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ENVIRONMENTAL EDUCATION AND YOUTH LEADERSHIP: SUSTAINABLE PROJECTS AS TOOLS FOR TRANSFORMATION IN MARANHÃO

EDUCAÇÃO AMBIENTAL E PROTAGONISMO JUVENIL: PROJETOS SUSTENTÁVEIS COMO FERRAMENTAS DE TRANSFORMAÇÃO NO MARANHÃO

EDUCACIÓN AMBIENTAL Y PROTAGONISMO JUVENIL: PROYECTOS SOSTENIBLES COMO HERRAMIENTAS DE TRANSFORMACIÓN EN MARANHÃO

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Abstract: This study explores the relationship between environmental education and the development of sustainable projects by high school, technical, and higher education students in the state of Maranhão. The research analyzes how environmental courses and educational programs encourage the creation of innovative initiatives with social impact. Through a qualitative study based on bibliographic research and an analysis of locally and nationally recognized environmental projects, several initiatives developed by young people in Maranhão were identified. Among the highlighted projects are sustainable solutions for açaí waste, alternatives for wastewater treatment, and automated irrigation systems for community gardens. Additionally, the study maps the availability of extension, technical, and higher education courses in the environmental field, emphasizing their role in shaping environmentally conscious and engaged citizens. The results indicate that integrating environmental education with social

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engagement enhances student leadership in the pursuit of sustainable solutions. The study concludes that expanding public policies for environmental education and valuing student-led projects are essential to establishing a sustainability culture, preparing future generations to address environmental challenges in an innovative and responsible way.
Keywords: Environmental Education, Sustainability, Student Projects, Maranhão.

Resumo: Este trabalho investiga a relação entre a educação ambiental e o desenvolvimento de projetos sustentáveis por estudantes do ensino médio, técnico e superior no estado do Maranhão. O estudo analisa como cursos e programas educacionais voltados para o meio ambiente incentivam a criação de iniciativas inovadoras e de impacto social. Por meio de uma pesquisa qualitativa baseada em levantamento bibliográfico e análise de projetos ambientais com reconhecimento local e nacional, foram identificadas diversas iniciativas desenvolvidas por jovens maranhenses. Entre os projetos destacados estão soluções sustentáveis para resíduos do açaí, alternativas para o tratamento de efluentes e sistemas de automação para a irrigação de hortas comunitárias. Além disso, o estudo mapeia a oferta de cursos de extensão, técnicos e superiores na área ambiental, evidenciando sua contribuição na formação de cidadãos conscientes e comprometidos com a preservação ecológica. Os resultados indicam que a integração entre educação ambiental e prática social potencializa o protagonismo estudantil na busca por soluções sustentáveis. O estudo conclui que a ampliação de políticas públicas para educação ambiental e a valorização de projetos estudantis são essenciais para consolidar uma cultura de sustentabilidade, preparando as novas gerações para enfrentar desafios ambientais de forma inovadora e responsável.
Palavras-chave: Educação Ambiental, Sustentabilidade, Projetos Estudantis, Maranhão.

Resumen: Resumen: Este artículo investiga la relación entre la educación ambiental y el desarrollo de proyectos sostenibles por parte de estudiantes de secundaria, técnica y universitaria en el estado de Maranhão. El estudio analiza cómo los cursos y programas educativos con enfoque ambiental fomentan la creación de iniciativas innovadoras y de impacto social. Mediante una investigación cualitativa basada en una revisión bibliográfica y el análisis de proyectos ambientales reconocidos a nivel local y nacional, se identificaron diversas iniciativas desarrolladas por jóvenes de Maranhão. Entre los proyectos destacados se encuentran soluciones sostenibles para los residuos de açaí, alternativas para el tratamiento de efluentes y sistemas de automatización para el riego de huertos comunitarios. Además, el estudio mapea la oferta de cursos de extensión, técnicos y universitarios en el

ámbito ambiental, destacando su contribución al desarrollo de ciudadanos conscientes y comprometidos con la preservación ecológica. Los resultados indican que la integración de la educación ambiental y la práctica social potencia el liderazgo estudiantil en la búsqueda de soluciones sostenibles. El estudio concluye que la expansión de las políticas públicas de educación ambiental y la valoración de los proyectos estudiantiles son esenciales para consolidar una cultura de sostenibilidad, preparando a las nuevas generaciones para afrontar los desafíos ambientales de forma innovadora y responsable.

