THE PROBLEM OF BULKY WASTE IN SCIENCE TEACHING

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ABSTRACT

This article seeks to analyze the problem of bulky waste in the teaching of Science in scientific productions between the years 2014 and 2024. The state of Rio Grande do Sul faced a period of flooding in May 2024, which resulted in large volumes of waste being generated, so the consequences related to its disposal have intensified. Therefore, Environmental Education can facilitate the debate on the social and environmental impacts associated with this waste, stimulating a critical and reflective understanding. The analyzed studies were based on *the a priori* categories of Bardin (2011). The results pointed to the scarcity of publications on the subject, evidencing the urgency of teacher training that promotes contextualized education. This research is part of the bibliographic review of a dissertation of the Graduate Program in Science Education (PPgECi) of the Federal University of Rio Grande do Sul (UFRGS).

Keywords: Bulky waste. Science teaching. Environmental education. Waste management.

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INTRODUCTION

As a society, we are using natural resources in an unsustainable way, putting our very existence at risk. The result of this has already generated numerous effects, such as: fires, floods, air, soil and water pollution, thus causing a series of environmental problems. Inadequate waste management can cause serious damage, and, as Campos (2001, p. 14) points out, "the population is not educated by the government to deal with the waste it generates, resulting in the pollution of cities and the degradation of natural spaces".

Among the various types of existing waste, this article focuses on waste classified as bulky waste. These include furniture, other large items, household equipment, such as refrigerators, stoves, TVs, washing machines and dishwashers, among others (ABNT, 2004).

In addition, these wastes usually have shapes and physical characteristics that favor water retention, creating environments conducive to venomous insects, such as spiders and scorpions, as well as disease-transmitting insects, such as the *Aedes aegypti* mosquito, and other vectors that pose significant risks to the health of the population (Ito; Colombo, 2019).

Recently, the state of Rio Grande do Sul faced a serious crisis with floods in May 2024, which resulted in large volumes of bulky waste being generated. The force of the waters dragged furniture, appliances and other items, creating an emergency scenario in several cities.

In the educational context, Environmental Education emerges as an essential tool to sensitize students about the importance of proper waste management, including bulky waste. The school, especially in Natural Sciences classes, is a privileged space to discuss environmental issues, assuming a role that goes beyond just promoting the selective collection of garbage (Travassos, 2006; Trindade, 2011; Layrargues, 2011). However, understanding how teachers approach the topic of bulky waste in the classroom is essential to evaluate existing pedagogical practices and identify challenges that still need to be overcome.

This article aims to review the scientific literature on the perceptions and pedagogical practices of Natural Sciences teachers when addressing bulky waste. The analysis seeks to identify the methodologies, the obstacles faced by teachers and the strategies adopted to integrate the theme in teaching, contributing to an Environmental Education that goes beyond the simple transmission of knowledge, but that promotes changes in behavior and values.

Since this is a problem of global concern, this work considered it relevant to carry out a survey of the productions of the last decade that contemplate bulky waste in the Teaching of Science in the context of Environmental Education. It is important to highlight that this research is part of the bibliographic review of a Master's dissertation in Science Education, carried out in the Graduate Program in Science Education of the Federal University of Rio Grande do Sul (UFRGS).

METHODOLOGY

The choice of the Brazilian Digital Library of Theses and Dissertations (IBICT/MCTI&C) and the Lume repository of UFRGS is due to its wide collection of research in Education and Sciences, which represent reliable sources for understanding current trends in Environmental Education and its pedagogical practices. This selection ensures that the data analyzed is aligned with contemporary discussions, providing a solid foundation for our investigation.

The survey was carried out between July 2023 and October 2024, following two stages:

i) Definition of search terms and a *priori categories;*

ii) Selection of dissertations through floating reading.

The selection of works was based on the application of conceptual filters, prioritizing materials that offered relevant and up-to-date contributions, which were selected through the terms: bulky waste, environmental education and science teaching, restricted only to dissertations. The choice of papers occurred through the reading of the title, keywords and abstract.

