

Analysis of the impact of plastic on the theme of Environmental Education for application in Brazilian public schools

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Abstract

Environmental issues have been a prominent issue worldwide and the increase in plastic production and the lack of post-consumer waste management programs result in inadequate disposal and deposition in terrestrial and aquatic environments, causing environmental impacts. This paper was developed through the analysis of aspects of pedagogical practice in relation to environmental education with the plastic theme and its environmental impact on the environment. In this perspective, environmental education through the individual and the collectivity builds social values, knowledge, skills and competences aimed at the conservation of the environment. However, it was observed that addressing environmental issues should be considered a challenge for teachers, as it is a broad and diverse subject, as they are not prepared for the development of these activities and schools do not have the infrastructure to meet the needs of approaches to environmental issues.

Keywords: Environmental education, Plastic, Environment, Sustainable society, Waste management

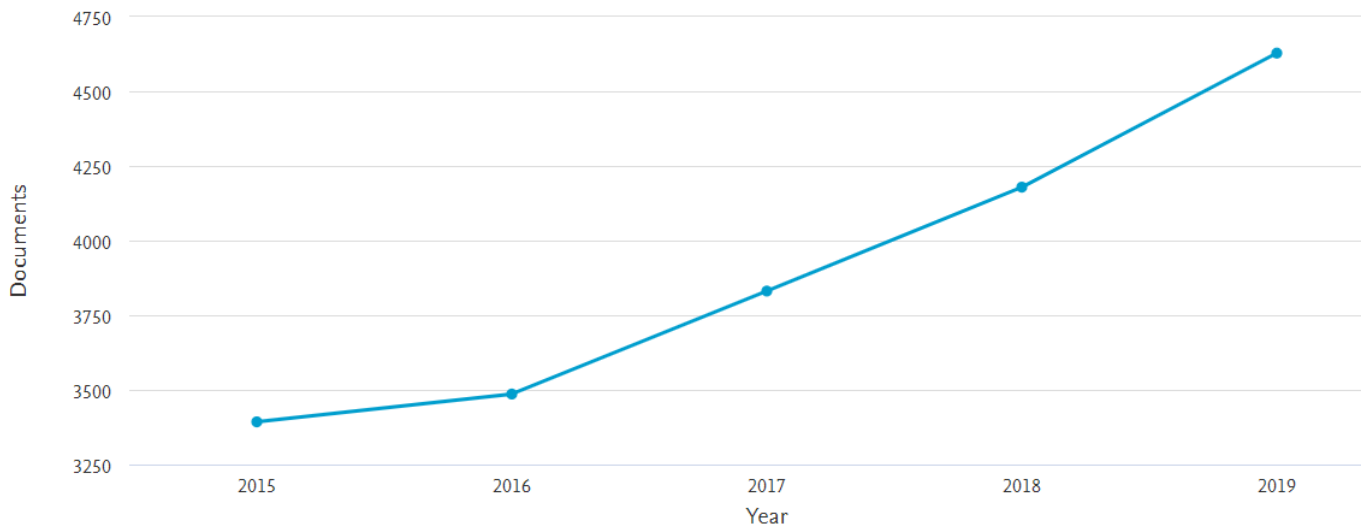
1. Introduction

Throughout the world, the educational system acts as an organization that prepare students to form a society, in order to assist in solving environmental problems, resulting in environmental awareness. As part of the structure of the educational system, in this context books are considered as an important tool in the transfer of concepts, meanings and values to students (AMINI & MASHALLAHI, 2015).

However, environmental education and education for sustainable development have become considerable topics for the curriculum in teaching. Historically, environmental education became part of the school curriculum in 1970, when interest on issues of environmental degradation was widely discussed worldwide (SCHÖNFELDER E BORGNER, 2020).

Hashemi (2020) and Haifaturrahmah et al. (2020) highlighted in their studies that the main element of Environmental Education is not linked to a national and local vision, but to a global, human and environmental context to structure the school curriculum. Efforts should be considered to include the importance of environmental education in the school curriculum to alter cognitive learning, effective and participatory knowledge, skills and behavior of students.