Palabras clave: Educación Ambiental, Sostenibilidad, Proyectos Estudiantiles, Maranhão.

INTRODUCTION

The theme of a balanced environment is widespread worldwide, the concern that hovers over how future generations will encounter the environment based on current experiences, is so pertinent that it is included in article 255 of the Federal Constitution of 1988. Thus, this concern must be supported by debates and discussions that ultimately promote practices that are transformative and one of these paths is through environmental education in the most diverse areas of society, such as in schools, with civil society, with companies and organizations.

Given this scenario, the following research problem arises: How has environmental education been transformed into recognized sustainable projects in Maranhão?

The overall objective of this work is to present sustainable projects stemming from the environmental education of regular/technical high school or higher education students in Maranhão. The specific objectives are to: Conceptualize Environmental Education and its impact on education; Map the availability of technical, higher education, or extension courses in Environmental Education; Present projects developed by regular/technical high school or higher education students in the state of Maranhão.

This study is justified by the importance of environmental education in fostering a differentiated perspective on the environment, aligning the race for extraction with preservation, using resources today but thinking about tomorrow. Thus, the examples presented throughout the research demonstrate that it is possible to introduce and implement sustainable practices, and that the educational environment is a favorable environment for developing these skills.

Therefore, this research is divided into Introduction, Theoretical framework named Environmental Education: recognized Maranhão projects originating from students of basic education and higher education, subdivided into the following subtopics: Environmental

Education: Concepts; Offer of extension, technical, higher and specialization courses in environmental education in Maranhão and finally, on Maranhão environmental projects originating from research by students of basic and higher education, the results and discussions are presented below and finally, the conclusions.

ENVIRONMENTAL EDUCATION: RECOGNIZED MARANHÃO PROJECTS ORIGINATING FROM BASIC AND HIGHER EDUCATION STUDENTS

The objective of this topic is to present the concept and role of environmental education in the process of raising awareness about environmental impacts and in building a balanced environment to ensure the well-being of future generations. The ways for this to happen are by offering and providing access to courses that have environmental education or the environment as their theme, as well as presenting and giving visibility to projects already developed by students from Maranhão.

Environmental Education: Concepts

The environment is in constant degradation mainly due to consumerism, in this sense, Pitanga (2016) states in his study that the main changes have been caused by the crisis of modernity, as seen:

> The world is in crisis! Is it an environmental crisis? Or a systemic crisis? economic? Capra (2012), Leff (2010), Santos (1988) and other scholars point to a crisis of modernity, derived from the adoption of a societal model based on developmentalist ideologies, with a view to scientific and technological progress, thus leading to a utilitarian and highly consumerist society, which only perceives the degradation of the natural environment as the main consequence of the critical process (Pitanga, 2015, p. 143).

It is observed that today's society encourages consumerism and utilitarianism, causing the demand for products/services to increasingly remove resources from nature without replenishing them at the same rate, causing the degradation seen today.

Regarding the objective of environmental education, Pelicioni (1998) asserts that it is

> to raise citizens' awareness and become a philosophy of life, leading to the adoption

> of environmentally appropriate behaviors, investing in the environment's ecological resources and processes. Environmental education must necessarily be transformed into action (1998, p. 22. Emphasis added).

It should be noted that environmental education presupposes action, therefore, based on the problems that arise, solutions that can be implemented and put into action must be sought in order to minimize environmental impacts.

According to article 225 of the Federal Constitution of 1988 (CF 88) "Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for present and future generations" (Brazil, 1988, np), the use of the environment must be balanced, thinking not only about current consumption, but taking into account the well-being of future generations.

