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Coral Reefs and Environmental Education: An Outreach Experience by the Distance Learning Biology PIBID in Basic Education in Maragogi, Alagoas

Recifes de Corais e Educação Ambiental: Uma Experiência Extensionista do PIBID Biologia EaD na Educação Básica em Maragogi - AL

Arrecifes de Coral y Educación Ambiental: Una Experiencia de Extensión del PIBID de Biología EaD en la Educación Básica de Maragogi, Alagoas

Camilla Thays Melquíades Tavares de Oliveira – Instituto Federal de Alagoas/PIBID, e-mail: cmto2@aluno.ifal.edu.br | ORCID: 0000-0004-9628-8674
José Aparecido da Silva Gama – Instituto Federal de Alagoas/PIBID, e-mail: aparecido.gama@ifal.edu.br | ORCID: 0000-0002-9082-6564
Dianny Carolyne Vasconcelos da Silva Lisboa – Instituto Federal de Alagoas/PIBID, e-mail: dy_carol@hotmail.com
Hélida Danielle Couto de Souza – Instituto Federal de Alagoas/PIBID, e-mail: hdcs@aluno.ifal.edu.br
Juliane Caroline de Albuquerque Santos – Instituto Federal de Alagoas/PIBID, e-mail: jcas6@aluno.ifal.edu.br
Felipe da Silva Correia Alves – Instituto Federal de Alagoas/PIBID, e-mail: fsca1@aluno.ifal.esu.br

Abstract: This paper describes an environmental education and outreach initiative focused on coral reefs, carried out under the Institutional Program for Teaching Initiation Scholarships (PIBID), specifically the Distance Learning (EaD) Biology sub-project at the Federal Institute of Alagoas (IFAL). The activity involved 65 eighth and ninth-grade students from the Antônio Verçosa Coelho Municipal Basic Education School in Maragogi, Alagoas, a municipality located within the Costa dos Corais Environmental Protection Area (APA). The pedagogical intervention comprised three stages: 1) administration of a diagnostic questionnaire to assess prior knowledge; 2) an interactive lesson on reef formation, biodiversity, and ecological importance; and 3) a creative workshop to build reef models using recyclable materials. Results showed significant student engagement, an expansion of ecological knowledge, and an integration of scientific and local insights regarding the marine ecosystem. The experience contributed significantly to the initial teacher training of the participating undergraduates by integrating teaching, research, and outreach through participatory methodologies in science education.

Keywords: Environmental Education. Science Education. Participatory Methodologies. PIBID.

Resumo: O presente trabalho descreve uma ação de extensão e educação ambiental centrada nos recifes de coral, realizada no âmbito do Programa Institucional de Bolsa de Iniciação à Docência (PIBID), subprojeto Biologia EaD do Instituto Federal de Alagoas (IFAL). A atividade foi desenvolvida com 65 estudantes do 8º e 9º ano da Escola Municipal de Educação Básica Antônio Verçosa Coelho, localizada no município de Maragogi (AL), inserido na Área de Proteção Ambiental (APA) Costa dos Corais. A intervenção pedagógica ocorreu em três etapas: 1) aplicação de questionário diagnóstico para mapear conhecimentos prévios; 2) aula dialogada sobre formação, biodiversidade e importância ecológica dos recifes; e 3) oficina criativa para confecção de maquetes/representações dos recifes com materiais recicláveis. Como resultados, observou-se engajamento expressivo dos alunos, ampliação do conhecimento ecológico e articulação entre os saberes científicos e locais sobre o ecossistema marinho. A experiência contribuiu significativamente para a formação inicial docente dos licenciandos ao

integrar ensino, pesquisa e extensão por meio de metodologias participativas no ensino de Ciências.

Palavras-chave: Educação Ambiental. Ensino de Ciências. Metodologias Participativas. PIBID.

Resumen: El presente trabajo describe una acción de extensión y educación ambiental centrada en los arrecifes de coral, realizada en el marco del Programa Institucional de Becas de Iniciación a la Docencia (PIBID), subproyecto de Biología EaD del Instituto Federal de Alagoas (IFAL). La actividad se desarrolló con 65 estudiantes de 8.º y 9.º grado de la Escuela Municipal de Educación Básica Antônio Verçosa Coelho, ubicada en Maragogi (AL), dentro del Área de Protección Ambiental (APA) Costa dos Corais. La intervención pedagógica se realizó en tres etapas: 1) aplicación de un cuestionario diagnóstico para identificar conocimientos previos; 2) clase dialogada sobre formación, biodiversidad e importancia ecológica de los arrecifes; y 3) taller creativo para elaborar maquetas y representaciones de los arrecifes con materiales reciclables. Los resultados mostraron una participación significativa del alumnado, ampliación del conocimiento ecológico y articulación entre los saberes científicos y locales sobre el ecosistema marino. La experiencia contribuyó significativamente a la formación docente inicial de los estudiantes de licenciatura al integrar enseñanza, investigación y extensión mediante metodologías participativas en la enseñanza de las Ciencias.