In this context, there has been a significant increase in the scientific importance of the theme over the years, signaling special attention from researchers to this area of research and development, according to Figure 1.



Source: Scopus

Figure 1. Evolution of research carried out in environmental education

Environmental education enables human beings to have a new way of facing their role in the world, proposing new models of relationships with nature, new paradigms and new ethical values. The adoption of interdisciplinary practices in the school environment is extremely important, as these are essential for the education of students in an integral way, enabling the global understanding of scientific knowledge (RAHMAN et al., 2020).

Some challenges are encountered in environmental education in Brazilian public schools, where teachers are aware of socio-educational responsibilities related to the transversal theme, however, there is a barrier in the application of activities related to the theme. The school as an opinion maker must have an established guideline on the best posture in relation to the environment, being a reference for action to promote a sustainable environment (SALLES, 2020).

Based on this information, this work aims to address the issue of environmental education with a focus on the impact caused by plastic in society and the interdisciplinary way in the pedagogical approach, favoring the understanding of an educational process with a critical and participative attitude of student.

1.1 Environmental Education and its importance

Environmental education emerged in the 1970s, a period in which concern about environmental issues was observed in society. As a result, several events emerged that addressed such issues, such as the Stockholm Conference in 1972, the Rio-92 Conference in 1992, held in Rio de Janeiro, which established an important measure, Agenda 21, which was an action plan for the 21st century aiming at the sustainability of life on Earth (DIAS, 2004), among others.

With the pattern of technology development and the concentration of capital, there was an inadequate

appropriation of nature, in which it was removed far beyond what is necessary for human sustenance in the name of profit-seeking capitalism, causing an imbalance in the relationship of man with the natural environment, where the degradation process is increasing every day, compromising the quality of life of society. In this way, urgent measures are needed worldwide in terms of raising awareness that leads to new concepts about the importance of preserving the environment in everyday life, and environmental education is a tool that will contribute significantly to this process.

Environmental education became law on April 27, 1999, through Law No. 9,795 - Environmental Education Law, where in its Art. 2 it states: "Environmental education is an essential and permanent component of national education, and must be present, in an articulated manner, at all levels and modalities of the educational process, in a formal and non-formal character". It is important to remember that Brazil is the only country in Latin America that has a specific national policy for environmental education.

In this perspective, environmental education has an interdisciplinary character, where its approach must be integrated and continuous, and not be a new discipline in the teaching curriculum in agreement with Law 9,795 / 9. It is considered an important component to rethink the theories and practices that underlie educational actions, considering formal or informal contexts, and should be interdisciplinary, enabling the orientation of problems related to local reality and adapting them to the target audience and their reality. It is important that there is a permanent participatory process in a way that is not just informative, practice is essential, in order to develop and instill a critical awareness of environmental issues (SALLES, 2020).

2. Plastics: characteristics, uses, production and environmental impacts

At the beginning of the 20th century, new types of materials called plastics were developed, which gradually became more and more used in the manufacture of the most varied objects. One of the decisive aspects responsible for the widespread use of plastic is the reduced purchase price, making it possible to manufacture the most different plastic articles and objects, being more accessible to the population.

At the molecular level, plastics are made up of organic polymeric molecules, many long units of matter in which a short structural unit is repeated several times. All feedstock used in the manufacture of plastic is obtained from petroleum. The simplest polymer is polyethylene, whose molecules are made up of thousands of units $-CH_2-$ linked together.

Depending on the way in which polymerization occurs, both low density polyethylene (LDPE) and high density polyethylene (HDPE) are formed. There are other polymers by addition similar to polyethylene in which one of the four hydrogen atoms is replaced by a group of X atom resulting in a specific polymer. Another commonly recycled plastic is transparent polyethylene terephthalate (PET) plastic. Its structure is a chain of two CH_2 units alternating with one unit of organic molecule of terephthalic acid. PET is used in the form of film (magnetic tape as well as photographic film, fiber and modeled resin).