Thus, using the elements of content analysis by Bardin (2011), the a *priori* categories were:

i) Objective of the work;

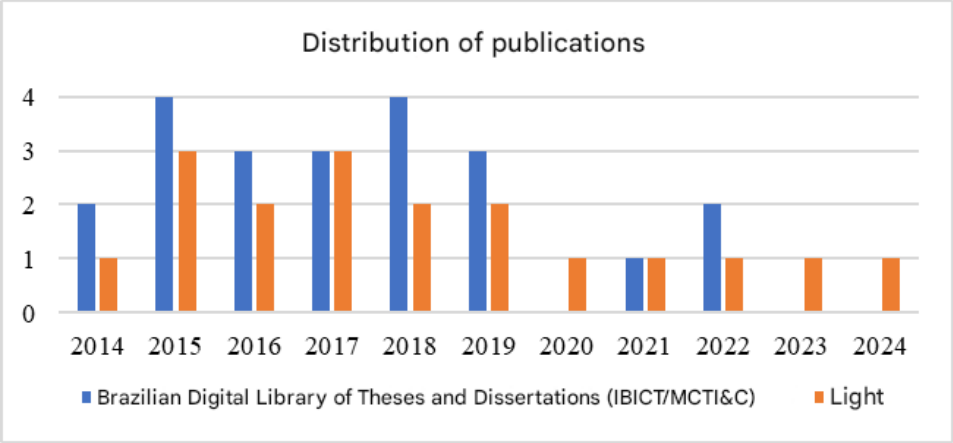
ii) Theoretical and methodological approach;

*iii)*Terminology used.

RESULTS AND DISCUSSIONS

As a result of the analysis, 22 publications on Environmental Education in Science Teaching were found in the Brazilian Digital Library of Theses and Dissertations (IBICT/MCTI&C) and 18 in the Lume repository of the Federal University of Rio Grande do Sul (UFRGS), although none of them directly addressed bulky waste.

Graph 1: Distribution of publications of the works over the period analyzed



Source: Prepared by the author.

Graph 1 shows the analysis of the two repositories, with the research restricted to dissertations, showing production peaks in certain periods, followed by a declining trend in more recent years. This reduction in production may be associated with a possible change in the focus of academic investigations, thus emphasizing the need to expand studies on the different approaches to Environmental Education. Such expansion is essential to strengthen an education that promotes citizenship and contributes to the integral formation of individuals.

According to Morin (2023), education should be an adventure that supports the pursuit of knowledge, allowing students to integrate knowledge and develop a contextualized understanding of the complex realities they face.

CATEGORY 1 – OBJECTIVE OF THE WORK

The selection of works was carried out through advanced search, using objectives and keywords as the main criteria for identifying the most relevant dissertations to the topic of study. This process resulted in an initial screening of nine dissertations that met the previously defined parameters, ensuring the adequacy of the contents to the focus of the research.

Table 1 – Dissertations of Lume

Author (Year)	Main objective	Keywords
Machado (2014)	To verify how Biology teachers integrate Environment, Sustainability and Environmental Education in their pedagogical practices.	Environmental education
Almeida (2017)	Investigate perceptions about the More Education and Environmental Education Program, exploring social themes and criticality.	Environmental education
Gonçalves (2018)	To analyze the relevance of Environmental Education in schools and its contribution to coastal management.	Environmental education
Schwalm (2022)	Analyze the activities of an existing Science Club, with a focus on Ecopedagogy and environmental awareness.	Environmental education

Source: Prepared by the author.

Chart 2 - Dissertations of the Brazilian Digital Library of Theses and Dissertations (IBICT/MCTI&C)

Author (Year)	Main objective	Keywords
Mourão (2014)	Investigate the reuse of household solid waste and its impact on the awareness of the educational community.	Environmental Education, Waste
Glory (2019)	Analyze the solid waste disposal process and propose an engaging environmental education.	Environmental Education, Waste
Manhiça (2020)	Use the Ecological Footprint as a didactic tool to promote sustainable consumption.	Environmental Education, Waste
Rodrigues (2022)	To stimulate the critical-reflective attitude about solid waste in the context of EJA, highlighting sustainable practices.	Environmental Education, Waste
Silva (2022)	Investigate educators' perceptions of environmental pollution and promote a new pedagogical approach.	Environmental Education, Waste

Source: Prepared by the author.