Palabras clave: Educación Ambiental. Enseñanza de las Ciencias. Metodologías Participativas. PIBID.

1. INTRODUCTION

Coral reefs are among the most complex, biodiverse and productive ecosystems on the planet, performing crucial ecological and socioeconomic functions such as maintaining marine biodiversity, protecting the coastline against erosion, and sustaining ecotourism and artisanal fishing. However, these environments face increasing vulnerability due to local and global human activities—especially marine pollution, unregulated tourism, overexploitation of resources and the severe effects of climate change, such as coral bleaching and ocean acidification. In Alagoas, the municipality of Maragogi contains significant portions of the Costa dos Corais Environmental Protection Area (APA), Brazil's largest marine-coastal conservation unit (Santana; Gama & Santos, 2018). Despite their physical proximity and the sociocultural bond that students in the region maintain with the reef ecosystem, there is routinely a gap between empirical/everyday knowledge and an in-depth scientific understanding of the ecology, functioning and conservation of this environment. This gap compromises the development of critical environmental awareness regarding the impacts experienced in their own surroundings. Faced with this challenge, Environmental Education (EE), guided by critical and reflective principles, has become an indispensable pedagogical

instrument. It acts as a bridge between systematized scientific knowledge and students' socio-environmental experiences, fostering territorial identity and a sense of belonging.

In this context, outreach practices linked to initial teacher education play a leading role. Through the Institutional Program for Teaching Initiation Scholarships (PIBID) of the Federal Institute of Alagoas (IFAL), Distance Learning Biology subproject, continuous dialogue between higher education and public schools becomes possible. Accordingly, this article aims to report the experience of an outreach-based pedagogical intervention grounded in active and participatory methodologies, carried out with elementary school classes in the municipal school system of Maragogi, Alagoas, with the purpose of raising awareness about coral reef conservation.

2 THEORETICAL FRAMEWORK

The theoretical foundation of this study is based on dialogue among Critical Environmental Education, Freirean Liberating Pedagogy, the guidelines of the National Common Curricular Base (BNCC), and teaching praxis within PIBID. This articulation seeks to understand the school as a privileged space for social transformation and the emancipation of individuals.

2.1 Critical Environmental Education and the Construction of Eco-Citizenship

Environmental Education (EE) cannot be reduced to a purely behavioral, naturalistic or naïve dimension focused only on changing individual attitudes or preserving resources. Grounded in Critical Environmental Education (Loureiro, 2012; Layrargues, 2004), this study conceives EE as a political and transformative act. From this perspective, the environment is understood in its entirety, encompassing physical, biological, social, economic and cultural dimensions. The anthropocentric and commercial view of nature is overcome in order to strengthen active citizenship, question socio-environmental inequalities and promote environmental justice. Critical EE seeks to enable students to understand the structural causes of the contemporary ecological crisis, encouraging community engagement and conscious, collective decision-making.

2.2 Freirean Pedagogy: Dialogue, Contextualization and Emancipatory Praxis

For Environmental Education to achieve its critical character, dialogue with the premises of Freirean Pedagogy is indispensable (Freire, 1987; 1996). The pedagogical act

rejects the “banking education” model, based on the passive transmission of content disconnected from reality, and embraces problem-posing education. Based on the concept of praxis (action-reflection-action), teaching requires valuing learners’ experiential knowledge (prior knowledge) and actively listening to their sociocultural context. From this perspective, teaching and learning form a horizontal dialogue between educator and learner, in which knowledge is critically constructed through investigation of reality. Environmental awareness therefore emerges from recognizing the student as a historical subject capable of intervening in and transforming their environment.

2.3 Science Education in the BNCC: Interdisciplinarity and Socio-environmental Problematization

The National Common Curricular Base (BNCC) for Elementary and Secondary Education (Brasil, 2018) establishes the need for an interdisciplinary and contextualized approach to Natural Sciences education. It states that scientific knowledge should be connected to cross-cutting and socio-environmental themes, encouraging scientific investigation and students’ scientific literacy. By proposing the study of the impact of human actions on ecosystems, socio-environmental sustainability, and the search for solutions to local and global problems, the BNCC aligns with STSE approaches (Science, Technology, Society and Environment). This normative orientation supports the creation of teaching sequences and pedagogical interventions that connect scientific concepts to civic action, encouraging student autonomy in facing the challenges of the twenty-first century (Chassot, 2003; Santos et al., 2023).