According to Mattos and Peres (2010), and considering the diversity of types of plastics due to their excellent characteristics, among them: transparency, resistance, lightness and atoxity; plastics are divided into two groups according to their melting characteristics:

- thermoplastics: those that soften when heated, can be molded, and when cooled they become solid and

take on a new shape. This process can be repeated several times and correspond to 80% of the plastics consumed (polypropylene, polyethylene);

- thermosets: those that do not melt when heated, which makes it impossible to reuse them through conventional recycling processes (rigid polyurethane).

Plastics formed from polymers are used in packaging, as indicated by the original use of Table 1 (BAIRD and CANN, 2011).

Table 1- Plastics commonly recycled

Number assigned to recycling	Plastic name	Example of using the original plastic	Example of using recycled plastic
1	PET Polyethylene terephthalate	Drink bottles, food bottles and cleaning products, pharmaceutical recipient	Insulation material, non-food recipient
2	PEAD High density polyethylene	Bottles of milk, juice and water, recipient of margarine, folding bags	Oil and soap bottles, shopping bags, piping
3	PVC Polyvinyl chloride	Food, water and chemical bottles, packaging, building material	Drain piping, floor tiles, traffic cones
4	PEBD Low density polyethylene	Garbage, milk and food bags, flexible packaging and recipients	Garbage bags and food products, piping and oil bottles
5	PP Polypropylene	Plastic cups and packaging, disposable cutlery, household items	Insulators, toys, trays, rubble recipient
6	PE Polystyrene	Plastic cups and packaging, disposable cutlery, furniture and household items	Insulators, toys, trays
7	Others	Several	Special plastics, pots, fences and reeds

Source: Baird and Cann (2011)

Considering the diversity of the types of plastics due to their excellent characteristics, among them: transparency, resistance, lightness and atoxity; plastics are divided into two groups according to their melting characteristics:

- thermoplastics: those that soften when heated, can be molded, and when cooled they become solid and take on a new shape. This process can be repeated several times and correspond to 80% of plastics consumed (polypropylene, polyethylene);
- thermo-rigid: those that do not melt when heated, which makes it impossible to reuse them through conventional recycling processes (rigid polyurethane).

Considering all the waste generated by humanity, 10% is plastic. Of all the plastic generated, only 9% was recycled and 40% was used only once and then discarded. From 8 to 13 million tons of plastic reach the seas causing the death of 100,000 marine animals every year, about 700 species of animals, including endangered species, have already been affected by plastic in the seas. In Brazil, 40% of the waste generated is disposed of irregularly. This makes the cooperatives work very inefficiently, about 10% of what they receive are rejected and cannot be reused. The city of São Paulo recycles between 2% to 3% of the waste generated (LIGÓRIO, 2020).

Another aspect to be highlighted in the problem of plastic in the environment is its bioaccumulation in the food chain, reaching the human. Environmental education is an ally in the school environment to promote awareness for the preservation of the environment and change of posture, causing current concepts to be modified to ensure that human have a more harmonious relationship with nature. In this context, the adoption of interdisciplinary practices in the school environment is important, promoting the training of students in an integral way and enabling the global understanding of scientific knowledge.

3. The importance of Environmental Education

The strategies used to face the environmental problem help in the construction of sustainable societies and involve a coordinated articulation between all types of environmental intervention, including actions in Environmental Education. As well as the political, juridical, institutional and economic measures related to social environmental protection, recovery and improvement, activities in the educational field also emerge. In view of the need to structure the pillars of sustainable societies, social systems are updated to incorporate the environmental dimension in their respective specificities, providing the appropriate means to effect the corporate transition towards sustainability.

The legal system creates the "environmental law", the scientific system develops the "complex science", the technological system creates an "eco-efficient technology", the economic system enhances an "ecological economy", the political system offers the "green policy", and the educational system provides "Environmental Education". It is up to each of the social systems the development of functions according to their specific attributions, responding to the multiple dimensions of sustainability. In this context, social systems act to promote environmental change, education assumes a prominent position to build the foundations of sustainable society and to promote the processes of cultural changes towards the establishment of an ecological ethics and social changes towards the challenges of contemporary times (EFFTING, 2007).

