



## **Environmental Education and Educational Practices in Teaching Institutions: Solid Waste Management**

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#### SUMMARY

Large amounts of solid waste are produced daily in the world, putting the environment and life on Earth at risk. In Brazil, Educational Institutions that provide meals for their students, employees and outsourced workers face the challenge of how to take advantage of organic and inorganic materials wasted by their users, which can generate negative impacts on the environment. The lack of public policies and government actions as a way of teaching the population to rethink, reuse, reduce, reuse and recycle solid waste through conscious educational practices that are adaptable to each public institution, developing techniques and ways of treating this waste, as well such as the discussion of environmental prevention actions. Given the above, this article reflects on the need to promote Environmental Education within the context of solid waste management in Brazil, indicating the relevance of composting and recycling in educational practices in the formal and non-formal educational environment as a way of collaborating for the environmental awareness of the academic community, giving them an environmentally appropriate destination, such as the development of sustainable resources and alternatives in accordance with Law 12305/10 on the National Solid Waste Policy (PNRS) created in Brazil in 2010.

**KEYWORDS:** Sustainable Alternatives. Environmental education. Teaching. PNRS.

#### 1. INTRODUCTION

What is the society we want to build for the future? And what actions need to be taken effectively to ensure the reduction of solid waste? Or, alternatively, how can we reuse them? These are certainly very difficult questions to answer, as they require a joint effort from all sectors of society. But, of course, we want to build a sustainable society, which is why we base ourselves a lot on the principles of sustainability, not forgetting to rethink, reuse, reduce, reuse and recycle solid waste.

With these discussions, the search for a new concept of development that aims to break the paradigm of the hegemony of development based exclusively on the economic dimension is strengthened (VEIGA; COUTINHO; TAKAYANAGUI, 2015). For Ferreira *et al.* (2019), when it comes to economic development, it is necessary to think consciously about developing technologies that are directly linked to quality of life and environmental sustainability, in order to solve the problems caused by the reckless use of natural resources, therefore, it is society's duty to learn to live sustainably so as to avoid the degradation of the entire environment.

In this context, Education has the ability to transform, motivate and sensitize people, and is capable of enhancing ways to carry out collective social actions (JACOBI, 2003). With that, Environmental Education (EA) comes in as a way of promoting actions directly related to the environment and sustainable development, in which the National Solid Waste Policy (PNRS) proposes, such as the non-generation of waste, recycling, reuse, reduction of this waste and environmental awareness.

EA constitutes an indispensable means for the creation and application of sustainable ways, promoting solutions and actions that contribute to the minimization of environmental impacts. Since, Education is the way to create the necessary conditions for sustainability (BRASIL, 2001). Through this, educational institutions are primarily responsible for the dissemination of Environmental Education in their teaching environment. Thus, as highlighted by the National Environmental Education Program (ProNEA), educational institutions are responsible for including EA in their pedagogical policy, as well as the “restructuring of education towards

sustainability, encouraging dynamic school management, making the inclusion disciplines on the environment in university education and promote joint events between the areas of formal and non-formal Environmental Education” (BRASIL, 2005, p. 50). Mainly, because educational institutions are considered small centers of solid waste generation of various types on a daily basis, therefore it deserves attention for the propagation of environmental awareness and a plan for managing its waste (KLIPPEL, 2015).

In view of the above, adequate treatment combined with the composting and recycling service has become efficient and effective alternatives and practices to mitigate environmental impacts and to reduce the volume of organic solid waste (food leftovers, leaves, etc.) and inorganic waste. (paper, plastic, metal, glass) improperly disposed of in the environment. The composting process carried out with organic waste is a technique in which the decomposition of animal and vegetable foods is controlled, resulting in an organic compound used for plant fertilization (BUSS; MORETO, 2019). In the same way, when it comes to inorganic solid waste, recycling is the appropriate alternative, as they are recyclable waste, where this waste is reused by renewing it or transforming it into new products, giving it a destination that contribute environmentally, socially and economically.

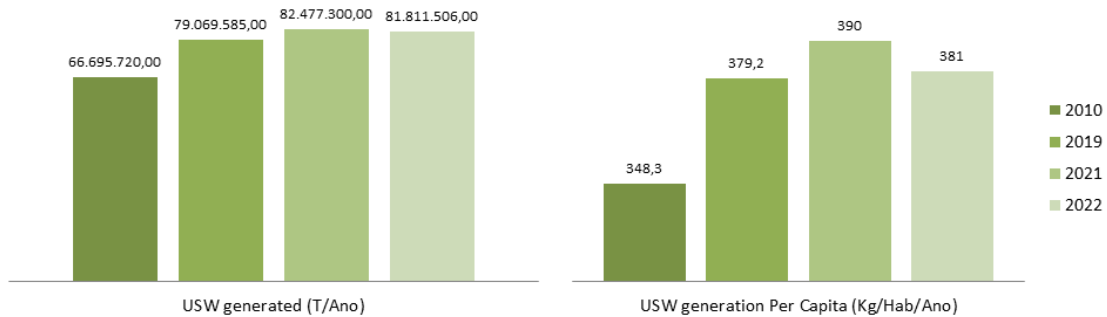
## 2 AN OVERVIEW OF THE SOLID WASTE SITUATION IN BRAZIL

The production of solid waste in Brazil and in the world is not new, since humanity began to consume products, this has become a major problem that has intensified even more over the years. Among the main causes, the exponential growth of the population stands out, the industrialization processes throughout history and the continuous increase in production, which requires a greater amount of natural resources, in view of the increase in demand and unbridled consumerism. , waste generation grows more and more (RAMOS *et al.*, 2017).