In the analysis of the selected works, we identified a variety of methodological approaches applied to the teaching of Science, which aim to integrate Environmental Education to the management of bulky waste. It was observed that, despite a considerable effort on the part of educators, many face challenges, such as lack of resources and the need for institutional support. For example, Mourão (2014) and Glória (2019) mentioned that the effective implementation of educational programs depends heavily on educational training, in addition to raising awareness about the impacts of solid waste on public health and the environment.

The dissertations available at Lume stand out for their emphasis on pedagogical practices and projects that promote environmental awareness, exploring various approaches within Environmental Education. The IBICT/MCTI&C dissertations, on the other hand, present a more technical approach, addressing topics such as solid waste management, sustainable consumption and the use of the Ecological Footprint as a didactic resource.

These works include analyses on the integration of themes, such as Environment and Sustainability, in teaching practices, emphasizing practices that stimulate critical reflections on socio-environmental issues. Reinforcing the role of Environmental Education as an essential tool for the formation of a citizen and sustainable consciousness, for Leff (2000), environmental education should be understood as a continuous process that seeks to form critical and conscious citizens.

This differentiation in focus reveals the diversity of strategies within Environmental Education, indicating the importance of integrating both innovative pedagogical practices and technical concepts in the educational process, with the objective of promoting the formation of a critical and transformative awareness in students, capable of stimulating responsible and sustainable actions in the school daily life and in society.

3.2 CATEGORY 2 – THEORETICAL AND METHODOLOGICAL APPROACH

The *a priori categories* used in this research were developed based on the theoretical foundations of Bardin (2011) and are directly related to the objectives of our investigation. When analyzing the dissertations, three main categories were identified: 'Objective of the work', 'Theoretical and Methodological Approach' and 'Terminology used', which together allowed a deeper understanding of the relationship between Environmental Education and bulky waste management. This stage, completed in October 2024, made it possible to identify and extract the most relevant theoretical and methodological contributions to support the discussion about Environmental Education and its various approaches within the scope of pedagogical practices.

This category aimed to identify the works that presented a direct relationship with the present study, with emphasis on the theoretical and methodological approaches adopted in the dissertations analyzed. Particularly, those that addressed themes related to Environmental Education, Science Teaching and bulky waste management were considered.

Chart 3 - Dissertations related to the research theme

Author (Year)	Dissertation title	Relationship with research
Mourão (2014)	Environmental Education and Sustainable Consumption: The Reuse of Solid Waste as a Teaching Tool.	It addresses solid waste management and the integration of Environmental Education in pedagogical practices, aligning with the focus on bulky waste.
Glory (2019)	The Solid Waste Disposal Process in the Community of Terezina III, in the Municipality of Tabatinga-AM: A Proposal for Environmental Education.	It emphasizes Environmental Education in the school community and the importance of sustainable practices in waste disposal.
Manhiça (2020)	Environmental Education for Sustainable Consumption: Use of the Ecological Footprint as a Didactic Resource.	Environmental Education as a pedagogical tool, focusing on sustainable consumption, is aligned with the analysis of educational practices on waste.
Rodrigues (2022)	Impacts of Solid Waste on the Environment: Discussions and Reflections from Critical Environmental Education.	He focuses on solid waste management with a critical approach, aligning with his study's focus on bulky waste and sustainable practices.

Source: Survey data.

CATEGORY 3 – TERMINOLOGY USED

Considering that the analyzed works comprehensively discuss the term solid waste, it is observed that the focus of the dissertations is on pedagogical practices and waste management strategies, with emphasis on aspects such as reuse and sustainable consumption, addressed in various educational and socio-environmental contexts.

Chart 4 - Terminologies used for waste in dissertations

Term	Quantity	Definition
Garbage	4	It is defined by Law No. 12,305, of August 2, 2010, regulated by Decree No. 7,404, of December 23, 2010, which provides for the National Solid Waste Policy (PNRS): "[...] material, substance, object or discarded good resulting from human activities in society [...]" (Brazil, 2010).
Solid waste	4	It is defined as "remains of human activities, considered by generators as useless, undesirable or disposable, and can be presented in a solid, semi-solid or liquid state" (ABNT, 2004).
Bulky Waste	0	They are heavy waste that does not offer easy handling conditions. They cannot be placed in the container (equipment used to transport cargo) and do not go to the municipal landfill (Brasil, 2010).

