

**THE USE OF SCALE MODELS AS AN ACTIVE METHODOLOGY IN ADDRESSING THE TOPIC OF WATER RESOURCES FOR ELEMENTARY SCHOOL STUDENTS AT A PRIVATE SCHOOL IN THE MUNICIPALITY OF BREVES, MARAJÓ ARCHIPELAGO**

**O USO DE MAQUETES COMO METODOLOGIA ATIVA NA ABORDAGEM DA TEMÁTICA DOS RECURSOS HÍDRICOS PARA ALUNOS DO ENSINO FUNDAMENTAL DE UMA ESCOLA PARTICULAR NO MUNICÍPIO DE BREVES, ARQUIPÉLAGO DO MARAJÓ**

**LA UTILIZACIÓN DE MAQUETAS COMO METODOLOGÍA ACTIVA EN EL ABORDAJE DE LA TEMÁTICA DE LOS RECURSOS HÍDRICOS PARA ALUMNOS DE LA ENSEÑANZA FUNDAMENTAL DE UNA ESCUELA PARTICULAR DEL MUNICIPIO DE BREVES, ARCHIPIÉLAGO DE MARAJÓ**

 <https://doi.org/10.56238/sevened2025.038-064>

**Kildery Gomes de Matos<sup>1</sup>, Vitória Maigda Magno Gomes<sup>2</sup>, Benedita da Costa Gonçalves<sup>3</sup>, Marcelo Almeida de Paulo<sup>4</sup>, Eduardo Antonio Abreu Pinheiro<sup>5</sup>, Rayane Pereira Barreiros<sup>6</sup>, Maria Emília de Oliveira Higino<sup>7</sup>**

---

**ABSTRACT**

Water is a natural resource that is essential for the survival of humans, fauna, flora and the development of economic activities. Unfortunately, water resources are limited and depleted due to human action that degrades water quality and harms ecosystems. In the process of raising environmental awareness, schools play a fundamental role in raising children's awareness of the environment, making them citizens who are aware of their actions. In this context, the objective was to promote environmental actions with elementary school students from a private school in the urban area of the municipality of Breves through the creation of models that allowed the teaching-learning process to be effective and meaningful, since they were important tools of active methodology of Environmental Education to awaken creativity, innovation and sustainable attitudes in students and to materialize through three-dimensional forms the main topics addressed on the theme of water.

**Keywords:** Environmental Education. Water Resources. Sustainability. Elementary Education.

---

<sup>1</sup> Undergraduate student in Environmental Management. Instituto Federal do Pará (IFPA).

E-mail: kilderyg376@gmail.com

<sup>2</sup> Undergraduate student in Environmental Management Technology. Instituto Federal do Pará (IFPA).

E-mail: vitoriamagnogomes@gmail.com

<sup>3</sup> Undergraduate student in Environmental Management Technology. Instituto Federal do Pará (IFPA).

E-mail: beneditacosta037@gmail.com

<sup>4</sup> Undergraduate student in Environmental Management. Instituto Federal do Pará (IFPA).

E-mail: ma7744100@gmail.com

<sup>5</sup> Dr. in Chemistry. Instituto Federal do Pará (IFPA). E-mail: eduardo.pinheiro@ifpa.edu.br

<sup>6</sup> Specialization in School Management and Organization. Instituto Federal do Pará (IFPA).

E-mail: rayane.pereira@ifpa.edu.br

<sup>7</sup> Graduated in Natural Sciences. Universidade Federal do Pará (UFPA). E-mail: mariaemiliah25@gmail.com



## RESUMO

A água é um recurso natural indispensável à sobrevivência humana, da fauna, da flora e para o desenvolvimento de atividades econômicas. Infelizmente, os recursos hídricos estão limitados e exauridos por causa da ação antrópica que degrada a qualidade da água e prejudica os ecossistemas. No processo de conscientização ambiental, as escolas desempenham um papel fundamental para a sensibilização das crianças quanto ao meio ambiente, tornando-as cidadãos conscientes de seus atos. Nesse contexto, objetivou-se a promoção de ações ambientais com alunos do Ensino Fundamental de uma escola particular na zona urbana do município de Breves através da confecção de maquetes que permitiram que o processo de ensino-aprendizagem fosse eficaz e significativo, uma vez que foram importantes ferramentas de metodologia ativa de Educação Ambiental para despertar, nos estudantes, a criatividade, a inovação e atitudes sustentáveis e materializar através de formas tridimensionais os principais assuntos abordados sobre a temática da água.

