmental Education (BT&D/EA). This five-year interval is particularly relevant to understanding the changes, challenges and advances that have taken place in a period of extreme importance for our planet, highlighting the complex interactions between the aspects.

RESUMO

A formação inicial e continuada de educadores ambientais possui um histórico marcado pela fragmentação do conhecimento e pela influência do determinismo científico. A Teoria da Complexidade, proposta por Edgar Morin, apresenta-se como um desafio de pensamento diferenciado, trazendo implicações relevantes na formação de educadores ambientais. Nesse contexto, o objetivo deste estudo é aprofundar a Educação Ambiental (EA) sobre a Complexidade, reforçando a intrínseca conexão entre as questões sociais e ambientais desde sua origem, e como essas interações se materializam de forma concreta, conforme proposto por Morin. O artigo em questão realiza uma revisão sistemática, explorando a contribuição dos estudos em Complexidade para a pesquisa em EA, analisando cinco trabalhos publicados entre 2017 e 2022 no Projeto EArTE (Estado da Arte da Pesquisa em Educação Ambiental), incluindo o Banco de Teses e Dissertações Brasileiras em Educação Ambiental (BT&D/EA). Este intervalo de cinco anos é particularmente relevante para compreender as mudanças, os desafios e os avanços ocorridos em um período de extrema importância para o nosso planeta, destacando as complexas interações entre os aspectos.

ARTICLE INFORMATION

Article Process:

Submitted: 02/09/2024

Approved: 06/08/2024

Published: 06/15/2024



Keywords:

Environmental Education, Complexity, Edgar Morin.

Palavras-Chave:

Educação Ambiental, Complexidade, Edgar Morin.

Introduction

The interest in the theme of this article was stimulated by the work in the Study and Research Group on Environment, Complexity and Sustainability (*Pesquisas em Meio Ambiente, Complexidade e Sustentabilidade - Nautilus*), within the scope of the Environmental Education (EE), Complexity and Sustainability project. During the development, pertinent issues became the focus of our research, especially those related to the teaching and learning process, as well as the teaching practice of future teachers. These issues involve several approaches and conceptions, which were identified as essential points to be explored.

It was observed that the training of EE teachers is influenced by different theoretical perspectives and ways of understanding knowledge. This diversity may suggest efforts to overcome traditional paradigms of interpreting reality. Thus, it is important to reflect on the training of teachers in EE, considering an approach that takes into account complexity and interdisciplinarity

In this context, the central question is: How do Morin's Complexity studies influence and contribute to research in Environmental Education?

For this, we used a systematic review from the chosen database, EARTE (State of the Art of Research in Environmental Education). This choice was made because EARTE is a specialized database that is dedicated exclusively to Environmental Education, making it a valuable tool for researchers in this specific area.

EARTE's relevance comes from its ability to compile a wide range of studies and publications that address various aspects of Environmental Education, including pedagogical practices, educational policies, and teaching methodologies. By focusing on this field, EARTE offers a rich and diverse collection of resources that makes it easy to identify trends, research gaps, and innovative approaches.

In addition, the EARTE database is widely recognized and used by researchers and professionals in Environmental Education, giving it a high degree of credibility and academic authority. Given our specific focus on research in Environmental Education, we selected the term “environmental education and teaching” as search descriptors, ensuring that our systematic review encompassed the most relevant and up-to-date studies on teacher training and practices in Environmental Education contexts.

During selection, each study was evaluated for its relevance and quality, using a peer-review approach to minimize bias. The combination of some criteria such as relevance, period of publication and type of document allowed a comprehensive and detailed analysis, making it possible to identify the most significant contributions of Morin's Complexity Theory to Environmental Education and teacher training.

We face the challenge of exploring the teacher's training in Environmental Education,

considering the foundations of knowledge and the methods of the Theory of Complexity. We ask: Does the teacher fully understand the implications of his view of reality and the consequences of his methodological choices in the process of teaching and learning of students on socio-environmental issues? We can also consider whether the teacher is aware of the impact and influence of EE, and whether it contributes to the construction of an understanding of the world and its interactions, of human life?