Still in its section VI, paragraph 1 of art. 225 establishes that the public authorities "must promote environmental education at all levels of education and public awareness for the preservation of the environment" (Brazil, 1988, np), therefore, it follows that environmental education must be encouraged both at the levels of education and among the general public through awareness.

Offering of extension, technical, higher education and specialization courses in environmental education in Maranhão

Environmental education is encouraged by the courses offered, therefore, this topic aims to present the institutions and courses offered at the level of continuing education, technical, higher education or specialization in the state of Maranhão.

Firstly, the Environmental School of Maranhão, linked to the State Secretariat for the Environment and Natural Resources of Maranhão (SEMA), offers extension courses for state employees and is open to the public. One of the courses being offered at the time of this research is the "Young Environmental Agent Training Program", which has a workload of 20 hours.

The State University of Maranhão (UEMA), through the Eskada platform, offers the 60-hour course "Building a Municipal Management Instrument for Environmental Education", aimed at students, teachers, professionals from the public and private sectors, and the community in general.

The Federal University of Maranhão (UFMA), through the Codó campus, offers a

specialization in Environmental Education and Sustainability aimed at holders of a higher education diploma, aiming at training as a specialist in Environmental Education, promoting research and practices in the area.

Anhanguera College of Maranhão (Anhanguera) offers Environmental Technician courses among its courses, aimed at those with a high school or higher education diploma.

The UNINTER International University Center offers the Environmental Management Technology course. The target audience is students holding a high school graduation certificate and diploma holders.

The Federal Institute of Maranhão (IFMA) offers among its courses the Environmental Technician in an integrated, concurrent and subsequent format, the first for students who have completed elementary school, which is carried out together with high school, the second for students who are already studying high school and are taking the technical course in parallel, and the third offered to those who have already completed high school.

In Table 1 it is possible to analyze in detail the objectives of the courses presented above, in order to understand their importance, since it is through technical training that environmental projects and concrete actions emerge.

Table 1 – Course offerings on the theme of Environment/Environmental Education

Institution	Course	Description
Environmental School of Maranhão	Young Environmental Agent Training Program - 20h	To train young people in sustainable development policies and other actions related to environmental education, as well as to contribute to the social and environmental inclusion of young people from Maranhão; To encourage the participation of young people in their communities, seeking to raise awareness among the local population of the importance of unity around actions that safeguard environmental sustainability.
State University of Maranhão-UEMA	Eskada: Building a Municipal Management Instrument for Environmental Education - 60h	The objective is to lead to an understanding of environmental education as a public policy, enabling knowledge of participatory methodologies, the importance of environmental citizenship and the stages of construction of an Environmental Education Action Plan, an important Municipal Management instrument.
Federal University	Specialization in	aims to scientifically and pedagogically train Basic

of Maranhão-UFMA	Environmental Education and Sustainability	Education professionals for the development of projects and actions in formal and non-formal Environmental Education in their fields of work.
Anhanguera	Environmental Technician	offers you the opportunity to specialize in environmental management and natural resource conservation. Develop skills in environmental analysis, impact reporting, and environmental education programs, while learning to monitor water, soil, and air quality, as well as propose solutions to reduce impacts. **Prepare to work in companies, NGOs, consulting firms, and government agencies,** with training that opens doors to a variety of professional opportunities.
UNINTER International University Center	Technology in Environmental Management	It trains professionals to care for the environment, aligning with a central objective of organizations that want to maintain a strong market position. We consider the **environmental manager** essential to making this possible.
Federal Institute of Maranhão - IFMA	Environmental Technician - 2,960 hours - (3 years duration)	It aims to train technical professionals capable of understanding the environment in order to enable actions that allow its management, minimizing the different impacts caused by the various human enterprises on the environment, since it presents an integration of the various areas of knowledge, through an interdisciplinary and contextualized methodology, thus allowing the fulfillment of the demands resulting from the society-environment interaction and the technical-training process itself.

Source: Prepared by the author (2024)

Therefore, there are a varied number of courses on the theme of environmental education or even the environment being offered, ranging from extension to specialization, in addition to fairs, events, seminars, which are essential for the creation of a sustainable culture.