The increase in waste has a crucial factor, the so-called "planned obsolescence", which is the manufacture of products with the purpose of being replaced by others in a short period of time. Thus, when these wastes do not have an adequate final destination, they cause several social and environmental problems currently experienced (MAIA; AZEVEDO; ARAÚJO, 2018). For Pozzetti and Caldas (2019), the way people currently live in cities are direct consequences of a modernity based solely on economics for development, without considering the ecosystem as an integral part of it, prioritizing profit.

In Brazil, the Brazilian Standard NBR 10.004/2004 defines solid waste as waste in the solid and semi-solid states, which result from industrial, domestic, hospital, commercial, agricultural, service and sweeping activities (ABNT, 2004). According to data collected by the Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE), between 2010, 2019, 2021 and 2022 (Figure 1), indicate that the generation of Urban Solid Waste (USW) in Brazil registered a considerable increase, going from 66 million to 81 million tons per year and the generation per person increased from 348 kg/year to 381 kg/year. It should be noted that, in 2019, Brazil unfortunately stood out with the fourth largest country in waste generation per year, behind only China, the United States and India. In addition, it was the largest waste generator in Latin America, producing about 40% of the region's total, a total of 541 thousand tons of waste per day, according to a ONU Environment survey (SILVA, 2019).

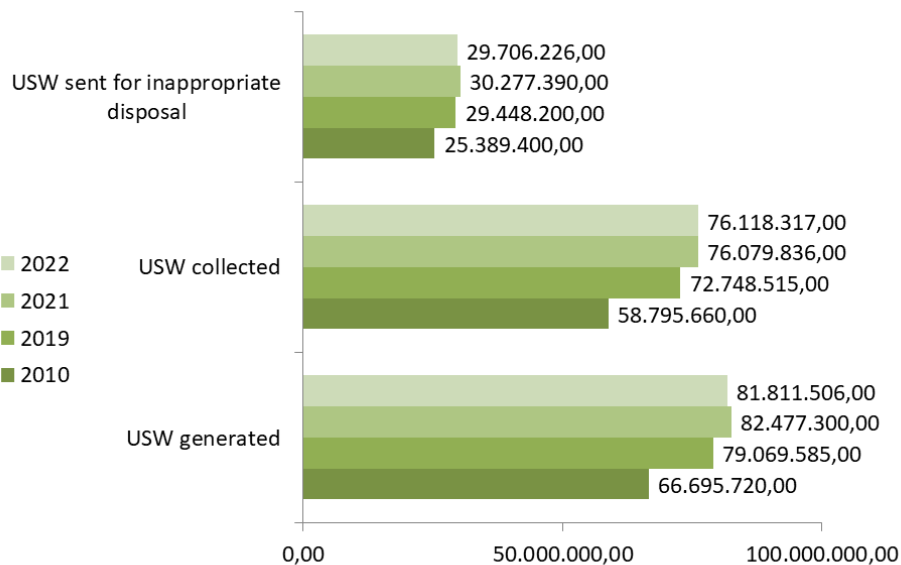
Figure 1 - Urban Solid Waste Generation in Brazil.



Source: Prepared by the authors based on data obtained by ABRELPE (2020; 2022).

Still according to ABRELPE, in 2022 there is still a significant inadequate final disposal of solid waste in the country. Despite the initiative of some municipalities, 61% of the USW is sent to sanitary landfills, while 46.4 million tons (39%) are sent to have an environmentally appropriate destination in the Brazilian territory. Figure 2 makes a comparison between USW generated, collected and sent to an inadequate disposal in Brazil between the years 2010, 2019, 2021 and 2022.

Figure 2 - Situation of Urban Solid Waste – MSW (T/year).



Source: Prepared by the authors based on data obtained by ABRELPE (2020; 2022).

It is noted that, in general, the collection of solid waste had an increase in 10 years, the amount of USW collected grew by about 22.8 % in a decade and about 61% of them receive an adequate destination, but the disposal inadequate use of this waste is still a reality and had an increase of 14.5% compared to 2010 in all regions. It should be noted that of the total solid waste collected, 39% continue to go to areas of inadequate disposal, highlighting the dumps and controlled landfills in all regions of the country, totaling 29.7 million tons with inadequate

disposal, mainly in the North and Northeast regions, which have the lowest rates of proper disposal. In this context, the number of municipalities with improperly adopted final disposal of USW totaled 2,826 in 2021. They still dispose of their waste inappropriately, such as in controlled landfills and open-air sites, which is environmentally inappropriate (BRASIL, 2020; COSTA; DIAS, 2020).

Therefore, it was clearly observed, given this situation, the need for public policies to at least point to the resolution of this environmental problem, which directly affects the health and daily life of the population. In this sense, the National Solid Waste Policy (PNRS) was instituted, as will be better seen in the following section.

### **3 THE NATIONAL POLICY ON SOLID WASTE (PNRS)**

For a long time, Brazil has been looking for legal mechanisms for the development of integrated public management policies, so that the problem involving waste is faced by society (FREITAS; PIRES; BENINCÁ, 2023). To combat the increase in solid waste production and the environmental problem in Brazil, several legislative initiatives were created, such as the first initiative through Senate Bill No. 354/89. However, it was only in 2010 that Law 12 n° 12,305 of 2010 was approved, which instituted the National Solid Waste Policy (PNRS), which brings a more current and broader approach on how to deal with environmental, social and economic problems caused by inadequate waste management solid waste (SOARES; MADUREIRA, 2018).

