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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY: A PEDAGOGICAL PROPOSAL IN THE BRAZILIAN SEMI-ARID

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ABSTRACT

This manuscript has as main objective to present the technical-operational procedure of the action research developed in a public high school in the North region of Ceará, in the period from 2012 to 2015, EEFM College Dom José Tupinambá da Frota, located at Avenue Dr. Guarany, 1.100, Neighborhood Cidao, Sobral, CE. This study was developed as an interdisciplinary pedagogical proposal with the first year classes of high school. It is a pedagogical practice, in which the pedagogical project "sustainable school" was developed, focused on the issue of water resources. The idea of the project was born from the observation of water waste in the school through the dripping of drinking fountains and air conditioning appliances and the generation of effluents, coming from kitchen sinks and bathrooms. The main objective of this project was to develop interdisciplinary pedagogical tools capable of involving students and the school community in sustainable practices, leading them to critical reflection about the relationship between man and nature in living with the semi-arid climate, where these resources are, in a sense, limited. In addition, strengthen the links between school and society, school and university, encouraging students to be interested in scientific research, to dream of a future academic career and to train citizens aware of their role in environmental issues.

KEYWORDS: Water Resources. Interdisciplinarity. Sustainable development.

RESUMO.
Este manuscrito tem como objetivo principal apresentar o procedimento técnico-operacional da pesquisa-ação desenvolvida em uma escola pública de ensino médio na região Norte do Ceará, no período de 2012 a 2015, EEFM Colégio Dom José Tupinambá da Frota, situado na Avenida Dr. Guarany, 1.100, Bairro Cidao, Sobral, CE. Este estudo foi desenvolvido como proposta pedagógica interdisciplinar com as turmas de primeiro ano do ensino médio. Trata-se de uma *praxe* pedagógica, na qual desenvolveu-se o projeto pedagógico "escola sustentável", voltado à questão dos recursos hídricos. A ideia do projeto nasceu da observação dos desperdícios de água na escola através do gotejamento dos bebedouros e dos aparelhos de ar-condicionado e da geração de efluentes, provenientes das pias da cozinha e dos banheiros. O objetivo principal desse projeto foi desenvolver ferramentas pedagógicas interdisciplinares capazes de envolver os estudantes e a comunidade escolar em práticas sustentáveis, levando-os à reflexão crítica acerca da relação do homem com a natureza na convivência com o clima semiárido, onde estes recursos são, de certo modo, limitados. Além de tudo isso, estreitar os laços entre escola e sociedade, escola e universidade, estimulando os estudantes a interessar-se pela pesquisa científica, a sonhar com uma futura carreira acadêmica e formar cidadãos conscientes do seu papel quanto às questões ambientais.
PALAVRAS – CHAVES: Recursos Hídricos. Interdisciplinaridade. Desenvolvimento Sustentável.

INTRODUCTION

The theme "sustainability" is very present in the media and in the official discourses of the world authorities in the present times. However, it seems a paradoxical perspective in the context of the globalized economy. This theme has led a portion of humanity to concern for the future of humanity, given the incorrect management of natural resources available to man. In this context, one of the main concerns is the misuse of water resources and their finitude on the planet earth. This fact has led world institutions such as the UN (2022) to carry out public policies of global scope, in order to sensitize the world population to this issue. In this context, 2013 was declared as the International Year of Water Cooperation.

According to scientific estimates, of all water resources available on the planet earth, about 97% of the total is salt water and only 2.7% is composed of fresh water, of which only 1%

is available in liquid form in rivers and lakes, suitable for human consumption. Knowing that water is an indispensable resource for life and its quality is increasingly compromised, especially in urban perimeters, where there is a greater population concentration. The case becomes more serious when it comes to the Brazilian semiarid region, where the availability of this resource is more limited. Therefore, it is necessary to reinvention of the teaching action plans and school pedagogical political projects as a means of providing the development of a more just society committed to the sustainable development of its habitat, the planet earth.

The availability of water resources in The Brazilian territory, located in one of the most privileged regions of the planet. The northern region of the country, where the main aquifers and rivers of this tropical territory are located, accumulates most of the approximately 12% of the fresh water available in the world. In addition, more than 90% of the Brazilian territory, located in the tropical region, receives abundant rainfall due to its geographical location.

The spatial section of this study is located in the north-central part of the State of Ceará, on the banks of the Acaraú River, an area typically flat and endorsed with alluvial soils, easy to use and occupy, the City of Sobral. This urban center is inserted in the domain of country depression, between the Uruburetama Mountains, Meruoca and the sedimentary plateau of Ibiapaba, positioning that directly influences its climate, whose average temperature is around 38º C, with low rainfall indexes, on average 854 mm/year. According to Ursolino (2006), in addition to all this, the fact that most of the municipal territory is situated on a crystalline crust contributes aggravating to the scarcity of local water resources.

Although there are important surface reservoirs of water in this municipal territory, the local population cannot enjoy them, either for domestic use or for fishing and/or leisure, because they are in high processes of pollution and degradation, aggravated in recent years by the dumping of sewage of domestic and industrial origin, often by means of clandestine connections to the public sewage system, in view of the urban development of recent years in the city Sobral citizen.

In this perspective, the "sustainable school project", which consisted of the construction of two equipment for the collection and treatment of effluents in the school? The project was developed in an interdisciplinary way, with the technical support of the Department of Urbanism, Housing and Environment of Sobral; of the Federal Institute of Ceará - IFCE, through the Environmental Management course and the Vale do Acaraú University - UVA, through the Department of Geography.