Analyzing the training of educators in Environmental Education from the perspective of complexity means looking at knowledge and practices that can support a training process that allows dialogue between the different social, political, economic and cultural spheres, as well as the human dimension.

This study aims to deepen the understanding of Morin's influence on Environmental Education (EE) research on Complexity, reinforcing the intrinsic connection between social and environmental issues since their origin, and how these interactions materialize in a concrete way, as proposed by Morin.

Exploring Edgar Morin's Complexity in Environmental Education

The importance of Environmental Education (EE) and the evident contemporary socio-environmental crisis are recognized, but there is still a lack of an understanding that can break with the Cartesian paradigm. In view of this, there is a need to replace educational approaches based on reductionist views of knowledge with proposals that promote knowledge and practices capable of leading subjects to adopt a posture based on ethical values, citizenship and solidarity. This makes it possible for researchers to become interested in exploring complex thinking, facing the challenge of finding ways to overcome fragmented thinking. Although this attempt may seem unusual, given the constraints imposed by the simplification paradigm, which involves principles of separation, reduction, and abstraction (Morin, 2001).

Morin, Bocchi and Ceruti (1996) point out that:

We are in an agonizing age, of death and birth, where as never before, threats converge on the planet, its biosphere, its human beings, our cultures, our civilization. "The most tragic, or comical, thing is that all these new threats (ecological disasters, nuclear annihilation, techno-scientific manipulations, etc.) come from the very developments of our civilization". (...) It is currently a question of controlling the uncontrolled development of our planetary era. The Homeland is in danger. We are in danger, and the enemy, we can finally grasp today, is none other than ourselves.

Reigota (1995) criticizes the current educational conceptions, affirming their inability to account for the complexity of the daily life in which we live. This process, as previously stated, needs to leave the scopes of disciplines, of the fragmented vision and be a proposal of all, in order to actually become a viable possibility for the reconstruction of a sustainable planet

(Araújo, 2011).

However, for this awareness to occur, it is necessary that the conceptions and teaching practices on Environmental Education are aligned with the complexity of environmental issues, as well as, “it is the most critical look possible at reality, which ‘un-veils’ it (*sic*) to know it and to know the myths that deceive and that help to maintain the reality of the dominant structure” (Freire, 2008, p. 33). That the socio-environmental relations that are established between man and the other elements of nature, by proposing this understanding of clarifications, are capable of leading individuals to review their conceptions and habits (Trevisol, 2003).

According to Moraes (2015, p. 08), transdisciplinarity goes beyond relating different disciplinary contents. It transcends the linguistic boundaries of its origin, building a unique linguistic domain that reveals a knowledge that transcends disciplinary boundaries. In summary, transdisciplinarity not only crosses the boundaries of knowledge between disciplines, but also crosses them, recognizing the importance of each while seeking to obtain knowledge in a holistic and contextualized way.

According to Morin (2001, p. 35) “[...] In order to articulate and organize knowledge, and thus to recognize and know the problems of the world, it is necessary to reform thought”. However, this reform is paradigmatic and not programmatic: It is the fundamental question of education, since it refers to our ability to organize knowledge. Considering Edgar Morin's thought, it can be said that it is related to an orientation so that the environmental issue is not understood in a fragmented way, but in a complex, interconnected way, which allows an integrated view of the problems that characterize it.

The complexity approach serves as the basis for interdisciplinary EE guidelines and actions within the pedagogical setting. To Layrargues (2004, p. 12):

Thinking in a complex way implies making the action conscious, in the sense of knowing the terrain in which we move, the scope of a given action, presenting coherence between what we want, the theoretical basis from which we start, where we want to reach and who benefits from the process. What framing, background or reading of reality is there.

According to Leff (1999), the importance of an environmental rationality is argued, in which complexity emerges as one of the foundations of EE. From this perspective, environmental knowledge, which is critical and complex, develops through the interaction of different types of knowledge and the interdisciplinary exchange of information.