Environmental projects in Maranhão resulting from research by basic and higher education students.

Given all the changes resulting from human exploitation of the environment, one way out is environmental projects carried out by educational institutions, both primary and secondary. This topic aims to present some projects by students from Maranhão that have had an impact on society and can be used as models.

Project 1- Biogas and biofertilizer biodigester using Aguapé.

Figure 1 – Biodigester

Source: Imirante (2023).

This project originated with high school students from the Sabino Barros High School, located in the municipality of Penalva, Maranhão. The goal was to transform aguapé [2] biomass into cooking gas. They were assisted by biology teacher Geovane Santos Muniz and history teacher Antônio Martins.

The project is not only innovative but also highly applicable, as the Iguapé plant is abundant in the region, and it grows rapidly and is resistant to adverse weather conditions. Combined with creativity and low cost, the project is sustainable. Furthermore, it's worth noting that the students envisioned this project as helping the local community and contributing to public health.

[2] **Scientific name:** *Eichhornia crassipes* (Mart.) Solms
Family: Pontederiaceae, **Popularly known as:** Water hyacinth; Baroness; Camalote. It is an aquatic, floating, annual or perennial plant, native to tropical America. The floating stem is creeping and forms stolons. (UFRG) available at: https://www.ufrgs.br/floracampestre/eichhornia-crassipes-aguape/#:~:text=Sobre%20essa%20esp%C3%A9cie%3A%20%C3%89%20uma,mancha%20amarela%20na%20p%C3%A9tala%20superior.

Project 2- “Inovaçaí” Biodegradable packaging made from açaí fiber.

A project carried out by high school students at the Educa Mais Professora Maria Pinho Center in São Luís, Maranhão, aimed to use açaí fiber to make biodegradable packaging. Led by math teacher Sandra Eloi.

Figure 2 – Biodegradable packaging made from açaí fiber.
Source: Reproduction/TV Cidade/RecordTV. (2023).

The project mentioned also has a high probability of being carried out on a large scale, as the region is also rich in this fruit, the State according to the IBGE is the third largest national producer of açaí, it is worth mentioning that the fiber is from the seed that is always discarded, as what is commonly used from the açaí is its pulp, about 80% is seed that goes to waste, so the project gives a sustainable destination to this waste.

Project 3 - project to minimize the impacts caused on the Itapecuru River by the release of effluents from washing cars and motorcycles on the banks of the Itapecuru River.

v

Figure 3 – Solutions for effluents from car and motorcycle washing in the Itapecuru River.
Source : SENAC (2017)

A project conceived by students of the Environmental Technician program at SENAC's Itapecuru campus in Maranhão, the project aimed to present to the government an infrastructure plan for the site where car and motorcycle washes take place, whose waste would be discharged into the river. The instructors were Juarez da Silva Júnior and Ana Júlia Nogueira, with educational supervision by Valdmilson Milhomem.

This project is interesting because it hasn't been implemented yet. However, based on observations of the locations where car and motorcycle car washes operate, generating waste that ends up in the Itapecuru River, the technical course students developed an infrastructure project that would allow the car washes to continue operating, but with less impact on the river. The project includes a piping system for each car wash's pits, grease traps to separate lubricant and gear oils, a separate area to retain particles, and finally, a reservoir that would be emptied by water trucks and transported to the city's treatment system, preventing them from reaching the river. The project was presented to car wash owners and municipal government representatives.

Project 4- “Sustainable School: Nourishing the Future through Technology”.

A project carried out by high school students at the Educa Mais Itaqui Bacanga Center in São Luís, Maranhão, the project aimed to automate an irrigation system for the community garden, especially on days when the school was closed. The school's composting system was also automated. Led by electrical engineer Felipe Borges, coordinator of the factory laboratory at the Maranhão State Institute of Education, Science, and Technology (IEMA) Itaqui-Bacanga.

This project is a union between environment and technology, where teachers and students who already had a community garden at the school saw that when they were not in class at school they would not be able to irrigate the garden, so, using the automation system and a board containing humidity and light sensors, they programmed it so that the system itself would carry out the irrigation process. Automation was also implemented in the school's composting system, helping in the production of compost, fertilizers and natural insecticide used in the garden.

