



## Contribution of waste management from recycling: An educational approach

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### ABSTRACT

This study was based on a lecture that addressed the importance of proper management of solid waste and its application in agriculture, in addition to the treatment of data obtained through the application of questionnaires to students at the beginning and end of the lecture, and also discussed the problem of large-scale waste generation. During the lecture, the types of solid waste and those responsible for managing each type of waste were presented. Consequently, it is paramount to direct greater resources to the dissemination of information and the advancement of technology. Making knowledge about the recyclability of materials accessible along with education on proper packaging disposal practices emerges as an essential measure. In parallel, it is crucial to invest in research and development to create technologies that make materials more prone to recycling, while also being environmentally harmless and inert, to preserve the environment.

**Keywords:** Agriculture, Motivation, Environment.

### 1 INTRODUCTION

Due to the accelerated economic and technological development during the nineteenth century, developed countries became victims of environmental catastrophes and ecological problems, mainly caused by the lack of environmental education. We can use educational lectures and practical activities in schools as an agent of awareness for adolescents, children, and adults, thus making it possible, for example, to reuse these inputs and likely discard organic and inorganic material in the environment in which we live.

It is important to emphasize that the treatment and management of solid waste face an exacerbated problem, especially regarding the awareness of the population and even of the public authorities. According to Ferreira et al (2001), the indiscriminate release of organic and inorganic waste into the environment is still a common practice. The presence of solid waste in urban areas is very significant, generating aesthetic and public health problems, including causing floods and increasing epidemics. Thus, it is urgent that environmental awareness actions make people start to operationalize actions that can promote the proper separation of waste, enabling the subsequent recycling of discarded products.

In this work, the focus was on PET bottle waste, commonly used as packaging for soft drinks, juices, cleaning products, among others. In its original composition, PET is polyethylene terephthalate. It has 67% textile fibers, 24% injection-blow molded packaging, 5% bio-oriented film and 4% engineering polymer.

This raw material arrived in Brazil in 1988, but it was only in 1993 that it began to have a strong expression in the packaging market, notably for soft drinks. Thus, there was a gradual replacement of glass



(returnable) by non-returnable packaging (one-way, cans and, above all, PET), which resulted in changes in consumer purchasing behavior, in the pattern of competition and in the market-share of the sector's strategic groups (ABEPET, 2009).

According to Cobra (1993), until the 90s, the soft drink industry used returnable glass packaging on a large scale, that is, they were delivered to the points of sale for the "repurchase" of soft drinks. This characteristic predetermined sales, because the purchase without the return of the old "hull" implies an extra expense, higher than the cost of the product itself, a factor that discourages its acquisition.

The growth in the production and use of PET packaging highlights the concern that society should give to the issue of the disposal of urban solid waste, especially non-organic waste, due to the estimated time for its decomposition in nature (ABIR, 2009). The chain that involves the production, distribution, use and disposal of PET bottles is made up of several stakeholders. In a concise way, we can identify as key actors the companies that fill bottles with water and soft drinks, the retail chains that sell these products, the consumers who purchase, use the contents and dispose of the packaging, in addition to the authorities responsible for the collection of urban solid waste from the emergence of PET, the need for education has also arisen. being an agent of pollution of groundwater, streets, sewage and soil. Following a certain theme, this study revolves around environmental education in schools as a form of sustainability, based on public schools, being carried out in a high school state school full time professor Francisco de Assis Dias Ribeiro - EETIPFADR in the city of Santa Cruz in the interior of Rio Grande do Norte, as an extension project of the research group PET - Tutorial Education Program. Regarding the central problems and solutions evaluated, models of sustainability practices of the school in question will be highlighted, possible attitudes to be taken by students to improve the environment, solid waste management, reuse of bottles for the garden.

After all, an environmental education focused on reuse will minimize the impact of disposables, introducing such products back into the production system in order to transform them into new products, being considered a complete education, one that deals with sustainable consumption, the reuse of materials and reduction of packaging disposal, (CORTEZ; ORTIGOZA, 2007, p. 12-34).