**Palavras-chave:** Educação Ambiental. Recursos Hídricos. Sustentabilidade. Ensino Fundamental.

## RESUMEN

El agua es un recurso natural esencial para la supervivencia de los seres humanos, la fauna, la flora y el desarrollo de las actividades económicas. Desafortunadamente, los recursos hídricos son limitados y se agotan debido a la acción humana que degrada la calidad del agua y daña los ecosistemas. En el proceso de sensibilización ambiental, la escuela juega un papel fundamental al sensibilizar a los niños hacia el medio ambiente, convirtiéndolos en ciudadanos conscientes de sus acciones. En este contexto, el objetivo fue promover acciones ambientales con estudiantes de la educación fundamental de una escuela particular del área urbana del municipio de Breves a través de la creación de modelos que permitieran el proceso de enseñanza-aprendizaje fuera efectivo y significativo, ya que fueron herramientas importantes de la metodología de Educación Ambiental activa para despertar, en los estudiantes, la creatividad, la innovación y actitudes sostenibles y materializar a través de formas tridimensionales los principales asuntos abordados sobre la temática del agua.

**Palabras clave:** Educación Ambiental. Recursos Hídricos. Sostenibilidad. Educación Elemental.

## 1 INTRODUCTION

The fluvial-maritime archipelago of Marajó on the coast of Pará is a diverse environment, both from an environmental and cultural point of view. Currently, this region already suffers from the impacts of climate change, such as erosion and the advance of the sea (OLIVEIRA et al., 2025). Environmentalists have already noticed the presence of seagulls that are seabirds, so the water is saltier than before in Marajó. Extractivist families also already notice the decrease in the amount of açaí, a drop in shrimp production, and changes in harvest periods, and scientists warn that a group of islands, such as Marajó, are more likely to be submerged if the temperature continues to increase (LOURENÇO, 2023).

The Marajó Archipelago is a highly threatened territory in the 21st century. Environmental racism, river pollution, criminal fires, land conflicts, mining, and illegal deforestation put biodiversity and the population at risk, due to the extinction of plant and animal species, the migration of riverside dwellers within their own territory, and the loss of islands. Therefore, the importance of protecting and conserving the territory and its communities is noted, and one of the alternatives is the monitoring of climate change by mapping with climate indicators (PEREIRA, 2024).

Good quality water is that which meets the established standards for various physical, chemical and biological parameters, however, the growing degradation of surface water quality is a worrying reality in Marajó, due to anthropogenic activities near rivers, especially the inadequate disposal of waste and discharge of effluents into the water body (MEIRELES et al., 2024). The large availability of water typical of this region also favors the proliferation of insects and the garbage accumulated on land or under houses can be potential creators of these vectors. The high proliferation of insects, poor public services and disorderly urbanization are risk factors for considering the Marajó Archipelago as a malaria-endemic area (XISTO et al., 2018).

Sanitation is an indicator of human development and its degree of deficiency determines both the thirst for social justice and the degradation of a society. The universalization of access to sanitation services is presented as a "sine qua non" condition for sustainable development. However, in the Marajó Archipelago, access to safe water for human consumption is the greatest current need of the Marajó population (ROCHA, 2023). According to Gallo (2015), "one thing is certain: this water is a danger!"

An unprecedented survey pointed out that 398 municipal schools in the Marajó Archipelago, in Pará, do not have the minimum basic sanitation necessary to serve



approximately 15 thousand students in this region. The data are from the Sanitation in Schools: Pilot – Marajó Island project, by the NGO Habitat for Humanity Brazil (D'ALMEIDA, 2024).

Due to the data presented above, it is essential that the educational process is sustained by the personal relationship of the teacher, who plays the role of facilitator to find dynamic ways to work on issues that are present in the student's daily life and arouse their curiosity, with the students, who need to develop skills and competencies that result in interest in learning and make the teaching-learning process more effective and meaningful (BARRETO et al., 2024). Because of this, in Science Teaching, teachers seek methodologies to make their classes more dynamic, promoting stimuli in the student for the development of their critical thinking, through the use of the process of investigation of scientific concepts, allowing them to be protagonists of the learning process (CRUZ, 2024). In this way, schools are a reflection of society as they are an instrument for citizenship training, social development, and innovation (CAFFAGNI, 2024). Understanding this role of schools is important when considering the implementation of new educational approaches, such as active methodologies (MARQUES et al, 2021).