Figure 4 – Automation of irrigation in the community garden and composting system at the IEMA Itaqui-Bacanga educational institution

Source : ASN. (2024).

Projeto 5- “reuso do caroço de açaí como fonte de energia para produzir tijolos”.

Projeto realizado pelos alunos do curso Técnico em Florestas do Instituto Federal do Maranhão -IFMA campus Açailândia - MA, o projeto teve como objetivo o uso da biomassa do caroço do açaí como uso nos fornos para fabricação de tijolos, substituindo a lenha convencionalmente utilizada. Sob a coordenação do professor Roberto Peres da Silva.

A importância desse projeto consiste na destinação útil dos caroços de açaí que são livremente descartados nas feiras/casas de despolpamento do fruto, além disso, reduz o desmatamento para coleta de lenha para alimentar os fornos das olarias. Sobre a eficácia do uso os pesquisadores notaram que gira em torno de 20% a eficiência da queima do caroço do açaí em detrimento da queima da lenha, tornando o processo de produção dos tijolos mais eficiente, além do uso na queima, os pesquisadores ainda experimentaram usar as cinzas resultantes da queima como insumo na composição dos tijolos, o que deu uma maior resistência aos tijolos.

Figure 5 – Reuse of açaí seeds as an energy source in brick production.

Source: IFMA. (2019).

These projects, spread throughout Maranhão, become models of sustainability requiring constant incentives. This research stimulates the generation of new ideas and new business models that are more beneficial and more sustainable, ensuring a greener future.

METHODOLOGY

This article used a qualitative approach, based on bibliographic research and academic database research, to explore the topic of environmental education and its application in the state of Maranhão. The methodology was divided into two main stages: Bibliographic Research, which consisted of a review of existing literature on environmental education. Books, academic articles, theses, and dissertations were selected to understand the theoretical concepts and pedagogical practices associated with environmental education. The bibliographic review identified the main challenges and opportunities in implementing environmental education programs in Brazil and in the Maranhão context.

An in-depth Google Scholar search was conducted to identify recent and relevant publications on environmental education. The keywords used were "environmental education," "Maranhão," "environmental education courses," and "school environmental projects." An online search for projects addressing environmental education in Maranhão was also conducted. The analysis and selection of these projects allowed us to contextualize environmental education practices in the region and identify notable initiatives. Data were collected on environmental education courses offered in Maranhão and environmental projects developed by students from public and private schools and institutions in the state. To this end, we consulted the official websites of educational institutions, project reports, and news about events and awards.

RESULTS AND DISCUSSION

Based on topics 2.1 and 2.2, which dealt respectively with the provision of extension, technical or higher education courses in Maranhão and examples of successful environmental projects in the State of Maranhão, it can be seen that both the provision of training/education and innovative practices have been implemented in the reality of Maranhão.

It's remarkable how much these institutions have been focused on fostering and developing positive projects, many of them groundbreaking in their efforts to develop environmentally friendly practices, focusing on the use of natural resources while respecting the provisions of Constitution 1988, and also considering future generations and sustainability. Based on the information presented above, the table below contains examples of environmental activities and fairs held at other schools in Maranhão.

Quadro 2 – Eventos/Feiras, seminários coma temática Meio Ambiente/Educação ambiental