We can assess the relevance of applying measures such as this, which have as their main objective the improvement of the environmental aspects of our planet. These projects applied by targeted educational programs, consumption will be able to return to fulfilling its function of meeting human needs without destroying the environment, because, in the affirmation that every production process has consumption as its final goal, the responsibility to create a responsible consumer is perceived (CORTEZ and ORTIGOZA, 2007, p.13) In this context, it is essential to emphasize the relevance of the environment for people's quality of life and, in the same sense, the Brazilian Federal Constitution, as established in its article 225, emphasizes: "Everyone has the right to an ecologically balanced environment, a good for the common use of the population is essential for a healthy quality of life..." (BRAZIL, 1988). To ensure this well-being,



it is worth passing on environmental education for new generations as a means of helping conservation and solving some of the problems we are facing due to the lack of it.

According to Mota (2000), recycling has been the "path" of plastic waste treatment that has concentrated the most efforts within the scope of business and government strategies, along with the economic motivations for increasing the useful life of landfills, generating jobs, social reintegration of waste pickers, saving energy and raw materials, reducing collection costs, transport and final disposal of garbage, proper reuse of waste and protection of the environment.

According to Costa and Costa (2011), environmental education should be understood as the appropriate process of transforming social values, knowledge, new attitudes aimed at environmental conservation and building environmental awareness, especially with the objective of forming conscious citizens.

## **2 GENERAL OBJECTIVE**

This article aims to analyze students' prior knowledge about solid waste management and raise awareness about the adverse repercussions that improper disposal of this waste causes to the environment. With this, it is intended to motivate them to adopt practices of proper separation of solid waste with the purpose of promoting the recycling of discarded products and encouraging the adoption of individual practices of reuse of waste from PET bottles and organic waste for the creation and maintenance of sustainable gardens and vegetable gardens, the latter with the possibility of using the hydroponic or semi-hydroponic technique.

## **3 METHODOLOGY**

For this work, a university extension lecture was held, developed by academics who are part of the Tutorial Education Program (PET - Chemistry) of the Federal College of Campina Grande (UFCG) - Cuité campus, in the sphere of public schools, being held in a high school, Escola Estadual de Tempo Integral Professor Francisco de Assis Dias Ribeiro (EETIPFADR) in the city of Santa Cruz/RN. The event took place on September 26, 2023 and was aimed at the first three grades, with the expectation of reaching a total of 120 students. The main objective of the lecture was to promote students' awareness of environmental responsibility, aiming to contribute to the formation of a sustainable society.

This study was based on a lecture that addressed the importance of proper management of solid waste, in addition to the treatment of data obtained through the application of questionnaires to students at the beginning and end of the lecture, and also discussed the problem of large-scale waste generation. During the lecture, the types of solid waste and those responsible for managing each type of waste were presented.



We problematize the fact that most Brazilian municipalities dispose of their household solid waste without any control (SCHALCH et al, 2002, p.1). In addition, the importance of sustainable individual practices that minimize environmental impacts was discussed, such as the separation of domestic solid waste, the use of PET and organic bottle waste in the production of vegetables, gardens, hydroponic gardens, as well as in the manufacture of brooms and potted plants.

In the presentation, we used samples of hanging gardens and hydroponic garden systems built from PET bottles and growing coriander in reused disposable cups, in order to encourage and stimulate students to assume sustainable practices. We have also demonstrated the use of organic waste, such as banana peels, coffee grounds, eggshells, seafood scraps, etc., as a source of fertilizers rich in NPK macronutrients (nitrogen, phosphorus, and potassium) for the nutrition of vegetables and plants in general.

As a way to assess the students' previous knowledge, we administered a questionnaire at the beginning of the lecture and, at the end of the lecture, we applied a final questionnaire to evaluate the knowledge constructed. The two questionnaires added up to ten multiple-choice questions and there were also questions with more than one answer to be marked. The questions covered topics related to environmental awareness as well as knowledge about sediment treatment and management.

#### **4 DEVELOPMENT**

Lectures focused on environmental issues in schools play a key role in raising students' awareness of their individual responsibility and participation in promoting the adoption of actions with less environmental impact. In addition, these lectures seek to strengthen the notion of belonging of individuals to a particular territory and community, while emphasizing the direct relationship between human beings and the environment in which they are inserted.

