

Space junk and possible risks to space exploration and the Earth environment: A focus on basic education

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Abstract. Since the launch of the first artificial satellite around the Earth until the present date, several non-functional objects are orbiting the planet, called space debris, or simply, space junk. In this work, we analyze the evolution of space debris that is present mainly in the three Earth orbits most explored by humanity, as well as the consequences generated by the accumulation of this debris, as well as presenting a proposal for educational intervention that was used in the basic education with the aim of objective of bringing Astronomy closer to this teaching level, engaging it in an interdisciplinary learning proposal.

Resumo. Desde o lançamento do primeiro satélite artificial ao redor da Terra até a presente data, vários objetos não funcionais estão orbitando o planeta, denominados de detritos espaciais, ou simplesmente, lixo espacial. Neste trabalho, analisamos a evolução do lixo espacial que se encontra presente principalmente nas três órbitas da Terra mais exploradas pela humanidade, bem como as consequências geradas pelo acúmulo desses detritos, como também apresenta uma proposta de intervenção educacional que foi utilizada na educação básica com o objetivo de aproximar a Astronomia a este nível de ensino, engajando-a numa proposta interdisciplinar de aprendizado.

Keywords. Earth – Space vehicles – Teaching of Astronomy

1. Introduction

Humanity had no way of predicting the real dimensions that the space debris problem would reach, especially in the 1960s. Over the following decades, satellite launches multiplied and their accumulation in Earth's orbital space grew in an ascending way to the need for their use by modern society. In this sense, it is pertinent to ask some questions about this problem that will support the development of this work. Where do all the objects used in space exploration go when they lose their functionality? What is Earth orbit like after decades of space exploration? Do basic education students have knowledge about space debris? What implications and risks can the accumulation of space debris cause in new scientific discoveries about space? These and many other questions inherent to the problem of space debris (see Fig. 1) are reasons for reflection that address a concern with the intensity with which man has been exploring and appropriating the orbital space of our planet in a predatory way (Carvalho, Lima & Gonçalves (2021)). A broad environmental awareness is necessary for the various sectors of society, including at the level of basic education, for reflection on the environmental impacts caused by man, seeking attitudes of sustainability.

The objective of this work is to analyze how the issue of Space Junk in Earth orbit can interfere with space exploration and generate social, economic and environmental consequences on the Earth's surface; sharpening the interest of basic education students in scientific knowledge related to Astronomy, in order to enable an educational action that articulates theory and practice, and contributes to the development of concepts and scientific thinking.

1.1. Methodology

There is an enormous lack in basic education of initiatives that promote the integration of Astronomy knowledge with the vari-

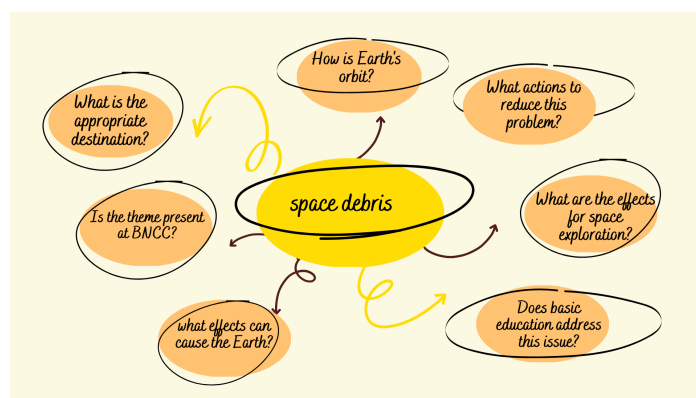


FIGURE 1. Questions about space junk.