Event	Summary
SEDUC in Partnership with SEMA (State Secretariat for the Environment) - Planting of tree seedlings of various species in the school environment [3].	Held in 2021, students from several schools across the state carried out seedling planting activities in their schools in celebration of World Environment Day, celebrated on June 5th. The initiative involved 22 Educa Mais Centers and eight Education Centers located on São Luís Island, totaling 30 schools united in defense of nature. Among the seedlings planted were three types of ipê: mahogany, bacuri, cupuaçu, and flamboyant. The schools were: Educa Mais Professora Maria Pinho Center; Educa Mais Barjonas Lobão Center, located in Jardim América; Educa Mais Almirante Tamandaré Center; Joaquim Gomes de Souza Education Center; among others.
Science, Sustainability and Innovation Fair, promoted by the Maranhão Department of Education - SEDUC[4]	Held in 2022, it presented and awarded scientific research, projects and experiments focused on sustainability, innovation and robotics, developed by high school students and teachers from public schools in Maranhão, and were the highlight of the Science, Sustainability and Innovation Fair, promoted by the State Government in six regional centers this Tuesday (28). Thousands of students, teachers and education professionals brought to the event the results of what is worked on in school spaces.
The Maranhão Government School Network (REMAR)[5]	Held on 11/27/2024 - Aimed at public servants from the State Legislative, Judiciary and Executive branches; university students and civil society carried out through the seminar "Environmental Education: What to do in times of Climate Emergencies in Schools and Societies".

Source: Prepared by the author (2024)

[3] Available at: https://www.educacao.ma.gov.br/escolas-estaduais-desenvolvem-acoes-para-proteger-meio-ambiente-e-conscientizar-populacao/ . Accessed on: December 1, 2024.
[4]Available at: https://www.educacao.ma.gov.br/feira-de-ciencia-sustentabilidade-e-inovacao-tem-saldo-positivo-e-se-torna-maior-evento-de-fomento-pesquisa-escolar-do-maranhao/ . Accessed on: Accessed on: 01 Dec. 2024.
[5]Available at: https://www.ma.gov.br/noticias/remar-promove-seminario-sobre-educacao-ambiental . Accessed on: Accessed on: December 1, 2024.

Based on the events presented above, it is clear that the theme of environmental education has been disseminated in the educational context, generating results in projects that use new methodologies or even use resources that would otherwise be discarded to avoid negative impacts on the environment.

In addition to schools, it is clear that the topic has also been discussed with a wide range of organizations, such as the seminar "Environmental Education: What to do in times of Climate Emergencies in Schools and Societies", which brought together 14 organizations from São Luís to discuss and exchange experiences on the integration of environmental education as an essential tool to face the challenges of climate emergencies affecting the state.

Therefore, the discussion about alternative and sustainable ways of using natural resources must begin in the educational environment and gain action through the dissemination and implementation of these projects. Therefore, the more incentives and more research, the more alternatives will emerge.

FINAL CONSIDERATIONS

The importance of environmental education has been highlighted throughout this article. It has been demonstrated how offering extension, technical, and higher education courses focused on the environment plays a crucial role in developing more conscious citizens who are committed to preserving natural resources, thus generating positive projects like those presented throughout the research. Through these educational initiatives, students are empowered to understand the complexity of environmental challenges and develop innovative solutions to address them, always remembering that it is necessary to use the environment in a way that does not deplete it, remembering that other generations will come.

In response to the initial question of this research, it was observed that students from Maranhão have presented innovative projects ranging from the production of natural gas using plants to automated irrigation using solar energy. These environmental projects demonstrate the positive impact that environmental education can have when discussed and translated into action. These projects not only demonstrate the students' creativity and commitment to sustainability but also inspire other segments of society to follow their lead, creating a culture of environmental responsibility that spreads throughout the school community and should also extend beyond its walls.

Another interesting point to be highlighted is the interdisciplinarity, allowing teachers from different areas to work on these projects. When developing the research, it was observed

that teachers from mathematics, engineering, biology, chemistry, and history participated in the projects, thus evidencing that the theme and concern for a balanced environment must go beyond one area, therefore, it must be a collective concern.

In addition to school projects, holding events and fairs focused on environmental practices has been fundamental to promoting the exchange of knowledge and experiences among students, professionals and the community in general. It is clear that a balanced environment requires the co-responsibility of everyone. Therefore, these events are spaces for the presentation of innovations, the discussion of good practices and the strengthening of collaboration networks. After all, the environment belongs to everyone and is for everyone.

Therefore, environmental education, through courses and practical projects, along with thematic events, has proven to be an effective strategy for strengthening ecological awareness and promoting concrete actions to improve environmental health. Therefore, continued investment in these areas is essential, thereby contributing to ensuring a sustainable future for future generations.

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