When discussing environmental issues, it is common for some people to associate them with events far removed from their daily lives, such as the extinction of animals, deforestation, melting of the polar ice caps, desertification, and other similar problems. This perspective may be related to a reductionist view of what constitutes the environment and the way the media have addressed these issues in recent decades. Often, the media tends to highlight isolated events, disengaging them from the underlying complexity of the phenomena and the underlying causes of these environmental problems. (PEREIRA; CURI, 2012, p. 38)

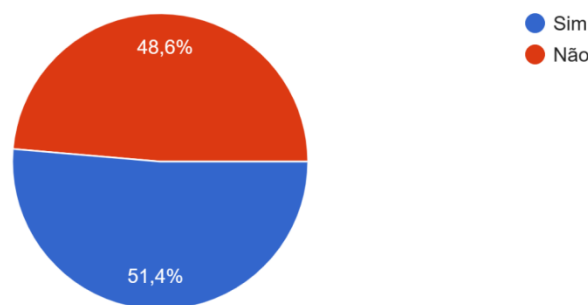
In this context, it is crucial to promote a fundamental change in the way individuals face and respond to existing environmental challenges. As highlighted by Sorrentino (2002, p. 19), it is imperative to awaken in each person a sense of "belonging", participation and responsibility in the search for solutions at both local and global levels, as proposed by the concept of sustainable development. This process aims to transform each individual from a passive observer of environmental reality to an active agent, effectively contributing to the preservation of the environment. (PEREIRA; CURI, 2012, p. 38)



Two questionnaires were used and developed to be applied at the beginning and end of the lecture. The purpose of these questionnaires was to assess students' previous perceptions regarding waste management and to collect important information about their practices in relation to solid waste separation in order to promote proper management. Finally, the purpose of the second questionnaire was to verify the level of comprehension of the students after the detailed presentation of the content covered during the lecture.

The data provided in graph 1 shows a discrepant percentage of the students who participated in the lecture when asked about the main theme of the lecture, precisely, 51.4% of the students answered "yes", indicating that most are aware of the proposed theme even without the orientations and clarifications of the lecture. We can observe a well-divided class, when the other half, which would be represented by 48.6% of the students, answered "no", indicating that they have no previous knowledge on the subject. What needs to be changed, because it is high implicit of human beings taking care of the environment in which they live, therefore, it is important to implement changes to ensure that students understand the relevance of this crucial topic.

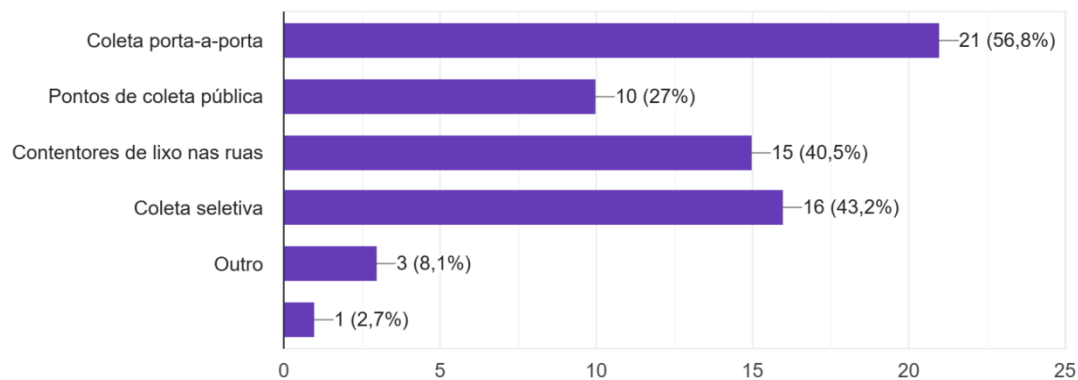
Graph 1. Interviewees' knowledge of waste management.