Active methodologies have great potential to meet the demands of current Education, as they stimulate the autonomy and protagonism of students, making learning occur in a collaborative and interdisciplinary way, associating the concept with experimentation by considering the reality of the student and the school and providing students with paths that give them conditions to think logically about the facts of everyday life, as well as solving practical problems; such intellectual skills will be valuable for any type of activity they develop during their life (SILVA and PIMENTEL, 2024).

The use of active methodologies for Environmental Education, with a focus on cooperation for a fairer and more sustainable society, allows us to broaden the view of environmental degradation caused by destructive anthropogenic actions, which have been occurring over time (SANTOS et al., 2024). In addition, active methodologies incorporate innovative approaches that allow students to engage in an engaged, effective, and inspiring way to understand that environmental preservation is essential to ensure quality of life for present and future generations (LAUBENSTEIN et al., 2024).

The use of active methodologies enhances the learning process about soil and water management and preservation, allowing for a broader understanding of the misuse of these natural resources, their interferences with climate change, and their conservation practices

(ELESBON et al., 2024). An active methodology that can be used to understand land use, water resources, and their impacts is the making of models, which provides knowledge of the local reality based on the spatialization of events and an interdisciplinary approach (FACCO et al., 2021).

In this context, the offer of workshops on the construction of models as an active methodology for understanding the importance of water resources emerges as an educational practice that enhances the re(signifying) educational processes that guarantee students autonomy and collaborative construction of knowledge, meeting quality teaching and the liberating and problematizing education proposed by Paulo Freire. Therefore, the present work aims at the debate and the supervised construction of models, by elementary school students of a private school in the municipality of Breves, Marajó Archipelago, which portray the importance of water, its problems and its forms of treatment.

## 2 METHODOLOGY

The study presents aspects inherent to qualitative research, which is an essential approach in scientific investigation, which focuses on the deep understanding and interpretation of the phenomena studied, exploring the complexity and richness of social, cultural, and individual contexts (GUERRA et al., 2024).

The study is a field research from an Environmental Education workshop, applied at the Colégio Núcleo de Excelência Marajoara (NEM), located in the urban area of the municipality of Breves, Marajó Archipelago. The institution is recognized for its dedication to promoting an education that covers various aspects of life and constantly seeks to provide meaningful experiences and learning to students, including environmental awareness as an essential part of the curriculum. The participating public was composed of 17 children (8 boys and 9 girls), from the 6th grade, from the morning shift. The survey was carried out from August to October 2024.

The methodology of the work was divided into five stages: problematization, bibliographic research, sensitization, construction of models and interview with the participants.

In the first stage, entitled Problematization, a moment of debate was held with students belonging to the 6th year of Elementary School of the Marajoara Excellence Center (NEM), in the municipality of Breves, Marajó Archipelago, generating guiding questions, seeking to understand the initial knowledge about: the geography of the messorregion, garbage dump,

leachate, contamination, rainwater harvesting, water treatment and other topics. Teaching through students' prior knowledge is an elementary tool that has proven to be motivating and promising, since the teaching-learning process has allowed for a more concrete and meaningful experience of the contents proposed in the classroom (PAULI and LÜDKE, 2022).

In the second stage, a bibliographic research was carried out on the problem of environmental impacts and their influence on the quality of water for the consumption of the population of Breves, as well as the geography of the municipality of Breves. After the second stage, the moment of awareness was advanced, which consisted of a moment where the facilitator sought to awaken the sensitivity of children in relation to the environment and society, as well as to encourage socio-environmental responsibility, citizenship and appreciation of natural resources, as stated by Gomes et al., 2024.

In the awareness stage, expository classes were held and even presentations of films such as "Ainbo-The Warrior of the Amazon" and "Dona Raimundinha do Rio Tapajuru" where chemical and socio-environmental issues were addressed, such as the concept of chemical substances and their properties, benefits, treatments, importance and impacts of water for the environment.

Progress was made to the fourth stage regarding the construction of models regarding the importance of water resources in the Marajó Archipelago. The school model is a pedagogical resource used by teachers to facilitate the learning of children and young people, as they help to simplify topics of greater complexity, helping students to visualize the subject of the class in a more concrete, practical, playful, interactive and interesting way (MAIA, 2022).