4. Environmental Education in Brazil as a transforming instrument

Education at all levels has the common objective of training citizens, applied students and qualified professionals. In this sense, we can highlight environmental education, which ranges from ecological issues to the transformation of knowledge, aiming at greater sustainability and conservation of the environment (BLANCHET-COHEN and REILLY, 2013).

Currently, environmental education is encouraged in all public bodies and is considered a disseminating instrument in all social spheres. However, there is a mistake in its organization and functioning, since the conduct of the participating members is not reflected in an example for society, signaling that the discourse is not linked to their actions as an institution. It is clear that for environmental education to exist in different spheres, it is necessary to form attitudes and engagement with the participation of all, and therefore, public policies must be structured to maintain the integrity of the planet ecosystem.

In this perspective, the administration of any public sphere must know and integrate the principles of sustainability in the management mechanisms, including public schools that must adapt to this new reality, contributing for this program to achieve success in the school unit. In order to minimize this problem, the Ministry of the Environment created the Environmental Agenda for Public Administration which aims to promote Socio-Environmental Responsibility as a government policy, helping to integrate the economic growth agenda with sustainable development. This document is based on sustainable principles and practices in public administration entities, being used as a tool for the study of the environment and awareness for its protection and enhancement.

However, it is essential knowing the limits between development and use of environmental resources in a balanced way so as not to generate conflicts. These problems are culturally rooted, through thoughts, attitudes and appreciation that constitute a major political, social and ecological crisis.

According to Luiz et al. (2019) Environmental Education is an active intellectual process, strengthening the interpretation of concepts arising from the prior knowledge of students or even from his learning at school. The approach to environmental issues in the classroom presents an articulation with other disciplines, in which the concepts learned have a new meaning. By intervening in this process, environmental education has a critical view on environmental issues, promoting the use of problematizations about the object of study and its solutions in different aspects to interact with socio-environmental problems and the construction of a sustainable society.

The environmental issue is a relevant theme that promotes great reflection and self-criticism around the formation of new thoughts, behaviors and knowledge. Educators have a very important and decisive role in this process of using environmental education as a transforming tool in school, stimulating and allowing a critical position around these environmental issues, such as changing habits and practices, guiding the student to an education for citizenship. Considered as an important component for the theories and practices that founded educational actions, whether in formal or informal contexts, it must be interdisciplinary, orienting towards the solution of current problems, adapting them to the target audience and their reality, as the environmental problems according to Dias (2004) must first be understood in their local context, and then be understood in their global context. It is important that there is a permanent

participatory process, in a way that is not just informative, it is essential to practice, in order to develop and instill a critical awareness of environmental issues in Brazilian society (SALLES, 2020).

5. Environmental Education related to various subjects in the school environment

Environmental Education, as an essential component in the instruction and continuing education process, aimed at solving problems, contributes to the active involvement of the public, makes the educational system relevant and realistic, establishing greater interdependence between these systems and the natural and social environment, aiming at favorable conditions for society. The implementation of environmental education in schools has been showed to be an exhausting task. There are great difficulties in awareness-raising and instruction activities, in the implementation of activities and projects and mainly in maintaining and continuing the schedule of activities.

Some factors such as the size of the school, the number of students and teachers, the willingness of these teachers to undergo a training process, the willingness of the board to really implement an environmental project that will change the routine in the school, in addition to factors resulting from the issues mentioned above can serve as obstacles to the implementation of environmental education. Given that environmental education does not happen through specific activities, but through a whole change of paradigms that requires continuous reflection and appropriation of the values that refer to it, the difficulties faced assume even more striking characteristics.