In the analysis of the answers in graph 2, which starts from the question about how waste collection is done in their local area, we can observe that the highest percentage, with 56.8%, marked door-to-door collection. For the other alternatives, selective collection was highlighted with a high percentage with 43.2%, so citizens have even more opportunity to be practicing the separation of waste for conscious disposal. 40.5% reported that they deposit their household waste in garbage containers on the streets. All alternatives are positive, because the most valid thing is that this garbage is not discarded on the street.

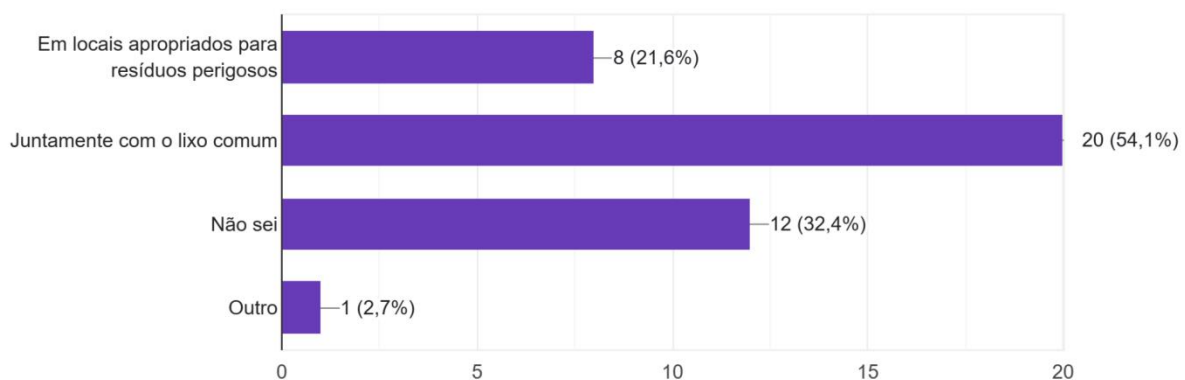


Graph 2. Methods of waste collection in the interviewees' locations.



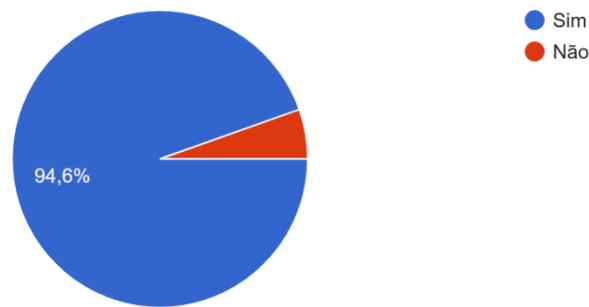
In graph 3, when asked about the disposal of hazardous waste, we observed that 32.4% do not know the destination of this material, possibly a part of society that may not be well informed about how to manage hazardous waste. One of the ways considered incorrect presented the highest percentage, 54.1% pointed out that they throw this input directly into the common garbage, which is an incorrect practice and can lead to several accidents and disorderly pollution. 21.6% answered that they dispose of hazardous waste in appropriate places, which is the correct way to dispose of them, which suggests that part of the population is aware of the importance of properly disposing of it. A small percentage of 2.7% pointed to another, less common form of disposal.

Graph 3. Methods of disposal of hazardous waste in the region studied.



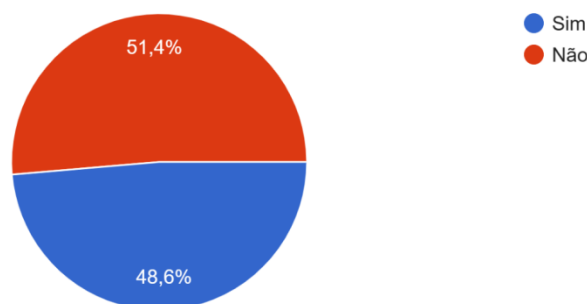
Regarding graph 4, it is evident that most participants have a clear understanding of the distinction between common garbage and waste. Precisely, 94.6% recognize that there is a significant difference between the two, highlighting that ordinary waste is not recyclable, while waste can have other uses. Only a minority of 5.4% of students did not identify this distinction.