We realize that the resolution of the paradigmatic crisis requires an initial review of educational institutions, as they play a significant role in representing the organization of society. To achieve this goal, it is important to create a type of knowledge that takes into account many different aspects. When Morin talks about complex thinking, he starts with ideas

like order, disorder, organization, individual, and autonomy, which are important parts of complexity (Petraglia, 1995).

The eco-formative mode of teaching, based on collaboration, transformation, autonomy and the integral development of the person, awakens collaborative attitudes and opens up possibilities for the construction of an ethics of understanding. In addition, it stimulates the imaginative spirit, which revisits the past and the present, constantly seeking new knowledge aimed at a planetary citizenship (Suanno, 2014).

Saturnino De La Torre (2005) highlights the relevance of the study of creativity in education, proposing a transdisciplinary approach that integrates classical concepts in an innovative way in the relationship between educational theory and practice.

Methodological procedures

We decided to conduct the research based on the proposed systematic review. Following the methodology proposed by Sampaio and Mancini (2007), which encompasses ten stages, including: Identification of data sources, formulation of the research problem, choice of keywords, definition of the search strategy and selection criteria, conducting the search, application of the selection criteria, analysis and evaluation, preparation of abstracts and, finally, presentation of conclusions, which will be detailed below:

After defining the research problem, the search terms were validated to identify the keywords to be used, as well as the selection of the database. We use the EArte Project - State of the Art of Research in Environmental Education (*Estado da Arte da Pesquisa em Educação Ambiental*), which includes the Bank of Brazilian Theses and Dissertations in Environmental Education (*Banco de Teses e Dissertações Brasileiras em Educação Ambiental - BT&D/EA*). This choice was made due to its nature as a comprehensive library in the context of Environmental Education.

For the search, we used the descriptors “environmental education and teaching”, which resulted in 13 studies. In addition, a selection criterion was established for works published between 2017 and 2022, a crucial period for understanding environmental changes, challenges, and advances. This five-year interval captures events and transformations that impact our planet and the way we relate to it.

Between 2017 and 2022, the world witnessed a growing debate around environmental issues, with emphasis on climate change, biodiversity loss, plastic waste, and the need for clean energy. The Covid-19 pandemic has accentuated the connections between human health and ecosystems, prompting countries to adopt conservation policies. Research in Environmental Education during this period can reveal the effectiveness of educational programs, curricular adaptations and the engagement of new generations in sustainable practices.

As search terms, we combined the words “environmental education and teaching” and “2017-2022”. However, 5 studies were found, all of which were dissertations, which was

sufficient to provide the basis for a systematic review.

During the process of analysis of the dissertations, a table was elaborated that comprises the following elements related to the 5 works under analysis: Code (developed with the purpose of simplifying identification); the higher education institution (HEI); the State of the HEI; the author's name; the title of the dissertation; keywords; the academic program; the year of production; and the link to access the respective dissertation. Thus, through the following table, it was more convenient to select and identify dissertations, also allowing the analysis of which years were more comprehensive in terms of academic production.

The analysis process involved the coding of the data, allowing the identification of patterns and recurring themes in the dissertations. We perform qualitative analysis, such as content analysis, to categorize and interpret the data, ensuring a deep understanding of the issues addressed by the studies.

The results of this analysis were used to meet the objective of the research, which is to deepen the understanding of the influence of Edgar Morin on research in Environmental Education. By identifying how the principles of Morin's Complexity Theory were applied and discussed in the dissertations, we were able to develop a comprehensive view of the contributions and challenges faced in the training of teachers in EE, as shown in the table below.

Looking at the picture, it is evident that, among the five dissertations submitted to analysis, three of them have their origin in the Southeast Region, one of them belongs to the South Region and the other to the North Region of Brazil. It is also important to note that one of the dissertations was produced in 2017, another in 2019 and the remaining three in 2020.

Table 1.