The models of models built were suggested by the students during the research. It is important to note that, during this process, the students were divided into pairs or trios and assisted by the NEM professor with relatively experience in the research area. In the making of the models, the following materials were used: Styrofoam, Styrofoam glue, tubes, PVC connections, brush, fabric paint, box cutter, wooden sticks, transparent water walking tube, clothing dye paint, A4 paper, among others. The presentation of the models was on October 4 at a science fair organized at NEM for the socialization of themes related to the environment by all elementary school students, since Nature Day is celebrated on this date.

After the elaboration of the models, the students participating in the construction were interviewed about knowledge and experience acquired on the subject studied. The interview took place through the personal report of the experiences lived during the making of the



models, through a semi-structured interview script. In the questionnaire, the guiding questions were: "Is the water in your home of good quality?", "Is the quality in your school of good quality?", "What do you understand by water preservation?", "What did you understand about the stages of water treatment of the Water Treatment Plant?", "Do you consider water treatment in your city efficient?", "Why was the use of the models important for your learning?".

### **3 RESULTS AND DISCUSSION**

It was possible to see that the students were excited to know that they would leave the routine of traditional and mechanistic teaching for a learning environment where they would feel free to explore, experiment, question and create models that portrayed their reality and important forms of environmental conservation. It was observed that, during the making of the models, the students debated among themselves notes made in the classroom and shared their speeches. For Manfio (2021), "To think about a richer and more interesting education, it is essential to contextualize space in the school field, since space is a learning ground from the child's childhood to his or her total formation and allows the creation of a critical and human subject."

It is urgent to say that it was also found that, at this moment of construction, the students were gaining autonomy and increasingly asking for help from the NEM teacher and the Environmental Education workshop team. For Debus (2019), "the student from the perspective of autonomy and emancipation is an active historical subject, who has before him the possibility of directing the meaning of his own life. This principle establishes a fairer and more egalitarian teaching-learning process." The results of the making of the models were presented at a science fair. The first model (Figure 1) is a representative scheme that allowed us to reflect on the importance of the hydrological cycle for the protection and restoration of ecosystems, the performance of the important role in the global climate system, the sustainable management of water resources and helped in the understanding of some concepts such as physical states (liquid and gas) and the stages of the water cycle (evaporation, perspiration and precipitation).

**Figure 1**

*Model representing the hydrological cycle*



Source: Authors, 2024.

The second and third models (Figure 2) allow us to visualize the flow of rivers and the valuable role of vegetation cover in regulating the flow of water in a watershed, since it increases storage, reduces erosion and sedimentation of watercourses, decreases the risk of flooding, and improves water quality. In addition, these models were fundamental to work on the concept of riparian forests, which are important for the protection and preservation of watercourses because the vegetation absorbs essential nutrients for the maintenance of the hydrological cycle and helps the soil to capture chemical contaminants before reaching the groundwater.

## Figure 2

*Models to represent the importance of the hydrographic basin in Marajó and the riparian forests*



Source: Authors, 2024.

The fourth model (Figure 3) represents the importance of rainwater harvesting for basic sanitation, since it brings numerous benefits to the management of the city, its industry and citizens, such as the expansion of tourism, environmental preservation, reduction of school delay, reduction of infant mortality, among others.

## Figure 3

*Model representing the water collection system*



Source: Authors, 2024.

According to data from the Amazon Foundation for the Support of Studies and Research (FAPESPA) and the Instituto Trata Brasil presented by journalist Azevedo (2025), the population of Marajoara lives an alarming reality and can say that it is isolated from the rest of Brazil because 68.6% have a deficit of treated water, 88.2% do not have access to sewage and only 0.62% have a sewage treatment index referring to contaminated water. In addition, waterborne diseases, such as hepatitis A, are persistent socioeconomic challenges in Marajó because the logistics are complex, there are variations in climatic conditions, and restricted and precarious access to health services (SILVA et al., 2024b). Therefore, it is of paramount importance to raise awareness among children and their families for the rational use of water and effective basic sanitation for quality of life.