Graph 4. The interviewee and the recognition of the difference between waste and common garbage.



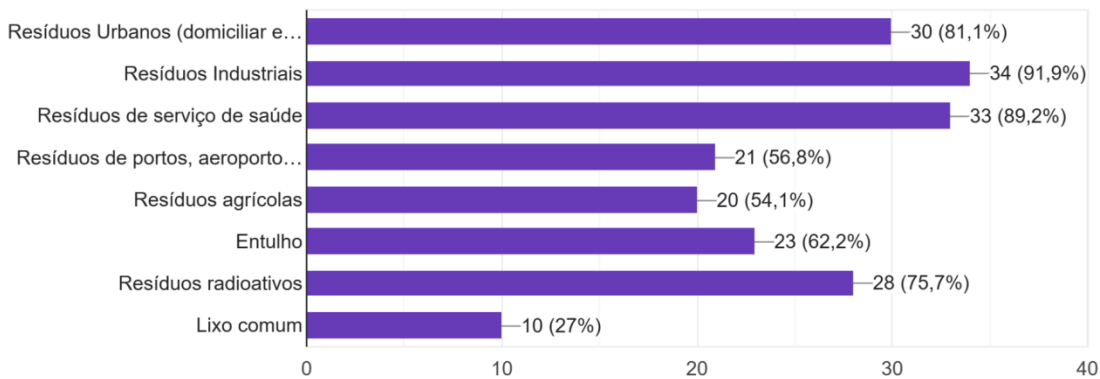
Graph 5 shows that 51.4% do not participate in waste separation in their own social environment, whether at home, workplace or school, which can generate environmental disorder and make the waste management effort unilateral instead of shared by all. From this perspective, the graph shows that 48.6% are part of humanity that is involved in the proper separation of waste, thus helping directly and indirectly in the conservation of the environment.

Graph 5. Carrying out retraining at home or workplace.



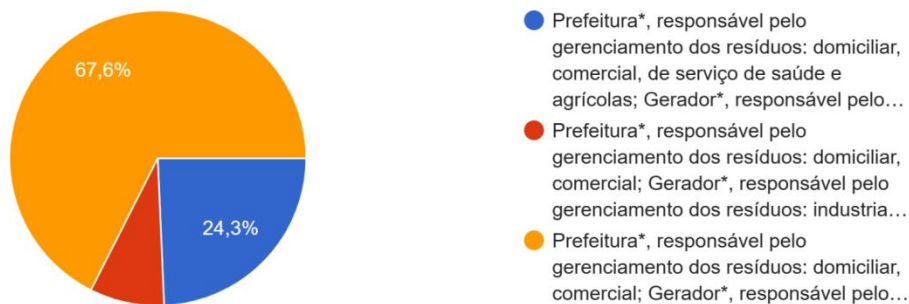
In graph 6, the first post-lecture question was a verification of the comprehension of the content applied. We requested a classification of the waste that was mentioned, presenting their opinions for each type of waste in percentage, being divided as follows: 81.1% believe that municipal waste fits into the group of solid waste, 91.9% marked that industrial waste is part of solid waste, 89.2% for health service waste showing that it also fits into solids, as well as waste from ports and airports with 56.8%, followed by agricultural waste with 54.1% and rubble with 62.2%, leaving radioactive waste that was also classified as solid waste with 75.7%, common waste was the one that received the lowest percentage 27% being considered by a smaller quantity in relation to the other groups of solid waste, which is a positive point, because common waste does not fit into the categories of solid waste.

Graph 6. Main categories of solid waste according to respondents.



In graph 7, we can observe that the students were attentive to our contents, as most of them answered correctly when asked about those responsible for the management of each type of waste, to specify 67.6% marked the right alternative, when it comes to the multiple responsible for each type of waste, which are the city hall: responsible for the management of household waste, commercial; generators: responsible for the management of industrial waste, health services, ports, airports, railway and road terminals, agricultural waste and rubble; and the National Nuclear Energy Commission (CNEN): responsible for the management of radioactive waste. As for the remaining 24.3%, they indicated another divergent alternative than expected, leaving only 8.9% in the alternative that did not contribute to what was proposed.