Analysis of the cut between 2017-2022 - environmental education and teaching

Code	EI	State	Author	Title	Keywords	Program	Year	Link
01	UFSC	Santa Catarina	Ana Júlia Cunha	Elaboration of an environmental education guide, focusing on the main threats against fauna in Brazil for high school biology teachers.	Environmental Education Guide. Environmental Biology Teaching. Threats against fauna.	PROFBIO – Ensino de Biologia em Rede Nacional.	2020	https://repositorio.ufsc.br/bitstream/handle/123456789/220435/PROFBI00030-D.pdf?sequence=-1&isAllowed=y
02	UFRJ	Rio de Janeiro	Andreia Nunes Costa Ciarlini	Places of memory, places of nature: Exploring relations between environmental education and the teaching of Biology, based on the production of narratives.	Place. Narrative. Environmental education.	PROFBIO – Ensino de Biologia em Rede Nacional.	2019	https://pantheon.ufrj.br/bitstream/1422/11091/1/888317.pdf
03	UNESP	São Paulo	Juliano Roberto da Silva Raramilho	Environmental education and teaching of Sociology: Analysis of the thematic notebooks of environmental education in the state of Paraná (2008-2028).	Environmental education. Thematic notebooks. Teaching of Sociology.	Sociologia em Rede Nacional.	2020	https://repositorio.unesp.br/bitstream/handle/11449/202558/raramilho_jrs_me_mar.pdf?sequence=5&isAllowed=y
04	UFPA	Pará	Odiel Brindeiro Sousa	Environmental education at school: Reality, innovation and change in teacher practice in elementary school 1.	Teachers. Technological Resources. Environmental education. Teaching Learning	Ciências e Meio Ambiente.	2020	Unavailable.
05	UNIFEI	Minas Gerais	Thailla Margareth da Silva Viana	Environmental education and biology teaching: A study based on the annals of ENEbio.	Environmental education. Teaching Biology. Knowledge. Values. Political Participation.	Educação em Ciências.	2017	https://repositorio.unifei.edu.br/jspui/bitstream/123456789/1082/1/dissertacao_viana_2017.pdf

Development

In this topic, we present a brief summary of the five works, which cover the period from 2017 to 2022. In the abstract, the title of each research, its main objective and the main theories that served as a foundation are highlighted.

Work 1 - Elaboration of an Environmental Education Guide: Addresses the importance of Environmental Education (EE) and its integration with the teaching of Biology in high school. Developed a guide of EE activities focused on the main threats to fauna in Brazil, such as trafficking, hunting, road impact, habitat loss, pollution and introduction of exotic species. The guide uses teaching by research and promotes scientific literacy, aiming to raise awareness among students about the conservation of fauna and stimulating the resolution of socio-environmental problems. EE is seen as fundamental to establish an ethical relationship between wildlife and society, contributing to a more sustainable citizenship education.

Work 2 - Places of Memory and Environmental Education: Explores the use of narratives as a tool to integrate Environmental Education into the teaching of Biology. The focus is on the relationships between history, memory, environment and society. The study involved field trips and the production of narratives by students, aiming to promote the understanding of the relationships between man and nature. The work resulted in the creation of a digital book that addresses memory paths in the teaching of Biology, using the students narratives as a learning tool.

Work 3 - Environmental Education and Sociology Teaching: The Thematic Notebooks of Environmental Education produced by the Paraná State Department of Education (*Secretaria de Estado da Educação do Paraná*), between 2008 and 2018, are analyzed. The objective is to investigate how these materials dialogue with Environmental Education and their possible insertion in the discipline of Sociology. The results show that the Cadernos are seen as support, but the training in Environmental Education is fragile among teachers. A continuing education program is suggested to promote the integration of EE in various disciplines.

Work 4 - Environmental Education and Technological Resources: The goal is to create a didactic resource for elementary school teachers, using technological resources to teach Environmental Education content. The study uses a website to address innovation and changes in classroom practices, aiming at meaningful learning. The focus is on the integration of technological resources to enrich EE teaching.

Work 5 - Environmental Education in the Teaching of Biology: This research explores the relationship between Environmental Education and Biology teaching, through the analysis of experience reports from the National Meeting of Biology Teaching (*Encontro Nacional de Ensino de Biologia*). The study seeks to identify aspects of the dimensions of human praxis present in these works, including knowledge, ethical and aesthetic values, and political participation. The research reveals the predominance of the knowledge dimension and identifies challenges in the articulation of the three dimensions.