The fifth model (Figure 4) represents a model of a Water Treatment Plant (WTP). Through it, we sought to explore, in practice, the processes of coagulation, flocculation, decantation, filtration and treatment. This playful and visual form of knowledge was important for the children to understand the dimension of the richness of this resource and to save water in simple daily actions such as properly using the tap to wash their hands, in addition to the fact that it is important to take good care of this natural resource so that there is no shortage in the future.

#### Figure 4

*Model representing the Water Treatment Plant (WTP)*



Source: Authors, 2024.

Regarding the data collected from the analysis of the questionnaires by the students' answers, 14 students (approximately 82.4% of the interviewees) answered that the water in

their homes does not have good quality. This response is consistent with the lack of basic sanitation being a very old problem in the municipality of Breves, and the main problem is the scarcity of drinking water, so much so that some neighborhoods do not have any water network and residents are forced to seek other forms of supply (CARDOSO et al., 2021).

When asked about the quality of water in the school environment, all interviewees said it was of good origin. This answer was surprising because it is contradictory to the reality of most schools in the Marajó Archipelago because 93% of schools do not have a public water supply for human consumption and general use, and 60% do not have any sewage treatment system (COELHO, 2024). Many residents in the Marajó Archipelago use the water from the rivers in their homes and it is not of quality, but there is an expectation that this reality will change through projects such as "Sanear Marajó Socioambiental" (IEB, 2024).

Regarding the question "What do you mean by water preservation?", answers such as "it is not throwing paper, plastic bottles, cans and any type of garbage on the street and in the rivers, avoiding clogging the drains", "turning off the taps when you are brushing your teeth" and "not burning the trees because they are important for the process of the water cycle". It was noticed that stimulating child protagonism in raising awareness of water resources is important because simple attitudes have a great differential to avoid, for example, diseases such as dengue, zika virus and chikungunya fever, coming from the *Aedes aegypti* mosquito that use places of stagnant water and without treatment for the proliferation of these epidemiological diseases (BESSE, 2016). In addition, fires have a large direct and significant impact on water resources because they disrupt the water cycle by destroying vegetation that would normally absorb and retain rainwater, decrease aquifer recharge, affect groundwater availability, and affect moisture as well (ROBLES, 2024).

Regarding the question 'What did you understand about the stages of the Water Treatment Plant?', answers such as "help in the elimination of substances that contaminate the water" and "are processes for water purification" stood out. Therefore, teaching topics such as the operation of a Water Treatment Plant in an interactive and educational way shows students the importance of basic sanitation and the impact of this process on public health and the environment (TAINAN, 2025).

When asked about the efficiency of water treatment in their city, all the interviewees said no because the water is very yellowish, orange or brown, dirty, has a lot of iron, that they even turn green water in front of several residences. Although color is an aesthetic parameter of acceptance or rejection of water, it can also indicate an excess of iron and manganese



ions. These metals, when above the recommended limits, can cause deposits, incrustations in pipes and water tanks and enable the appearance of harmful ferruginous bacteria in supply networks and interfere with industrial processes and human health (MICRO AMBIENTAL, 2021).

Regarding the importance of using models in learning about the issue of water, they highlighted answers such as "they contextualize the path we must take to preserve this important natural resource", "address various themes such as garbage, sewage, diseases and water suitable for consumption" and "show that the water cycle has a significant importance for all living beings". Therefore, Sousa et al. (2019) argue that models are important tools implemented in the school environment for the fixation and, mainly, the understanding of the proposed themes. For Moreira (2023), models are motivational instruments that help to understand concepts in a more dynamic and interesting way and are capable of explaining social, natural, and cultural phenomena in a playful and effective way.

#### **4 CONCLUSION**

Throughout this research, it was realized that active methodologies can have a great effect on education when they are used and assimilated, as they contribute to the formation of reflective teachers, who value dialogue and who are competent to act in unpredictable learning contexts, with autonomy to intervene in the solution of problem situations. Finally, it enables the consolidation of student autonomy and a new culture, based on the progress of society. In this context, the models emerge as didactic-pedagogical resources that can be used as mediators of the teaching-learning process to stimulate the development of students' spatial perception.

The construction of the models also provided the development of environmental awareness in a playful-pedagogical and interdisciplinary way, in addition to a relevant environmental education tool that allowed students to build their own knowledge resulting from their acquired experiences and belonging to the Marajoara territory. Therefore, the authors hope that this research contributes to meaningful learning and didactic flexibility to increase the repertoire of strategies that stimulate skills in students such as protagonism, autonomy, proactivity, cooperativity and self-esteem.