2.4 PIBID as a Space for Praxis and Theory-Practice Articulation in Initial Teacher Education

The experience provided by the Institutional Program for Teaching Initiation Scholarships (PIBID) reshapes initial teacher education by promoting the early inclusion of undergraduate teaching students in the daily life of public schools (Gatti, 2010; Pimenta, 2012; Nóvoa, 2019).

PIBID consolidates the inseparability of teaching, research and outreach, transforming the partner school into a living laboratory of pedagogical praxis. Within this project, PIBID served as the integrating link between academic theoretical foundations and the real demands of the classroom. By developing dynamic, investigative methodologies in Critical

Environmental Education, the undergraduate students not only apply concepts but also reflect on their own practice, investigate the school context and build a teaching identity based on research and social commitment.

3. MATERIALS AND METHODS

3.1 Research Characterization and Methodological Approach

This is a descriptive and analytical study in the form of an Outreach Experience Report, based on a qualitative approach to educational research. The action was conceived and carried out as an outreach practice of the Institutional Program for Teaching Initiation Scholarships (PIBID)—Distance Learning Biology Teaching Degree Subproject at the Federal Institute of Alagoas (IFAL). The intervention was guided by the principles of action research and inquiry-based teaching, seeking to integrate academic scientific knowledge with the socio-environmental experiences of the school community.

3.2 Context of the Action and Participants

The pedagogical intervention was conducted in Maragogi, on the northern coast of the state of Alagoas. The municipality has considerable socio-environmental importance because it lies at the heart of the Costa dos Corais Environmental Protection Area (APA), one of Brazil's largest marine-coastal conservation units.

Action Site: Antônio Verçosa Coelho Municipal Basic Education School.

Target Audience: 65 students duly enrolled in the 8th- and 9th-grade classes of Elementary School.

Outreach Team: Distance Learning Biology teaching-degree students (PIBID scholarship holders), supervised by a Basic Education teacher and the IFAL area coordination.

3.3 Data Collection and Analysis Instruments

To assess the effectiveness of the action and student engagement, a combination of pedagogical and qualitative data-collection instruments was adopted. Preliminary Diagnostic Questionnaire: administered at the beginning of the action, with open- and closed-ended questions designed to map students' prior and empirical knowledge of local reef ecosystems. Participant Observation and Field Diary: systematic records made by PIBID scholarship holders during classroom discussions, considering the level of participation, students' language and comments on Maragogi's socio-environmental problems. Analysis of Material Productions:

evaluation of the models and three-dimensional representations produced by students during the creative workshop.

3.4 Planning and Pedagogical Implementation Stages. The outreach intervention was methodologically structured into three linked pedagogical moments: STAGE 1: Diagnosis. STAGE 2: Interactive Lesson. STAGE 3: Creative Workshop, using a knowledge questionnaire, projector presentation and models made with recyclable materials.

Stage 1: Diagnosis and Initial Awareness. This action surveyed students' alternative conceptions and prior knowledge. The questionnaire investigated whether students recognized the biological function of corals, the associated biodiversity and the main threats faced by the ecosystem in the Maragogi region.

Stage 2: Interactive Lesson and Problematization (Use of Audiovisual Resources). An interactive lesson used a multimedia projector to display images and explanatory diagrams. The presentation addressed: coral biology and formation (symbiosis with zooxanthellae); associated marine biodiversity and socioeconomic importance (coastal protection, fishing and ecotourism); and local and global human impacts (improper waste disposal, predatory boat tourism, and climate change/bleaching). The activity prioritized Freirean problematization, encouraging students to share accounts of their daily experiences at the beach and natural pools.

Stage 3: Creative Workshop and Construction of Three-dimensional Representations

As a practical and playful conclusion, a craft workshop focused on recycling and reusing materials. The 65 students were divided into teams to create models and three-dimensional representations of coral reefs and associated organisms (fish, mollusks, crustaceans and echinoderms). Figures 1 and 2 show three-dimensional representations of marine organisms associated with coral reefs.

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Figure 1 – Three-dimensional representation of a fish



Source: Produced by the authors

Figure 2 presents the three-dimensional production of an echinoderm, an organism that lives in the reef environment.

Figure 2 – Echinoderm produced in the creative workshop



Source: Produced by the authors

Teaching Resources and Reused Materials: Cardboard, newspaper, PET bottles, gouache paints, scissors, glue and other recyclable materials.

Pedagogical Objective: To support retention of the biological concepts discussed and promote environmental awareness about solid-waste management and reducing plastic waste in the oceans.

4. RESULTS AND DISCUSSION

The analysis of the results obtained during the outreach action was organized into three main axes: characterization of participant engagement and profile, conceptual development and students' socio-environmental perception, and the impact on the initial teacher education of PIBID scholarship holders.