This law provides for the principles, objectives, instruments and guidelines, leading to the responsibility of generators and public authorities for an integrated management of solid waste, including waste classified as hazardous and excluding radioactive waste (LAVNITCKI; BAUM; BECEGATO, 2018, p. 382). Among the relevant aspects of this law, the definition of responsibility for the proper disposal of Solid Waste in the environment stands out, as well as prohibiting the improper disposal or destination, that is, the open sky of such waste, proposing the management and development of research on clean technologies applied to solid waste. The PNRS classifies solid waste according to origin as: a) household waste; b) urban cleaning; c) commercial establishments and; d) service providers, industrial, health services, civil construction and mining (BRASIL, 2010).

The Law is based on principles, objectives and instruments that connect with the other laws that must be practiced by the four spheres of government and private entities, individually or jointly, in search of carrying out the proper management of solid waste, giving them a destination environmentally suitable. In this case, “the principles focused on sustainability, addressed through selective collection, recycling, reverse logistics and technologies that allow the energy use of waste” (LAVNITCKI; BAUM; BECEGATO, 2018, p. 383).

A relevant point of Law 12.305/2010 is the so-called Reverse Logistics, which is configured as an instrument for economic and social development, considering that it is characterized by a set of actions, procedures and means to enable the collection and restitution of solid waste to the business sector, for reuse, in its cycle or in other production cycles, or other environmentally appropriate final destination (BRASIL, 2010). Thus, through Reverse Logistics, the solid waste generated is reinserted into a new sustainable production cycle, aiming to

contribute to the reduction of its production and deposit in landfills, as well as to reduce the use of raw materials.

In Art. 3, paragraph 7 of the PNRS, establishes the appropriate and sustainable final destination for solid waste, a destination that includes reuse, recycling, composting, recovery and energy use or other destinations allowed by the competent bodies listed in this law. Among the forms of disposal, the final disposition stands out, “observing specific operational norms in order to avoid damage or risks to public health and safety and to minimize adverse environmental impacts” (BRASIL, 2010).

By the way, Art. 3 of the PNRS, regulates the integral control of solid waste management as a set of actions aimed at finding solutions for solid waste, in order to consider the political, economic, environmental, cultural and social dimensions, with social control and under the premise of sustainable development (CRIVELARO; MOREIRA; SILVA, 2018). In addition, the law in its chapter 2, Art. 14, cites a fundamental instrument in this process of facing the environmental problem, the so-called Solid Waste Plans that the Union, States and Municipalities need to prepare, aiming at the environmentally appropriate destination of solid waste in each territory.

Integrated Management Plans need to present “Diagnosis, proposition of scenarios, targets for reducing waste, programs, actions and projects” (MAIA; AZEVEDO; ARAÚJO, 2018, p. 29). The same authors emphasize that “the general panorama of solid waste treatment in Brazil has become an integrated system, composed of selective collection, with participation at the social and governmental level, by the composting of organic waste and its final disposal”, however, this is only seen on paper, the reality is completely different, having to improve in several aspects the implementation of actions that actually materialize (MAIA; AZEVEDO; LIMA, 2018). As ABRELPE itself reports, despite 20 years of discussion in the National Congress and creation of the PNRS, the indices that have been presented demonstrate that there are great difficulties in putting into practice the advances planned by the new waste management system country solids. Fundamental principles such as reducing generation, implementing reverse logistics systems, increasing material recovery and ensuring adequate final disposal of only waste are still far from being achieved (ABRELPE, 2020, p. 34).

Thus, Brazil still has a long way to go in facing the environmental crisis related to the problem of solid waste, which is inevitable, but can be controlled, following the guidelines regulated by the PNRS. Therefore, it is still necessary to think and build waste management plans, and to promote Environmental Education, since they are necessary actions to minimize the effects caused by the large volume of solid waste improperly handled (POZZETTI; CALDAS, 2019).

#### **4 THE PNRS ALLIED ENVIRONMENTAL EDUCATION**

Issues related to the environment over time became the focus of many researchers and scholars, but not only they but society in general stopped to question the various phenomena and more frequent environmental disasters, caused by the pollution of solid waste, deforestation, fires etc. These consequences, caused by the actions of man, and that every day it becomes more necessary to rethink about them towards the environment (DIMAS; NOVAIS;



AVELAR, 2021). As in other sectors of society, environmental issues have also found space for discussion in the educational environment, which has become a strong ally in promoting environmental awareness and promoting sustainable and appropriate practices for each institution.

As a practice of social transformation, Education is a great tool for discussing environmental issues, and this is where Environmental Education enters, which must be included in social reality in order to promote education for the formation or change of individual and social values. , with concrete actions and causes focused on individual and collective responsibility that are concerned with the environment and life (FRIEDE *et al.*, 2019). According to Law nº 9.795/1999, which instituted the National Environmental Education Policy (PNEA), Environmental Education (EA) is understood to be the processes that allow both the individual and the community to build social values, knowledge, skills, attitudes and skills aimed at conserving the environment, an asset for common use by the people, essential to a healthy quality of life and its sustainability (BRASIL, 1999).

In this sense, for Mousinho (2003), Environmental Education seeks to awaken concern for the environment individually and collectively, promoting comprehensive access to information for all and contributing to critical and conscious development in relation to environmental issues. At the same point, the National Curriculum Guidelines for Environmental Education point out that EE is verified as a dimension of Education; being, therefore, an intentional activity of social practice, which should imbue individual development with a social character in its relationship with nature and with other human beings, aiming to enhance this human activity in order to make it full of social practice and of environmental ethics (BRASIL, 2012).