## REFERENCES

- Amaral, S. M. P. do. (2012). Memórias, cotidianos e escritas às margens dos Marajós: navegando entre o saber e o poder (Dissertação de Mestrado). Universidade da Amazônia – UNAMA.
- Azevedo, A. L. (2025, maio 18). Os extremos do Marajó: ilha que sintetiza riqueza e desigualdade da Amazônia. *O Globo*. Disponível em: <https://uc.socioambiental.org/en/noticia/229610>
- Barreto, D. P., Nery, T. V. P., Ferreira, E. F. B., & Silva, F. D. (2024). Metodologia ativa: abordando a temática água por meio da produção de maquete 3D no ensino de Química. *Revista DELOS*, 17(61), 1–17. Disponível em: <https://ojs.revistadelos.com/ojs/index.php/delos/article/view/2538/1536>
- Besse, V. (2016, março 23). Crianças promovem atividades lúdicas e culturais sobre o uso consciente da água. *LBV*. Disponível em: <https://lbv.org/criancas-promovem-atividades-ludicas-e-culturais-sobre-o-uso-consciente-da-agua/>
- Caffagni, C. W. do A. (2024). Qual a função social da escola? Reflexões de nuances sociais e políticas a respeito da instituição escolar. *Ensaio: Avaliação e Políticas Públicas em Educação*, 32(122), 1–18. Disponível em: <https://www.scielo.br/j/ensaio/a/CGxSk5mzHLNFYSFC7zrzWTn/>
- Cardoso, A. S., Costa, A. S., & Reis, B. L. C. dos. (2021). A qualidade da água para consumo humano e a incidência de doenças de veiculação hídrica: estudo de caso do bairro Jardim Tropical–Breves–Marajó–PA. In R. E. S. Sales & R. S. Sales (Orgs.), *Educação ambiental e cidadania: Pesquisa e práticas contemporâneas* (Vol. 1, pp. 31–50). Editora Científica Digital. Disponível em: <https://downloads.editoracientifica.com.br/articles/201202626.pdf>
- Coelho, M. (2024). ‘A gente pega água do poço para fazer a merenda’: escolas da Ilha do Marajó enfrentam falta de saneamento básico. *Terra*. Disponível em: <https://www.terra.com.br/noticias/educacao/a-gente-pegua-agua-do-poco-para-fazer-merenda-escolas-da-ilha-do-marajo-enfrentam-falta-de-saneamento-basico>
- Costa, E. M., & Lima, N. L. de. (2023). As juventudes dos territórios rurais da Amazônia Marajoara e a extensão na Universidade Federal do Pará – UFPA (pp. 16–25). In E. M. Costa, N. L. Lima & S. Hage (Orgs.), *Juventudes marajoaras em movimento na defesa da vida, do bem viver, do território e da diversidade*. CUMB–UFPA. Disponível em: [https://www.campusbreves.ufpa.br/images/conteudo/Juventudes\\_marajoaras\\_-\\_mar2023\\_compressed.pdf](https://www.campusbreves.ufpa.br/images/conteudo/Juventudes_marajoaras_-_mar2023_compressed.pdf)
- Cruz, E. K. T. (2024). O ensino de Ciências: o uso da metodologia por investigação. *Revista Educação Pública*, 24(25). Disponível em: <https://educacaopublica.cecierj.edu.br/artigos/24/25/o-ensino-de-ciencias-o-uso-da-metodologia-por-investigacao>