4.1 Characterization of Participation and Pre-intervention Diagnosis (Qualitative-Quantitative)

The intervention had the effective participation of 65 students from the 8th- and 9th-grade classes of Antônio Verçosa Coelho Municipal Basic Education School. The initial diagnostic questionnaire revealed a pattern characteristic of coastal communities: although 100% of the students live in Maragogi and routinely interact with the marine environment, most held a naïve and strictly utilitarian view of coral reefs.

Many students associated corals with "rocks" or "sea plants," unaware of the animal nature of the phylum Cnidaria and the symbiotic relationships (zooxanthellae) that are fundamental to maintaining marine biodiversity. Furthermore, when asked about threats to the ecosystem, their reports were limited to visible litter left by beachgoers, overlooking the impacts of predatory boat tourism and the acidification and warming of the waters. This finding supports Layrargues (2004) and Carvalho (2006), who warn of the risk of Superficial Environmental Education, which reduces complex problems to isolated actions without an adequate ecological understanding of the processes.

4.2 The Interactive Lesson and Critical Reasoning: Freirean Praxis in Action

The transition from empirical knowledge to grounded scientific knowledge took place during the interactive lesson. Multimedia projection served as a visual trigger for problematization, allowing students to connect conceptual content (cnidarian anatomy, food webs and coastal protection) with the reality of the Costa dos Corais APA. During discussions facilitated by PIBID scholarship holders, a significant change in attitude was observed. Appropriation of Scientific Vocabulary: students began using terms such as "biodiversity," "symbiosis," "bleaching" and "conservation unit." Socio-environmental Problematization of Everyday Life: when discussing tourism in Maragogi's natural pools, students critically identified coral trampling and fuel spills from boats. This stage fully met the skills prescribed

by the BNCC (Brasil, 2018) for Natural Sciences in Elementary School, which recommend analyzing human impacts on local ecosystems.

4.3 The Creative Workshop: Materialization of Learning and Waste Awareness

The practical workshop represented the synthesis of learning. Building three-dimensional reef representations with recyclable materials (cardboard, newspaper, paints and plastics) promoted two pedagogically connected reflections:

Anatomical and Taxonomic Consolidation: To represent coral structures and associated organisms (fish, mollusks and crustaceans), students had to retrieve the anatomical and morphological aspects discussed in the topics studied.

Awareness of Plastic Pollution: The use of cardboard and discarded materials generated a practical discussion about the life cycle of plastics and the severity of microplastics in marine food chains. The active, hands-on methodology encouraged teamwork, creativity and self-efficacy among the 65 students, resulting in aesthetically pleasing productions that were ecologically faithful to the ecosystem studied.

4.4 Contributions of the Outreach Practice to Initial Teacher Education (PIBID/IFAL)

From the perspective of the Distance Learning Biology Teaching Degree, the outreach experience within PIBID/IFAL brought immeasurable contributions to the undergraduate students/authors:

Overcoming the Theory-Practice Distance: The opportunity to plan, conduct and evaluate a teaching sequence in a partner public school made it possible to test dynamic pedagogical strategies in Science Education.

Inseparability of the Academic Triad: Integrating Teaching (Biology curriculum content), Research (questionnaire data collection and analysis), and Outreach (social return to the Maragogi community) consolidated the education of teacher-researchers (Pimenta, 2012).

Inclusion and Challenges of Distance Learning: For distance-learning students, face-to-face immersion in the everyday setting of a public school strengthened the construction of their teaching identity and sense of belonging to the educational ecosystem.

FINAL CONSIDERATIONS

The outreach experience developed within PIBID/IFAL, Distance Learning Biology Teaching Degree Subproject, demonstrated that Critical Environmental Education, grounded in

active and participatory methodologies, is a powerful pedagogical strategy for transforming Science Education in Basic Education. The action carried out with 65 students from Antônio Verçosa Coelho Municipal Basic Education School in Maragogi, Alagoas, fully achieved its objectives by promoting connections between scientific knowledge and learners' socio-environmental reality.

Immersion in the everyday setting of a public school fostered the inseparability of teaching, research and outreach, allowing future teachers to experience the real challenges of pedagogical mediation, planning and developing contextualized teaching resources. For distance-learning students, the experience significantly strengthened the construction of teaching identity and ethical and social commitment to high-quality public education. Finally, it is recommended that Environmental Education practices focused on marine-coastal ecosystems be incorporated continuously and interdisciplinarily into the political-pedagogical projects of schools located in Conservation Units. This report is expected to support other educators and initial teacher-education programs in developing investigative, participatory and transformative methodologies in Science and Biology Education.

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