Given this, the importance of educational institutions in this process of environmental, critical and reflective training of citizens for the implementation of sustainable practices is noted. The school as a training agent and Environmental Education, is able to promote social, collective and individual learning processes, which contributes to the development, cultural, inclusive, solidary and responsible citizens (REIGOTA, 2014). Reflecting on EA in solid waste, Fuzzi , Santos and Leal (2015) highlight its relevance to sensitize people about the problems associated with daily activities regarding its improper disposal .

It should be noted that schools and universities are establishments that produce a large amount of solid waste, so it is important that the institution has a management plan for this waste. In addition, they are essential for the insertion of paradigms related to sustainability, in the task of promoting awareness actions with teachers and students and changes in thinking and acting, when disposing of waste (ALMEIDA, 2018; SANTOS; COSTA; SANTOS, 2019).

According to Gomes *et al.* (2018), in particular, higher education institutions need to act actively in stimulating teaching and research in the environmental area, as well as in responsible management aimed at preventing the environment in which it operates. Furthermore, they play an important role in construction and development of a sustainable and fair society through the process of technological development, in the preparation of students providing information and knowledge.

In Basic Education institutions, according to Pinheiro, Oliveira Neto and Pinto (2018), it is important for schools to innovate and work on raising student awareness and pedagogical

guidance related to the environment, as well as promoting activities that incite skills in relation to nature and citizenship, and that seek to develop in students the ability to perceive that they are an integral part of nature and need to be involved in its prevention. In this way, EE actions and practices have great relevance in schools in promoting awareness and sustainable thinking.

The PNEA (1999) maintains that it is the responsibility of educational institutions to promote Environmental Education in an integrated manner with the educational programs they develop. One of these responsibilities concerns the following:

§3rd study, research and experimentation actions will focus on:

I - the development of instruments and methodologies, aiming at the incorporation of the environmental dimension, in an interdisciplinary way, in the different levels and modalities of teaching; II - the dissemination of knowledge, technologies and information on the environmental issue; III - the development of instruments and methodologies, aiming at the participation of those interested in the formulation and execution of research related to environmental issues; IV - the search for curricular and methodological alternatives for training in the environmental area; V - support for local and regional initiatives and experiences, including the production of educational material; VI - setting up a database and image network to support the actions listed in items I to V. (BRAZIL, 1999).

Thus, EA can have an interdisciplinary nature as Pinheiro, Oliveira Neto and Pinto (2018) point out when stating that from an educational perspective, Environmental Education can be permanently inserted in all disciplines, taking into account that, by itself, will not solve environmental problems, but in a certain way it can be decisive in forming conscious and responsible citizens who respect and care for all forms of life on Earth.

EA becomes an integrating instrument, capable of raising awareness throughout the school community and encouraging critical and conscious thinking when it comes to the environment and issues related to the management of solid waste in the school environment (SANTOS; COSTA; SANTOS, 2019 ). Environmental Education, in accordance with what the Curriculum Parameters for National Education (PCN's) require, must therefore highlight:

being /human being and human being/nature relations , in all teaching areas, in approaching different contents: whether in the study of the various forms of social and cultural organization, with its most diverse conflicts, or in working with the various forms of communication, expression and interaction, whether in the study of phenomena and characteristics of nature or in the discussion of technologies that mediate the various dimensions of current life (BRASIL, 2001, p. 194 ).

According to the Tbilisi Intergovernmental Conference on Environmental Education (1977), among the principles of Environmental Education addressed by it, schools need to apply an interdisciplinary approach, taking advantage of the specific content of each area, so that a global perspective of the environmental issue is achieved. . Therefore, didactic strategies are needed that deepen the teaching of the environment, in this case, the teacher needs to work with the environment in a broad way, whose whole process involves the study of the natural, physical, biological and social elements of the relationship between man with the environment (BRASIL, 1999).



Thus, as has already been said, Education is the main means of promoting Environmental Education, introducing the problem in the school environment or in a community, contributing to the learning, knowledge and awareness of the population, in an attempt to introduce it into the lives of students and other users the adoption of sustainable practices and habits in their daily lives. Furthermore, making use of adequate tools and means that allow working in a sustainable way, consequently contributes to the minimization of environmental impacts.

## 5 COMPOSTING AND RECYCLING OF SOLID WASTE AND ENVIRONMENTAL EDUCATION

The PNRS emphasizes the disposal or final destination given to solid waste, and then, through reuse, recycling, composting, recovery and energy use (BRASIL, 2010). In this sense, according to ABRELPE (2020, p. 38), in order to start this process, it is necessary to have knowledge of the composition of waste, which will allow adequate planning of the sector, adopting strategies, public policies and specific processes that ensure the destination environmentally appropriate recommended by the PNRS, taking into account the best available and applicable alternatives, according to the types and amounts of existing waste.

Regarding the composition of urban solid waste, the amount of organic waste (leftover food) remains higher, at 45.3%. While dry recyclable inorganic waste such as plastics, paper and cardboard, glass, metals and multilayer packaging add up to 35%. Waste (waste that is no longer suitable for treatment, recycling or recovery) corresponds to 14.1% and is composed mainly of sanitary materials. Textile waste, leather and rubber, add up to 5.6% and also 1.4%, which include several materials theoretically objects of reverse logistics (ABRELPE, 2020).

It should be noted that the issue of the disposal of organic waste is a major problem in the country, as the generation is increasing every year and, when not properly managed, these wastes cause major environmental problems, since they have numerous capacities for pollution. In this case, for this waste, the National Solid Waste Policy recommends composting as the way to treat it, giving it an environmentally appropriate destination. Composting can be the best solution to deal with urban organic waste, through the use of nutritional additives and urban agriculture reduces the environmental burden (AWASTHI *et al.*, 2020).