- D'Almeida, D. (2024). Na ilha do Marajó quase 15 mil estudantes frequentam escolas sem água nem banheiro, aponta pesquisa. G1-Pará. Disponível em: <https://g1.globo.com/pa/para/noticia/2024/06/22/na-ilha-do-marajo-quase-15-mil-estudantes-frequentam-escolas-sem-agua-nem-banheiro-aponta-pesquisa.ghtml>
- Debus, J. C. dos S. (2019). A autonomia do estudante nas relações de ensino e aprendizagem: reflexões sobre a atualidade do conceito de autonomia. *Revista Educação e Emancipação*, 12(2), 188–209. Disponível em: <https://periodicoseletronicos.ufma.br/index.php/reducacaoemancipacao/article/view/11487/6526>
- Elesbon, A. A. A., Silva Júnior, J. M. da, Bendinelli, P. V., Castro, M. G. L. de, & Castro, F. S. (2024). Metodologias ativas de aprendizagem aplicadas na mitigação de mudanças climáticas em bacias hidrográficas. *Boletim de Conjuntura*, 19(55), 369–394. Disponível em: <https://revista.ioles.com.br/boca/index.php/revista/article/view/5249/1230>
- Facco, J. F., Cancelier, J. W., & Medeiros, L. M. (2021). Recursos hídricos em sala de aula: construção de maquete como metodologia ativa. *Disciplinarum Scientia*, 22(2), 135–150. Disponível em: <https://periodicos.ufn.edu.br/index.php/disciplinarumCH/article/view/3956/pdf>
- Gallo, G. (2015). *Marajó: A ditadura da água* (4ª ed.). Edições O Nosso Museu.
- Gomes, V. C., Ito, F. M., & Barbado, N. (2024). Educação ambiental aplicada: um relato de experiência na Educação Infantil. *Revista Educação Pública*, 24(21). Disponível em: <https://educacaopublica.cecierj.edu.br/artigos/24/21/educacao-ambiental-aplicada-um-relato-de-experiencia-na-educacao-infantil>
- Guedes, A. C. B., Moraes, I. P., Guedes, O. M. B., Castro, N. M. de S., & Silva, F. N. L. da. (2021). Reflexões sobre o ensino de história e conservação dos recursos hídricos no Marajó (PA). *Revista Tecnologia e Sociedade*, 17, 168–186. Disponível em: <https://www.researchgate.net/publication/349567712>
- Guerra, A. L. R., Stroparo, T. R., Costa, M., Castro Júnior, F. P. de, Lacerda Júnior, O. da S., Brasil, M. M., & Camba, M. (2024). Pesquisa qualitativa e seus fundamentos na investigação científica. *Revista de Gestão e Secretariado*, 15(7), 1–15.
- IBGE. (2022). Breves. Disponível em: <https://cidades.ibge.gov.br/brasil/pa/breves/panorama>
- IEB. (2024). Tecnologias Sociais: Projeto Sanear Marajó entrega as primeiras Tecnologias Sanear, em Portel (PA). Disponível em: <https://iieb.org.br/noticias/tecnologias-sociais-projeto-sanear-marajo-entrega-as-primeiras-tecnologias-sanear-em-portel-pa/>
- Laubenstein, F. L., Sari Júnior, C. A., & Silva, R. B. da. (2024). Metodologia ativa na educação ambiental: um novo paradigma na interação do ser humano com o meio ambiente. *Revista de Direito e Sustentabilidade*, 10(1), 55–74. Disponível em: <https://www.indexlaw.org/index.php/revistards/article/view/10437/7328>