Therefore, alternatives should be sought that promote continuous reflection that culminates in a change in mentality. Only in this way will we be able to implement true environmental education in our schools, with activities and projects not merely illustrative, but with the purpose of the school community in building a future in which we can live in a balanced environment, in harmony with the environment, with others living beings and with our fellow men. The necessary knowledge for the construction of citizenship will be presented in schools, with the involvement of different bodies that guarantee the rights and duties of each individual in society. Among these bodies we can mention the military police, the fire department, health surveillance and topics related to improving the quality of life of the population and reducing the environmental impact, as shown in Table 2.

Table 2- Themes to be worked on in Environmental Education

Theme to be worked on at school	Action to be realize
Trash	Reduction, reuse, recycling
Hospital waste	Correct destination
Water	Adequate consumption, waste reduction, remediation, preventive actions of pollution in water bodies
Pesticides	Reduction of risks to human health, reduction of environmental damage, reduction of bioaccumulation of chemical compounds in biological systems

Illegal hunting	Respect for wild and domestic animals
Drugs and alcohol (psychoactive substances)	Reduce the risk of accident and violence
Traffic Safety	Complementation of environmental legislation
Citizenship	Rights and duties for an individual living in society
Plastic	Reduction of plastic waste in the aquatic and terrestrial environment, material degradation, recycling
Surface air pollution chemistry	Technological control of emissions
Energy and climate change	Reduction of major greenhouse gases
Waste, soil and sediment	Domestic waste disposal and minimization, waste recycling, reduction of environmental impacts on the soil

Source: Author

With environmental content included in all subjects of the school curriculum and contextualized with the reality of the local community, the school will help students to understand the correlation of facts and have a world view of the problems related to the subject. As a result, environmental education must be approached in a systematic and transversal way, that is, at all levels of education, ensuring the environmental context in an interdisciplinary way in the various school subjects and activities (EFFTING, 2007).

In this context, the development of Science and new technologies applied in the development of plastics becomes fundamental, considering, for example, the packaging of juices and drinks, aiming to preserve their quality and prolonging their shelf life. If on the one hand these packages facilitate transport and ensure the conditions of conservation and hygiene of the products, on the other hand, they cause problems with the amount of waste produced, since they are not biodegradable and difficult to decompose in the environment. In this way, the management of plastic waste represents a pertinent theme today, because in addition to exercising a direct action on the environment, they interfere in the economic sector and in human behavioral patterns (OZÓRIO et al., 2015). According to the hierarchy of waste management, shown in Figure 2, the appropriate options for the destination of plastic waste include reduction, reuse, recycling, incineration and disposal in landfills.

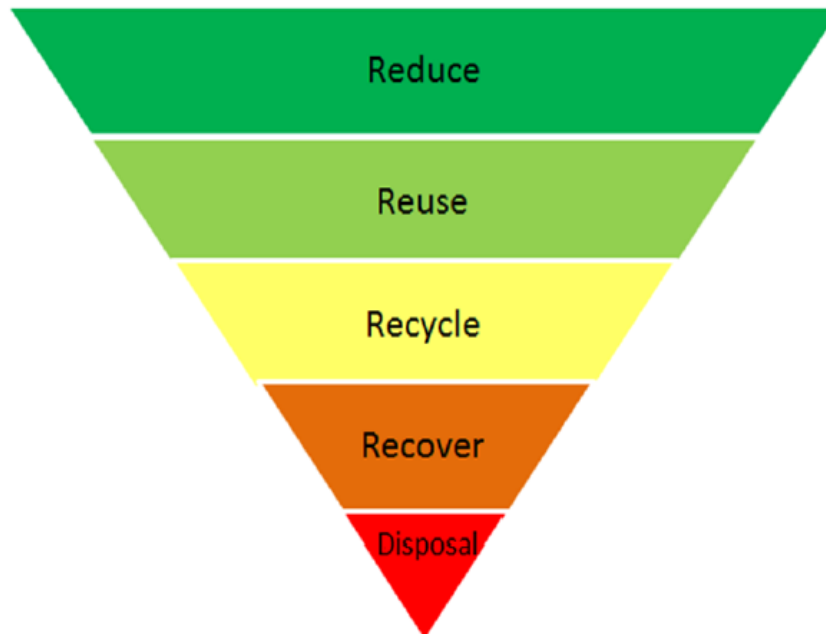


Figure 2. Hierarchy of waste management in descending order of preference.