In this sense, composting is understood to be “a biological process of recycling solid organic waste by natural fermentation with the aid of microorganisms (fungi and bacteria), these so-called consumer organisms in the food chain that are responsible for the degradation of organic matter” (FATESG, 2017, p. 2). Crivelaro, Moreira and Silva (2018) comment that this process of natural degradation is called composting due to man, who, over the years observing nature, allowed him to develop techniques to accelerate the process of decomposition of organic matter, as soon as this composting process will allow man to meet his needs more quickly.

sanitized final product is obtained, rich in humic compounds and whose use in the soil does not pose risks to the environment (VALENTE *et al.*, 2009). The same authors also emphasize that, to achieve efficiency, optimal conditions must be provided for the factors that act in the degradation of organic matter, such as humidity, aeration, C/N ratio, pH and granulometry. Once these factors and techniques are met and the composting conditions are ensured, the

composted material will have excellent physical, chemical and biological nutritional qualities, important for the preservation, fertilization and maintenance of the soil, in addition to being useful for the recovery of degraded areas. by human action (BRUNI, 2005).

In educational practices, composting emerges as an educational proposal of easy access, low cost and simple reproduction (BASTOS; SILVA; FURTADO, 2019). Thus, it allows transforming available organic materials, considered until then as garbage, into fertilizer, which can be used, for example, in a vegetable garden. Thus, it is understood that the implementation of educational practices in the precepts of Environmental Education, such as the use of composting in teachers' classes and the implementation of composting itself in the management of solid waste generated in educational institutions, can instigate/sensitize people interest in preserving the environment in which they live and adopting habits that contribute to sustainability.

In addition to composting, PNRS considers Recycling to be an environmentally appropriate destination given to solid waste, especially inorganic waste, through reuse as well. It should be clarified that these are materials of non-biological origin, produced by non-natural means ; being, therefore, produced by man through technological processes, especially plastic, aluminum, glass, metal. These residues cause major environmental problems when improperly discarded, mainly because they have compositions that prevent their decomposition more quickly by nature, taking longer in the environment and causing various types of pollution such as: noise pollution, soil and river pollution.

According to Lomasso *et al.* (2015), the recycling process takes place from waste products, which when consumed are discarded to the environment inappropriately, as they are considered useless. Therefore, these residues are collected and reinserted in the production cycle through their use as raw material for the manufacture of new products that receive the proper treatment according to the material to be reused, as organic or inorganic residue. Recycling becomes a relevant action for both the environment and society, as described by Krauczuk (2019), since it constitutes a source of income for many families, as well as a fundamental contribution to the environment, reducing the demand forwarded to landfills when recyclable material is collected for reuse or reuse. Therefore, these workers, the collectors of recyclable materials, develop an important task of recycling through the selective collection of materials that until then would have been destined for dumps or controlled landfills.

In this way, recycling includes a series of activities that involve the separation, collection and processing of waste to be reused and transformed into new products. In general, recycling processes aim at reinserting solid waste into the production cycle, based on actions known as the 5R's (Recycle, Reduce, Reuse, Rethink and Refuse).

The 5R's are fundamental to encourage sustainable attitudes and contribute environmentally , socially and economically. It should be noted that recycling refers to the process of transforming waste into a new product; reducing is related to the conscious purchase of goods and services, adopting conscious actions to avoid waste; o Reuse is an action aimed at combating waste, but, unlike recycling, the material does not enter a new production cycle, but is used for other purposes; and Repensar refers to reflection actions on the choice and need for consumption; and, currently, there is Refuse, which extends to actions aimed at not consuming products that are in plastic packaging.

For Arruda *et al.* (2018, p. 18), environmental attitudes and recycling behavior were shown to be related to social norms, motivation, identity, altruism and awareness. On the other hand, Environmental Education can be a form of resource that can instill in people an interest in preserving the environment in which we live and thus have proper and correct sustainability (ROOS; BECKER, 2012). Therefore, more action is needed to promote the importance of environmental prevention, so that environmental attitudes and actions are increasingly reinforced and reach a greater number of people who are willing and concerned about taking care of natural resources and preserving life in the world. planet.

## 6 FINAL CONSIDERATIONS

Educational institutions are establishments that produce a certain amount of solid waste, but most do not have adequate planning to dispose of these materials, despite the existence of Law 12.305/10 of the National Solid Waste Policy - PNRS created in Brazil in the year 2010. As a way of including the discussion in the school environment, it is emphasized that composting and recycling are major topics that generate discussions about solid waste, its benefits, harms, correct and incorrect disposal, among others. Bringing these discussions to the school environment is working in an interdisciplinary way, as Environmental Education covers all areas of knowledge and allows contextualizing with the subjects worked in the classroom.

Therefore, Environmental Education needs to be recurrent in formal and non-formal environments to sensitize the population to think critically and reflect on environmental problems, with the aim of transforming them into action to prevent, solve and preserve environmental conditions in a sustainable way. Through such expositions, this article awakens both social and environmental discussions, which can result in projects by the educational institutions that wish to work with the environmental theme, especially teachers who are looking for active methodologies for the theme in their classes in a way significant and generating discussions and actions to prevent the environment.

## REFERENCES

ALMEIDA, J. A. Gestão de resíduos sólidos em instituições de ensino: experiências internacionais, nacionais e no município de belo jardim/PE. **Revista Gestão e Sustentabilidade Ambiental**, v. 7, p. 467-485, 2018. Disponível em: [http://portaldeperiodicos.unisul.br/index.php/gestao\\_ambiental/article/view/6007/3600](http://portaldeperiodicos.unisul.br/index.php/gestao_ambiental/article/view/6007/3600). Acesso em: 25 de ago. 2021.