- Lourenço, F. (2023, outubro 3). O avanço do oceano pode tirar o Marajó do mapa? *Ambiental Media*. Disponível em: <https://ambiental.media/crise-climatica-os-sinais-da-emergencia-no-marajo/>
- Maia, J. (2022). Qual a finalidade da maquete na educação? Disponível em: <https://www.bastosmaia.com.br/qual-a-finalidade-da-maquete-na-educacao/>
- Manfio, V. (2021). O encontro entre Geografia e Educação pode mudar o espaço vivido? *Revista Ensino de Geografia*, 4(3), 141–160. Disponível em: <https://www.researchgate.net/publication/356451679>
- Marques, H. R., Campos, A. C., Andrade, D. M., & Zambalde, A. L. (2021). Inovação no ensino: uma revisão sistemática das metodologias ativas de ensino-aprendizagem. *Avaliação*, 26(3), 718–741. Disponível em: <https://periodicos.uniso.br/avaliacao/article/view/4815/4504>
- Meireles, R. R., Ribeiro, H. M. C., Moraes, V. M. C., Almeida, T. C. de, Rocha, T. S., Pantoja, D. N. S. M., ... Souza, L. G. N. de. (2024). Avaliação da qualidade da água na Baía de Portel e do Rio Camaraipi, município de Portel-Marajó, Amazônia Oriental. *Revista Brasileira de Geografia Física*, 17(2), 1251–1267. Disponível em: <https://periodicos.ufpe.br/revistas/index.php/rbgfe/article/view/258710/46118>
- Micro Ambiental. (2021, abril 6). Como resolver problemas relacionados à cor na água? Disponível em: <https://microambiental.com.br/monitoramento/como-resolver-problemas-relacionados-a-presenca-de-cor-na-agua/>
- Moreira, J. de F. R. (2023). Maquetes e jogos como recursos didáticos para o ensino de geografia nos anos iniciais do ensino fundamental. *Revista de Ensino de Geografia*, 14(6), 170–185. Disponível em: <https://seer.ufu.br/index.php/revistadeensinodegeografia/article/view/76329/40098>
- Nicoli, B. (2022). Ilha do Marajó, Pará: guia do maior arquipélago fluvial do mundo. *Worldpackers*. Disponível em: <https://www.worldpackers.com/pt-BR/articles/ilha-do-marajo>
- Oliveira, P. C. de, Fenzi, N., Lopes, L. O. do C., Gomes, K. R., & Santos, M. C. (2025). Impactos climáticos e superexploração dos recursos da biodiversidade do Marajó. *Revista Caderno Pedagógico*, 22(4), 1–25. Disponível em: <https://ojs.studiespublicacoes.com.br/ojs/index.php/cadped/article/view/13896/7842>
- Pauli, A. M., & Lüdke, E. (2022). Os conhecimentos prévios e suas implicações na formação científica de acadêmicos de Agronomia da UFSM. *Revista Vivências*, 18(35), 147–160. Disponível em: <https://www.researchgate.net/publication/357507822>
- Pereira, J. (2024). Uso de mapas para defesa do território marajoara. *Escola de Dados*. Disponível em: <https://escoladedados.org/coda/coda-amz2024/uso-de-mapas-para-defesa-do-territorio-marajoara/>



- Robles, T. (2024, setembro 28). Queimadas alteram o ciclo da água e podem causar desabastecimento deste recurso hídrico. *Meteored*. Disponível em: <https://www.tempo.com/noticias/ciencia/queimadas-alteram-o-ciclo-da-agua-e-podem-causar-desabastecimento-deste-recurso-hidrico.html>
- Rocha, J. (2023). Por que fazer saneamento no Marajó? Grupo Samnit. Disponível em: <https://www.gruposamnit.com.br/por-que-fazer-saneamento-no-marajo/>
- Santos, F. C. dos, Azevedo, S. L. M. de, & Almeida, M. do S. P. de. (2024). Metodologias ativas para a Educação Ambiental. *Revista Brasileira de Educação Ambiental*, 19(8), 84–89. Disponível em: <https://periodicos.unifesp.br/index.php/revbea/article/view/19055/12963>
- Silva, G. L. da, & Pimentel, E. T. (2024a). Metodologias ativas de aprendizagem para o ensino de ciências: uma revisão sistemática. *Contribuciones a las Ciencias Sociales*, 17(4), 1–13. Disponível em: <https://ojs.revistacontribuciones.com/ojs/index.php/clcs/article/view/1773/4206>
- Silva, J. L. da, Rocha, J. F. da, Silva, M. G., Costa, W. R. A. da, Bernal, M. K. M., Sarmiento, V. P., ... Araújo Júnior, J. R. R. de. (2024b). Prevalência da Hepatite A na Ilha do Marajó no período de 2010 a 2020. *Contribuciones a las Ciencias Sociales*, 17(5), 1–18. Disponível em: <https://ojs.revistacontribuciones.com/ojs/index.php/clcs/article/view/6529/4539>
- Sousa, M. G. de, Cordeiro Junior, I. de O., & Albuquerque, E. L. S. (2019). Aulas de geografia física e metodologias aplicáveis ao ambiente escolar. *Geosaberes*, 10(22), 81–90. Disponível em: <https://www.researchgate.net/publication/335551384>
- Tainan, S. (2025, maio 20). Como funciona Estação de Tratamento de Água: Como trabalhar o tema em sala de aula? Apoio ao Professor. Disponível em: <https://apoioaoprofessor.com.br/como-funciona-estacao-de-tratamento-de-agua/>
- Xisto, I. S., Oliveira Filho, A. B., & Oliveira, G. C. S. (2018). Diagnóstico das condições ambientais relacionadas à saúde humana na área urbana de Breves, Arquipélago do Marajó, Pará, Brasil. *Educação Ambiental em Ação*, (53). Disponível em: <https://www.revistaeea.org/artigo.php?idartigo=2121>