ous other applied sciences in the Brazilian basic education curriculum. Astronomy has a substantial potential to be associated with the disciplines of the Brazilian basic school curriculum (Carvalho & Ramos (2020)), favoring several contributions to the teaching of Human Sciences, in particular, Geography, enabling the implementation of a teaching based on interdisciplinarity. The methodological proposal was developed in 5 thematic workshops, based on oral discussions, image analysis, games, data analysis, videos and texts, model production, papercraft construction, use of applications and websites, realization of textual productions, stories in comics and diversified activities. The development of the thematic workshops was organized in a systematic and sequenced way in order to enable an educational action that awakens in the students an investigative culture regarding the research theme (Arriada & Valle (2012)). The themes of the workshops were: Earth gravity and Earth orbits;

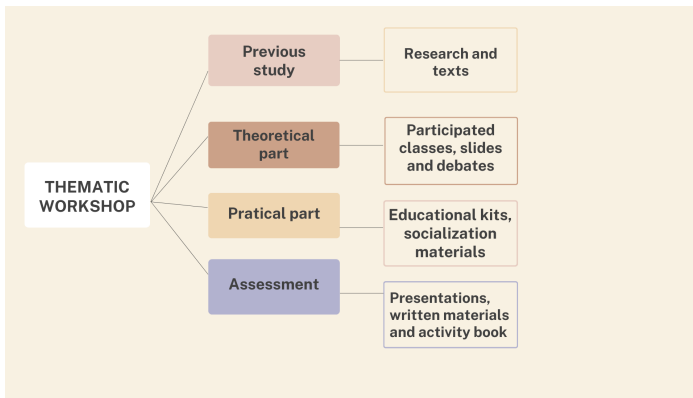


FIGURE 2. Workshop development stages.



FIGURE 4. Development of the thematic workshops.

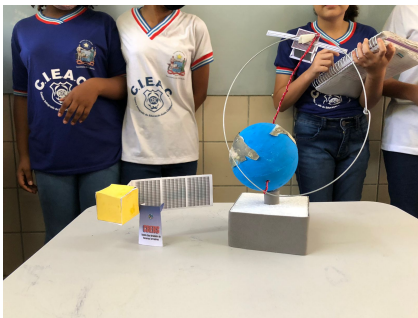


FIGURE 3. Development of the thematic workshops.

Space junk: classification and consequences; Sustainability of the Space Environment; International space law – Case studies; Space junk mitigation. Figure 2 shows a diagram of the organization of the thematic workshops.

2. Results

Some images shown in Figs. 3, 4 and 5, demonstrating the development of the workshops, which stimulated the students protagonism, and valued the teaching-learning process based on abilities and competencies, involving the scopes cognitive, scientific and social. This work provided students with a significant increase in knowledge about the subject of study - space debris, and its global consequences for the planet Earth. During the activities developed, the evolution of learning, the understanding of concepts, the relationships established between the themes and the construction of the knowledge can be seen in the classes. As well as narrowing the interdisciplinarity between the contents related to Astronomy and Geography, making them meaningful for the students, and developing in them the interest and the search for scientific knowledge.

3. Conclusion

It is pertinent to raise awareness and involve other professors, from different areas of knowledge, for greater dissemination of the study theme of this research, so that learning in the areas involved is interdisciplinary, motivating and reaches a greater number of students as possible, helping them to earn more autonomy and confidence, thus contributing to the formation of more critical subjects who are aware of their position in the Universe.

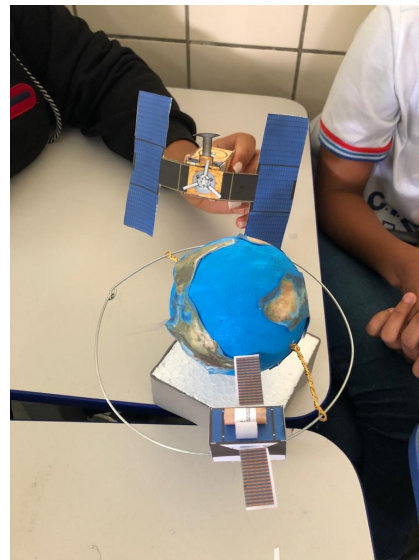


FIGURE 5. Development of the thematic workshops.

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