ARRUDA, E. C; ROSA, A. L. M.; MACUCH, R. S.; GROSSI-MILANI, R. Pro-environmental behavior and recycling: literature review and policy considerations. **Ambiente & Sociedade**, v. 21, p. 21-37, 2018. Disponível em: <https://www.scielo.br/j/asoc/a/rzWM4SZG9B4Xx7SCqZQnmb/?format=pdf&lang=pt>. Acesso em: 18 jun. de 2023.

ASSOCIAÇÃO BRASILEIRA DE EMPRESAS DE LIMPEZA PÚBLICA E RESÍDUOS ESPECIAIS (ABRELPE), 2020. **Panorama de resíduos sólidos no Brasil 2020**. Disponível em: <<http://abrelpe.org.br/panorama/>>. Acesso em: Acesso: 30 de ago. de 2021.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS (ABNT). **ABNT NBR 10004**: Resíduos sólidos – Classificação. Rio de Janeiro, 2004.

AWASTHI, S. K.; SARSAIYA, S.; AWASTHI, M. K.; LIU, T.; ZHAO, J.; KUMAR, S.; ZHANG, Z. Changes in global trends in food waste composting: Research challenges and opportunities. **Bioresource Technology**, v. 299, p. 122555, 2020.

BASTOS, L. de A. G.; SILVA, M. C. B. C. da; FURTADO, G. D. Compostagem de algas arriba das como ferramenta de Educação Ambiental em uma escola pública. **Revista Brasileira de Educação Ambiental (RevBEA)**, [S. l.], v. 14, n. 1, p. 416–438, 2019. DOI: 10.34024/revbea.2019.v14.2699. Disponível em: <https://periodicos.unifesp.br/index.php/revbea/article/view/2699>. Acesso em: 20 jun. 2023.

BRASIL. **Decreto-lei n. 9795, de 27 de abril de 1999**. Dispõe sobre a Educação Ambiental e institui a Política Nacional de Educação Ambiental e dá outras providências. Diário Oficial da República Federativa do Brasil. Brasília, 1999.

BRASIL. Ministério da Educação. Conselho Nacional de Educação; Conselho Pleno. Resolução nº 2, de 15 de junho de 2012. **Estabelece as Diretrizes Curriculares Nacionais para a Educação Ambiental**. Diário Oficial da União, Brasília, 18 de junho de 2012, Seção 1, p. 70. Disponível em: [http://portal.mec.gov.br/dmdocuments/rcp002\\_12.pdf](http://portal.mec.gov.br/dmdocuments/rcp002_12.pdf). Acessos em: 10 de ago. de 2021.

BRASIL. Ministério da Educação. Secretaria da Educação Fundamental. **Parâmetros Curriculares Nacionais: meio ambiente. sade. 3. ed** Brasília-DF, 2001.

BRASIL. Ministério do Desenvolvimento Regional. Secretaria Nacional de Saneamento – SNS. **Sistema Nacional de Informações sobre Saneamento: Diagnóstico do Manejo de Resíduos Sólidos Urbanos** – 2019. Brasília: SNS/MDR, 2020. Disponível em: <http://www.snis.gov.br/diagnostico-anual-residuos-solidos/diagnostico-do-manejo-de-residuos-solidos-urbanos-2019>. Acesso em 21 ago. de 2021.

BRASIL. **Parâmetros curriculares nacionais: meio ambiente, saúde**. Secretaria de Educação Fundamental. Brasília, 1997.

BRASIL. ProNEA - **Programa Nacional de Educação Ambiental**. Ministério do Meio Ambiente, Departamento de Educação Ambiental; Ministério da Educação, Coordenação Geral de Educação Ambiental. ed. 3, Brasília: MMA, DF, 2005. Disponível em: <<http://portal.mec.gov.br/secad/arquivos/pdf/educacaoambiental/pronea3.pdf>>. Acesso em 09 mar 2021.

BRUNI, V.C. **Avaliação do processo operacional de compostagem aerada de lodo de esgoto e poda vegetal em reatores fechados**. Dissertação (Mestrado em Engenharia de Recursos Hídricos e Ambiental). Paraná: UFPR, 2005. Disponível em: <https://acervodigital.ufpr.br/handle/1884/8556>. Acesso em: 20 de ago. de 2021.

BUSS, A.; MORETO, C. A prática da compostagem como instrumento no ensino de conteúdos e na Educação Ambiental Crítica. **Revista Monografias Ambientais (REMOA/UFSM)**, v. 18, p. 6, 2019. Disponível em: <https://doi.org/10.5902/2236130839699>. Acesso em: 20 de ago. 2021.

CARVALHO, G. O. Sustentabilidade e desenvolvimento sustentável: uma visão contemporânea. **Revista Gestão e Sustentabilidade Ambiental**, Florianópolis, v. 8, n. 1, p.779-792, jan/mar. 2019. Disponível em: [http://www.portaldeperiodicos.unisul.br/index.php/gestao\\_ambiental/article/view/6707](http://www.portaldeperiodicos.unisul.br/index.php/gestao_ambiental/article/view/6707). Acesso em: 30 ago. 2021.

COSTA, I. M.; DIAS, M. F. Evolution on the solid urban waste management in Brazil: A portrait of the Northeast Region. **Energy Reports**, Amsterdã, v. 6, n. 1, p. 878-884, fev. 2020. Disponível em: <https://www.sciencedirect.com/science/article/pii/S2352484719312429>. Acesso em: 09 de set. de 2021.