Source: Survey data.

The absence of mention of bulky waste in the analyzed dissertations reveals an important gap in the treatment of environmental issues related to waste management in educational contexts.

Although this waste is often considered to be of low hazard, its main environmental impact is related to the large volume it occupies in landfills. Despite the implementation of public programs for the proper disposal of bulky waste, these materials are still frequently disposed of irregularly (Ito; Colombo, 2019).

At the end of the analysis of the data collected on bulky waste in the context of Environmental Education in Science Teaching, it is essential to critically reflect on the findings and their implications for the field. The results obtained reveal a significant gap in the literature, especially with regard to the specific approach to bulky waste in pedagogical practices. Although Environmental Education has advanced on several fronts, the scarcity of studies focused on this topic suggests that there is still a long way to go to effectively integrate this issue into educational discussions.

The analysis of the dissertations showed significant gaps in the integration of Environmental Education with the teaching of Science. Although there are initiatives, most still lack effective pedagogical practices that promote critical and transformative understanding. The challenges faced by educators, such as the scarcity of resources, need to be addressed to ensure an education that truly instigates a change in behavior and values regarding waste management. The literature on Environmental Education has evolved, with new research emphasizing the management of bulky waste. Recent studies, such as those by Ito and Colombo (2019), reinforce the importance of sustainable approaches to waste management, pointing to educational practices that can transform students' perception and behavior in relation to proper disposal.

The need for continuing education for teachers was another point highlighted, where many feel unprepared to address complex topics related to sustainability and conscious

consumption. They emphasized the importance of discussing the impacts of solid waste on public health and the environment to promote changes in behavior and sustainable habits.

FINAL CONSIDERATIONS

The flood that occurred in 2024 in Rio Grande do Sul brought to light the importance of bulky waste management. The lack of proper disposal practices has contributed to a worsening of environmental conditions, demonstrating that Environmental Education must include a specific focus on waste management to prepare students for emergency situations and promote sustainable actions.

The results indicate that, although there are efforts to discuss solid waste management, the specific approach to bulky waste remains little explored. Thus, it is essential that future research and teacher training focus on developing innovative methodologies that promote student awareness about the importance of proper disposal of these materials.

However, it is important to recognize the limitations of this research. Data collection, although it has provided a more comprehensive view, also presents challenges, such as the difficulty in generalizing the results due to the restricted sample of dissertations. In addition, the research was carried out in a specific context, which may limit the applicability of the findings to other educational realities. These limitations not only highlight the need for further studies on the topic, but also suggest that future research should consider a broader approach, involving different contexts and populations.

In summary, the results of this analysis not only contribute to the understanding of existing pedagogical practices, but also point to the urgent need for a greater integration of the theme of bulky waste in Environmental Education. The critical reflection on the findings and limitations of the research emphasizes the importance of continuing to explore this area, aiming to promote an education that not only informs, but also transforms behaviors and values in relation to waste management. This transformation is essential to form critical and conscious citizens, capable of facing contemporary socio-environmental challenges.

Therefore, this study not only contributes to the understanding of existing pedagogical practices, but also points out that the need for continuing education for teachers was another point highlighted, where many feel unprepared to address complex issues related to sustainability and conscious consumption. Studies carried out by Mourão (2014) and Rodrigues (2022) highlight the importance of continuing education for educators, which is essential to prepare them to deal with complex issues related to

sustainability.

For future research, a broader approach is recommended, involving different educational contexts and population, as well as the consideration of diverse methodologies that can enrich the discussion on Environmental Education and the management of bulky waste. In addition, it is essential to promote continuing education for educators, preparing them to address complex issues related to sustainability with more confidence and competence.

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REFERENCES

1. Almeida, L. H. (2017). Entre concepções e práticas de educação integral e educação ambiental: Ausências, contradições e possibilidades [Dissertação de mestrado, Universidade Federal do Rio Grande do Sul]. Repositório UFRGS.