Source: Azapagic et al., 2003

Considered as the most desirable option in this hierarchy, the reduction in the use of resources also makes it possible to reduce the generation of waste. It can be understood as the reduction in the use / consumption of plastic products by the consumer or reduction in the amount of plastic resin used in the industry for the manufacture of its products. The reuse of plastic materials is an usual practice that results from the durability and resistance of resins, therefore depending on the type of polymer. Plastics can be reused in many ways and for many different purposes. After several cycles of use, plastic materials start to degrade and it is no longer useful and must be reprocessed. In the third stage of the waste management hierarchy pyramid, recycling stands out, which has been identified as a destination option most used in post-consumption. Within this context, the landfill represents the last desirable alternative. The National Solid Waste Policy, instituted by Law 12.305, which deals, among others of plastic waste, establishes strategies for sustainable development and imposes the reverse logistics system, in addition to dealing with the life cycle of products and encouraging reuse and the recycling of materials, discouraging disposal in landfills, aiming to reduce environmental impacts (OLIVEIRA, 2012).

6. Final considerations

In the history of modern society we have highlighted several points that cover the environmental issue and indifference in relation to the production of waste and its control, as well as the remediation of degraded areas. The environmental problems related to the lack of awareness of human is considered one of the main intensifiers of the degradation of ecosystems. In view of this fact, it is evident the need for environmental education to be considered as an effective element, mandatory at all educational levels in the country, guiding the development of a sustainable environmental awareness and an active society in the preservation of the environment.

In Brazil some measures regarding the reduction of environmental impacts, such as recycling, result from the inadequate management of solid waste, including plastics. Essential factors for the proper functioning of a recycling system are selective collection and reverse logistics, which are national incipient practices. The National Solid Waste Policy is an important guideline to redirect the inappropriate waste disposal, in addition to regulating and encouraging procedures for its treatment. In addition, other government actions by states and municipalities are necessary, as well as the union between governments and industries for the development of an efficient management of urban waste.

In this process, the school plays an important role, forming critical citizens, aware and committed to the preservation of the environment. The environmental theme can be approached in the classroom in agree with the philosophy of environmental education considered an essential tool for the training of human. In this sense, the teacher needs to be prepared to act as a transforming agent and an awareness of environmental issues.

The implementation of environmental education in schools, makes it possible to understand the difficulties and challenges faced by teachers during the approach in the classroom, because as the environmental education is broad and diversified in concepts, teachers feel unprepared for such approaches. The teacher does not receive stimuli and the school community does not provide necessary support for the development of activities, creating a gap in knowledge for students, who act as listeners and non-practitioners, when they should be stimulated through activities and projects to exercise this awareness a from your reality. Another fact is that in public schools the situation is even more aggravating, as there are no adequate conditions for the development of an effective and good quality education. The lack of practical, innovative and interdisciplinary methodologies justifies the difficulty in carrying out the work on the part of teachers when addressing environmental issues, it is being developed during classes in some disciplines such as Science, Biology and Chemistry.

The activities of environmental education developed from the theme related to plastic, as presented in this work, allows the knowledge of the species of polymers, the problematic issue of the generation of residues in the environment and the remediation of the affected areas, however, actions must be planned so that they can integrate a set of activities developed in the environmental, social, political and productive sector.

The articulation of educational actions for the preservation of the environment is important and the school is the most suitable and privileged space for the implementation of these activities, since environmental education allows the student to live in harmony with the environment, generating new concepts and values about nature , signaling what should be done to contribute to the preservation of the environment. These actions will make it possible to establish a balance between human being and nature in the search for a better world, so that a global perspective is acquired and in this way it can disseminate such knowledge to society.

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