CRIVELARO, A. L. R.; MOREIRA, M. A. C.; SILVA, J. A. F. Gestão de Resíduos Sólidos e Compostagem Orgânica: Estudo de Caso para Escolha de Tecnologia de Processo em Macaé, Brasil. **Boletim do Observatório Ambiental Alberto Ribeiro Lamego**, v. 12, n. 1, p. 89-110, 20 jul. 2018.

DECLARAÇÃO DE TBILISI. **Algumas Recomendações da Conferência Intergovernamental sobre Educação Ambiental aos Países Membros**. Tbilisi, CEI, de 14 a 26 de outubro de 1977. Disponível em:

<http://educacao.riodasozas.rj.gov.br/rearo/pdf/decltbilisi.pdf>. Acesso em: 24 ago. 2021.

DIMAS, M. S.; NOVAES, A. M. P.; AVELAR, K. E. S. O ensino da Educação Ambiental: desafios e perspectivas. **Revista Brasileira De Educação Ambiental**, v. 16, n. 2, 2021. Disponível em:

<https://periodicos.unifesp.br/index.php/revbea/article/view/10914>. Acesso em: 22 de ago. de 2021.

FACULDADE de Tecnologia SENAI de Desenvolvimento Gerencial (FATESG). **Plano de Desenvolvimento Institucional da FATESG – Compostagem de resíduos orgânicos**. Disponível em:

[https://www.senaigo.com.br/repositoriosites/repositorio/senai/editor/Image/PGRS\\_Compostagem\\_Residuos\\_Organicos.pdf](https://www.senaigo.com.br/repositoriosites/repositorio/senai/editor/Image/PGRS_Compostagem_Residuos_Organicos.pdf). Acesso em: 22 de ago. 2021.

FERREIRA, L. C.; MARTINS, L. C. G. F.; PEREIRA, S. C. M.; RAGGI, D. G.; SILVA, J. G. F. Educação ambiental e sustentabilidade na prática escolar. **Revista Brasileira de Educação Ambiental (RevBEA)**, v. 14, n. 2, p. 201-214, 2019.

FREITAS, M. F.; PIRES, M. de M.; BENINCÁ, D. Gestão de resíduos sólidos urbanos: uma revisão sistemática aplicada à realidade brasileira. **OBSERVATÓRIO DE LA ECONOMÍA LATINOAMERICANA**, [S. l.], v. 21, n. 5, p. 2337-2359, 2023. DOI: 10.55905/oelv21n5-001. Disponível em:

<https://ojs.observatoriolatinoamericano.com/ojs/index.php/olel/article/view/528>. Acesso em: 20 jun. 2023.

FRIEDE, R.; SOUZA REIS, D.; AVELAR, K.; MIRANDA, M. G. Coleta seletiva e Educação Ambiental: reciclar valores e reduzir o lixo. **Educação e Formação**, Ceará, v.4, n. 11, p. 117-141, maio/ago. 2019. Disponível em:

<https://dialnet.unirioja.es/servlet/articulo?codigo=7146577>. Acesso em: 20 de jun. de 2023.

FUZZI, F. R.; SANTOS, D. C.; LEAL, A. C. Oficina Pedagógica sobre Educação Ambiental em Resíduos Sólidos Urbanos no município de Alfredo Marcondes/SP. **Periódico Eletrônico Fórum Ambiental da Alta Paulista**, v. 11, n. 4, 2015.

Disponível em: [https://publicacoes.amigosdanatureza.org.br/index.php/forum\\_ambiental/article/view/1289](https://publicacoes.amigosdanatureza.org.br/index.php/forum_ambiental/article/view/1289). Acesso em: 1 mai. 2023.

GOMES, A. L. N.; FREITAS, R. C. A.; MARQUES, T. H. G. D.; OLIVEIRA, L. C. S. Gerenciamento de resíduos sólidos em uma universidade pública: um estudo sobre práticas sustentáveis na UFERSA. **Revista Ibero Americana de Ciências Ambientais**, v.9, n.2, p.304-319, 2018. Disponível em: <http://doi.org/10.6008/CBPC2179-6858.2018.002.0025>.

Acesso em: 25 de ago. de 2021.

IAQUINTO, B. O. A Sustentabilidade e suas dimensões. **Revista da ESMESC**, v. 25, n. 31, p. 157-178, 2018. Disponível em: <https://www.revista.esmesc.org.br/re/article/viewFile/187/161>. Acesso em: 26 ago. 2021.

JACOBI, Pedro. Educação ambiental, cidadania e sustentabilidade. **Cadernos de Pesquisa**. n. 118, p. 189-206, 2003.

KLIPPEL, Adriana da Silva. **Gerenciamento de resíduos sólidos em escolas públicas**. 2015. Monografia (Especialização em Gestão Ambiental em Municípios), Universidade Tecnológica Federal do Paraná, 2015.

KRAUCZUK, H. M. Reciclagem. **Revista FESPPR Pública**, Paraná, v. 3, n.1, p.01- 18, 2019. Disponível em: <http://publica.fesppr.br/index.php/publica/issue/view/18/showToc>. Acesso 03 de set. 2021.

LAVNITCKI, L.; BAUM, C. A.; BECEGATO, V. A. Política Nacional dos Resíduos Sólidos: abordagem da problemática no Brasil e a situação na região sul. **Revista Ambiente & Educação**, v. 23, n. 3, 2018. Disponível em:

<https://periodicos.furg.br/ambeduc/article/view/7783/5616>. Acesso em: 21 de ago. 2021.