2. Associação Brasileira de Normas Técnicas. (2004). Classificação de resíduos sólidos - Norma ABNT NBR 10.004:2004. ABNT. https://www.unaerp.br/documentos/2234-abnt-nbr-10004/file

3. Bardin, L. (2011). Análise de conteúdo. Edições 70.

4. Brasil. (2010). Lei nº 12.305, de 2 de agosto de 2010. Institui a Política Nacional de Resíduos Sólidos; altera a Lei nº 9.605, de 12 de fevereiro de 1998; e dá outras providências. Diário Oficial da União. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

5. Campos, A. C. A. (2001). Resíduos sólidos urbanos: Educação ambiental e análise de comportamento de estudantes de escolas de Feira de Santana/BA [Dissertação de mestrado, Universidade Federal do Rio Grande do Sul]. Repositório UFRGS.

6. Glória, C. R. C. (2019). O processo de descarte dos resíduos sólidos na comunidade de Terezina III, no município de Tabatinga-AM: Uma proposta de educação ambiental [Dissertação de mestrado, Universidade Federal Rural do Rio de Janeiro]. Repositório UFRRJ.

7. Gonçalves, C. M. R. (2018). A educação ambiental nas escolas como subsídio para o gerenciamento costeiro: O caso de Maquiné/RS [Dissertação de mestrado, Universidade Federal do Rio Grande do Sul]. Repositório UFRGS.

8. Ito, M. H., & Colombo, R. (2019). Resíduos volumosos no município de São Paulo: Gerenciamento e valorização. Urbe - Revista Brasileira de Gestão Urbana, 11, e20180117. https://doi.org/10.1590/2175-3369.011.e20180117

9. Layrargues, P. (2011). O cinismo da reciclagem: O significado ideológico da reciclagem da lata de alumínio e suas implicações para a educação ambiental. In C. F. B. Loureiro, P. Layrargues, & R. S. Castro (Eds.), Educação ambiental: Repensando o espaço da cidadania (pp. 1–23). Cortez.

10. Leff, E. (2000). Complexidade, interdisciplinaridade e saber ambiental. In A. Phillippi Jr. & outros (Eds.), Interdisciplinaridade em ciências ambientais (pp. 19–51). Signus. https://www.unievangelica.edu.br/files/images/Interdisciplinaridade%20e%20Ci%C3%AAncias%20Ambientais%20(3).pdf

11. Machado, M. M. B. (2014). Meio ambiente, sustentabilidade e educação ambiental nos currículos de Biologia: Um estudo nas escolas de Ensino Médio de Sapucaia do Sul, RS [Dissertação de mestrado, Universidade Federal do Rio Grande do Sul]. Repositório UFRGS.

12. Manhica, J. A. (2020). Educação ambiental para o consumo sustentável: Uso da pegada ecológica como recurso didático [Dissertação de mestrado, Universidade Federal de Uberlândia]. Repositório UFU.

13. Morin, E. (2023). Os sete saberes necessários à educação do futuro. Cortez. https://cepedgarmorin.com/wp-content/uploads/2022/04/Sete_Saberes_EdgarMorin.pdf

14. Mourão, L. O. A. (2014). Educação ambiental e consumo sustentável: O reuso de resíduos sólidos como ferramenta de ensino [Dissertação de mestrado, Centro Universitário UNIVATES]. Repositório UNIVATES.

15. Rodrigues, M. R. (2022). Impactos dos resíduos sólidos no ambiente: Discussões e reflexões a partir da educação ambiental crítica [Dissertação de mestrado, Universidade Federal do Amazonas]. Repositório UFAM.

16. Schwalm, F. U. (2022). Ecopedagogia em um Clube de Ciências com enfoque na educação ambiental: Uma proposta de humanização e sensibilização ambiental [Dissertação de mestrado, Universidade Federal do Rio Grande do Sul]. Repositório UFRGS.

17. Silva, I. P. (2022). Poluição ambiental desfocada: Percepções de educadores de Ciências e Biologia e uma nova perspectiva para ensinar [Dissertação de mestrado, Fundação Oswaldo Cruz]. Repositório Fiocruz.

18. Travassos, E. G. (2006). A prática da educação ambiental nas escolas. Mediação.

19. Trindade, N. A. D. (2011). Consciência ambiental: Coleta seletiva e reciclagem no ambiente escolar. Enciclopédia Biosfera, 7(12), 1–15. https://www.conhecer.org.br/enciclop/2011a/humanas/consciencia%20ambiental.pdf