The five texts analyzed converge in emphasizing the importance of EE in the educational context. All recognize the need to awaken the paradigmatic shift, a fundamental and comprehensive transformation in the patterns of thinking among students, addressing topics related to conservation and preservation, sustainability and environmental impacts. This change is seen as fundamental for a more sustainable citizenship education and to face the environmental challenges of the present and the future.

The surveys that focus on the year 2020 may reflect a growing concern with environmental issues, both in Brazil and worldwide. In the mentioned period, several occurrences related to the environmental context gained prominence, such as the increase in natural disasters, political discussions on environmental policies, and a growing economic interest in sustainable practices. These events may have influenced the research agenda and motivated a greater number of studies on AE, and its connections with Morin's Complexity Theory.

Another point is the search for innovative approaches in EE teaching. They share the idea that traditional teaching methods are often not effective in conveying the complexity of environmental problems and the importance of preservation and conservation. Thus, all works explore pedagogical alternatives, such as activity guides, use of narratives, technological resources and analysis of pedagogical materials, aiming to make learning more engaging and meaningful.

It is worth mentioning that in the 5 studies analyzed there are variations in the methodologies used, such as the use of narratives to promote the understanding of the relationships between man and nature.

Final Considerations/Conclusions

The results of our research indicate that Morin's approach, which emphasizes the complexity of interactions between various environmental aspects, is a valuable resource in the construction of knowledge in the field of EE. In addition, his theory helps to overcome challenges, promoting a more critical, reflective and transformative society, which is crucial to face today's complex environmental issues.

The five studies analyzed present both significant differences and similarities. In terms of similarities, the studies approach AE from the perspective of Edgar Morin's Complexity Theory, emphasizing the need for an interdisciplinary approach. In addition, they explore innovative methodologies in EE teaching. However, they differ in the specific topics addressed: While some focus on initial teacher training, others examine continuing education programs or specific pedagogical projects.

Some studies explore how the principles of complexity can be integrated into pre-service teacher education, highlighting the importance of preparing future educators to deal with the interconnectedness of environmental problems.

Other works analyze pedagogical projects that use approaches, such as problem-based learning and outdoor experiential education, seeking to promote a deeper understanding of environmental issues. There are also investigations into the impact of EE methodologies on students awareness of environmental issues and their behavioral changes.

The results indicate that innovative approaches in EE teaching, based on Complexity Theory, have had a significant positive impact. There was evidence from students about environmental issues and changes in their behaviors, such as greater involvement in sustainable practices and more critical and reflective attitudes towards the environment. For example, problem-based learning allowed students to better understand the interconnectedness of environmental problems and their solutions.

The results of these studies can contribute significantly to the educational practice in EE. The proposed approaches and methodologies have the potential to be applied in other educational institutions or contexts, promoting a more integrated and effective environmental education.

This study aims to enrich the reflections on the integration of Environmental Education in teacher training, playing a relevant role in this process. By considering the contributions of Morin's Complexity Theory, we hope that our research will broaden the understanding of how EE can be more present in the initial and continuing education of teachers. We believe that this knowledge can be an important step towards a more equitable, supportive and humanitarian society, in which environmental paradigm shift and the transformation of mentalities are more frequent and sustainable.

In the literature, it is possible to find survey and knowledge studies that are similar to the proposed work. However, it is important to note that the present work differs in that it specifically emphasizes Morin's Complexity Theory and conducts a detailed analysis of specific dissertations during the pandemic period. This unique approach contributes to a deeper understanding of how Complexity Theory can be applied effectively in educational practice, with a particular focus on teacher education.

Ultimately, this investigation proposes to be a valuable instrument to improve the teacher education process, providing a consistent and applicable theoretical basis.

The in-depth understanding of the implications of Complexity Theory in EE and in teacher training allows not only a more robust and complete approach to environmental issues, but also contributes to the construction of a more sustainable society, prepared to face contemporary ecological challenges and committed to the promotion of a sustainable future for all.

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