LOMASSO, A. L.; SANTOS, B. D.; ANJOS, F. D. S.; ANDRADE, J. D.; SILVA, L. D.; SANTOS, Q. D.; CARVALHO, A. D. Benefícios e desafios na implementação da reciclagem: Um estudo de caso no Centro Mineiro de Referência em Resíduos (CMRR). **Revista Pensar Gestão e Administração**, v. 3, n. 2, 2015.

MACIEL, N. M. T. C. A importância da educação ambiental para o aprimoramento profissional, docente e humano. **Ensino Em Perspectivas**, Fortaleza, v. 2, n. 1, p. 1-12, 2021. Disponível em: <https://revistas.uece.br/index.php/ensinoemperspectivas/article/view/4544/3756>. Acesso em: 23 de ago. 2021.

MAIA, A. L. A.; AZEVEDO, E. B.; ARAÚJO, N. M. S. A questão ambiental no capitalismo: o destino dos resíduos sólidos na gestão pública do meio ambiente. **Libertas**, v. 18, n. 2, 2018. Disponível em: <https://periodicos.ufjf.br/index.php/libertas/article/view/18591/9717>. Acesso em: 30 de ago. de 2021.

MARTINS, K. M. L.; ANDRADE, C. D.; LAVOR, O. P. Utilizando Objetos de Aprendizagem que abordam a conscientização do Meio Ambiente. In: **CONIMAS- I Congresso Internacional de Meio Ambiente e Sociedade e III Congresso Internacional da Diversidade do Semiárido**, 2019, Campina Grande. I CONIMAS e III CONIDIS. Campina Grande: Realize, v. 1., 2019.

MOUSINHO, P. Glossário. In: Trigueiro, A. (Coord.). **Meio ambiente no século 21**. Rio de Janeiro: Sextante. 2003. POZZETTI, V. C.; CALDAS, J. N. O descarte de resíduos sólidos no âmbito da sustentabilidade. **Revista de Direito Econômico e Socioambiental**, Curitiba, v. 10, n. 1, p. 183-205, 2019. Disponível em: DOI:10.7213/rev.dir.econ.soc.v10i1.24021. Acesso em: 18 de jun. 2023.

PINHEIRO, A. A. S.; OLIVEIRA NETO, B. M.; PINTO, E. S. Reciclar, reduzir, reutilizar, repensar, recusar inseridos na avaliação quantitativa em um estágio da saúde da criança. **Revista Cadernos de Educação, saúde e Fisioterapia**, v. 5, n. 10, 2018. Disponível em: <http://revista.redeunida.org.br/ojs/index.php/cadernos-educacao-saudefisioter/article/view/2184>. Acesso em: 15 de ago. de 2021.

RAMOS, N. F.; GOMES, J. C.; CASTILHOS JUNIOR, A. B.; GOURDON, R. Desenvolvimento de ferramenta para diagnóstico ambiental de lixões de resíduos sólidos urbanos no Brasil. **ENGENHARIA SANITÁRIA E AMBIENTAL**, v. 22, p. 1233-1241, 2017. Disponível em: <https://www.scielo.br/j/esa/a/P4Fb6pMrPHfrH9XRSqcV5NC/?lang=pt>. Acesso em: 18 de jun. 2023.

REIGOTA, M. **O que é Educação Ambiental**. São Paulo: Brasiliense, 2014.

ROOS, Alana; BECKER, Elsbeth Leia Spod. Educação ambiental e sustentabilidade. **Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental**, p. 857-866, 2012.

SANTOS, A.; COSTA, V. S. O.; SANTOS, T. G. Diagnóstico da gestão dos resíduos sólidos em duas unidades escolares. **Revista Brasileira De Educação Ambiental**, v. 14, n. 4, 25-39, 2019. Disponível em: <https://periodicos.unifesp.br/index.php/revbea/article/view/9658/7234>. Acesso em: 25 de ago. 2021.

SILVA, L. **Brasil gera 79 milhões de toneladas de resíduos sólidos por ano**. São Paulo, 08 de Nov. 2019. Disponível em <https://agenciabrasil.ebc.com.br/es/geral/noticia/2019-11/brasil-genera-79-millones-de-toneladas-de-residuos-solidos-al-ano>. Acesso em: 09 de set. de 2022

SILVA, V. P. M.; CAPANEMA, L. X. L. Políticas públicas na gestão de resíduos sólidos: experiências comparadas e desafios para o Brasil. **BNDES**, Rio de Janeiro, v. 25, n. 50, p. 153-200, set. 2019.

SOARES, L. S. V.; MADUREIRA, A. S. Cenários que desafiam a implementação emergencial da política nacional de resíduos sólidos: uma questão ambiental e de saúde. **Revista de Direito e Sustentabilidade**, v. 4, p. 74-89, 2018. Disponível em: <https://indexlaw.org/index.php/revistards/article/view/4954>. Acesso em: 21 de ago. de 2021.





VALENTE, B. S.; XAVIER, E. G.; MORSELLI, T. B. T. G. A.; JAHNKE, D. S.; BRUM JR, B.; CABRERA, B. R.; LOPES, D. C. N. Fatores que afetam o desenvolvimento da compostagem de resíduos orgânicos. **Archivos de zootecnia**, v. 58, n. 224, p. 59-85, 2009.

VEIGA, T. B.; COUTINHO, S. S.; TAKAYANAGUI, A. M. M. Avaliação de indicadores para gestão de resíduos sólidos urbanos. **Periódico Eletrônico Fórum Ambiental da Alta Paulista**, v. 11, n. 3, 2015.