Graph 7. Responsible for the management of each type of waste according to the interviewees.

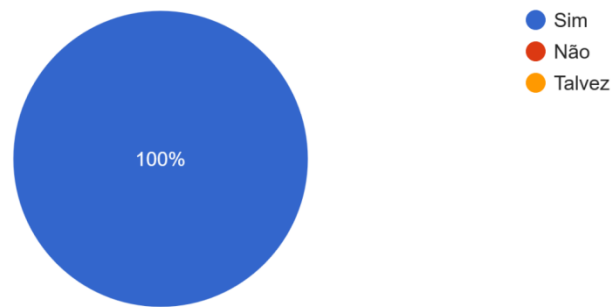


In graph 8, there was unanimity among the students who believe that the lack of waste management directly contributes to environmental pollution, in this question the percentage was 100% for "yes". We can notice that they are aware of how pollution can cause harm to the environment.



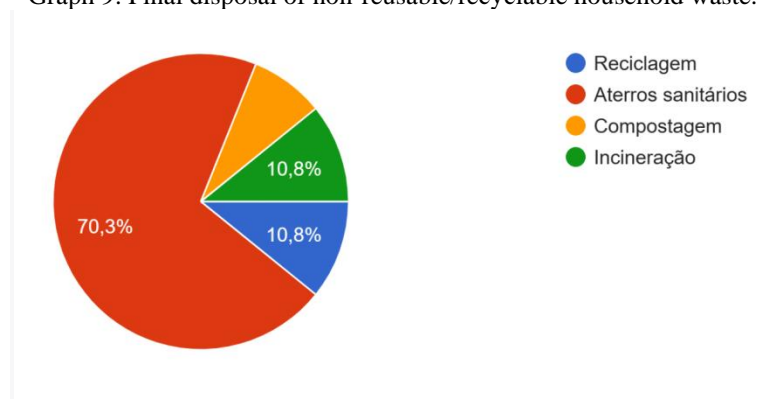


Graph 8. Answer to the question: "Do you believe that the lack of management or inadequate management of waste generates environmental problems?"



Regarding the final disposal of household waste that cannot be reused, a point depicted in graph 9, we can say that the majority answered that this waste is destined for landfills. A part of these students is well divided among the other alternatives. However, it is important to highlight that the 10.8% marked for recycling is not a non-viable alternative, in the case of non-recyclable materials.

Graph 9. Final disposal of non-reusable/recyclable household waste.



In graph 10, we return to a very recurrent discussion about landfills, which was one of the topics addressed in the lecture, mainly because it is a polluting agent. We can see in the result of this graph that the majority understood how the location for a new landfill is arranged, in an attempt to minimize soil contamination and poor distribution of this garbage, reaching the mark of 97.3% considering that the majority understood about this.



Graph 10. Justification of the studies to identify appropriate areas for the location of sanitary landfills.



## 5 CONCLUSION

Recycling in Brazil is currently facing significant dilemmas, which despite its rapid growth over the past decade, require resolution to move towards more advanced levels of sustainability. One of the main dilemmas lies in the need to balance the essential function of the packaging system with the environmental problems resulting from post-consumer disposal without adequate consideration. This is a challenge that affects both research entities, companies that produce packaging and society. Consequently, it is paramount to direct greater resources to the dissemination of information and the advancement of technology. Making knowledge about the recyclability of materials accessible along with education on proper packaging disposal practices emerges as an essential measure. In parallel, it is crucial to invest in research and development to create technologies that make materials more prone to recycling, while also being environmentally harmless and inert, to preserve the environment.

It is concluded that the lecture on the correct management of solid waste proved to be an event of relevance, providing clarity on the awareness and importance of this crucial topic for society and the environment. First, it was evident that a significant part of the participants already had some degree of awareness about solid waste management before the lecture. This suggests that concern about the environmental issue is, in fact, widespread, but it also points to the need to improve the public's knowledge and understanding of this topic. Additional clarifications on the disposal of hazardous waste, such as safe handling and identification of disposal sites, are becoming necessary.

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