The school project directly and indirectly involved the teachers of the said school, from the various areas of teaching, and the students of the first year of high school, who followed the project during the three years of secondary school. The pedagogical use of the project consisted of the use of equipment, a collection tank of gray effluent (coming from sinks, drinking fountains and air conditioning appliances) and ecological trench for the treatment of black effluent (discharge of toilets), as a didactic resource by school teachers, in addition to the greater involvement of students in practical classes.

The project promoted, thus, a pedagogical proposal aimed at the critical training of students regarding their role in the face of the challenges associated with the culture of sustainability. The theme environment is present effectively in the curricular proposal of said high school, which is based on the public policies of sustainable development,

provided for in resolution No. 2 of June 15, 2012, of the CNE, as it says its Article 2 of Chapter I, Title I:

> Environmental Education is a dimension of education; it is an intentional activity of social practice, which should impress on individual development a social character in its relationship with nature and with other human beings, aiming to enhance this human activity in order to make it full of social practice and environmental ethics (MEC, 2012).

The "sustainable school" project was sought to involve the school community as a whole, so that the idea of sustainability could be evidenced in practical actions, led by internal agents, students, teachers and employees; and by the agents outside the school, the local and scientific community, whose partnership between the various actors could generate criticality, resilience and empathy about the idea of sustainability in living in the semi-arid, from basic education. This action research is highlighted as an innovative pedagogical practice capable of making a difference in the citizen education of students and contributing to the formation of individuals ecologically committed to the preservation and rational use of natural resources.

METHODOLOGY

This study was methodologically based on Harvey's dialectical approach (1984), in which the author defends the idea of naturalism-geographical-dialectical, considering the interrelationship between time, space, social being and objective reality in its entirety in the geographical understanding of space-territory, conceiving nature in an integrated way. This experience had as a guiding principle the concern with the waste of water in the school itself and with the pollution and degradation of the local hydrographic network by the daily dumping of domestic sewage. This concern led us to the elaboration of this project.

This pedagogical project was inspired by the techniques of Urban Perm culture initially developed in Criciúma-SC, in the 1992 decade, where an initiative similar to that developed by the school mentioned above gained municipal public policy status. This city was one of the pioneers in Brazil to encourage the use of perm culture techniques in urban areas. In the USA and European countries, the implementation of studies in this area began shortly after the Second World War, in the 1950s, using this technique of agriculture in the residential sector, according to Lot (2018).

Regarding the technical-operational procedures, this study was divided into five main stages: 1) observation of the phenomenon, water waste and effluent production; 2) constitution of the project, planning of actions and presentation of the idea to the school community; 3) execution of actions, construction of equipment; 4) technical follow-up; 5) presentation of results to the school community and participation in scientific fairs.

Step - 1

At this stage, we proceeded with the monitoring of the points of water waste; production and disposal of effluents generated in the daily life of the school unit (see Figure 1). During the observation period, two months, more than 200 liters of water were wasted per shift through dripping of drinking fountains (two), air conditioners (six) and poor use by students. The production of daily effluent from the school, gray and black waters, were discarded directly in the network of public exhaustion, whose final destination is the Acaraú River and the making lagoon, located in its surroundings, which present visible traces of pollution.

Figure 1: observation of the phenomenon, water waste and effluent production

Source: author's file, 2012

Image A: monitoring of effluent disposal points in the school
Image B: planning of intervention actions in the Geography class
Image C: conversation wheel and discussion of the research theme
Image D: fat box inspection sample collection for laboratory analysis
Step - 2

With the data related to this monitoring, we sought, together with a group of students to discuss environmental issues and the relationship of men with these resources, focusing on the school case study. At this stage workshops and lectures were held on the theme in question with the school community (figure - 2). Figure 2: constitution of the project and presentation of the idea to the school community

Source: author's file, 2013

Image A: workshop for the manufacture of effluent recycling instruments in the Geography class

Images B, C, D: distinct moments of presentation and discussion of the theme sustainability at school, presentation of the previous results of action research and planning of actions.

Step - 3

After the idea was discussed with the school community and the planning of the actions was carried out, the practical part of the project was carried out, directly involving a class of 40 students from the first year of high school. The actions were performed by the students themselves, with the contribution of some teachers and school managers, where two effluent collection and treatment equipment was built, connected to a distribution network by low pressure irrigation (as shown in figure - 3).

Figure 3: execution of actions and construction of sustainable equipment

Source: author's file, 2014

Image A: start of equipment foundation

Image B: ecological trench ready for operation

Image C: soil sample collection of ecological trench for laboratory analysis

Image D: ash water collection and treatment tank

Step - 4

After the installation and operation of the equipment, it was used as an interdisciplinary pedagogical resource in the planning of some disciplines, such as philosophy, geography, biology, mathematics and chemistry. During the period of operation of the effluent treatment system, the equipment received technical visits from IFCE teachers, PIBID/UVA students and students from other school units in the region (figure - 4).

Figure - 4: technical accompaniment and pedagogical visit

Source: author's file, 2014

Image A: soil sample collection and geography class in the ecological trench

Image B: visit of the school community to the project equipment

Image C: technical visit of ifce teachers

Image D: technical visit of PIBID/UVA students

Step - 5

As the final pedagogical product of this interdisciplinary project, we had the production of articles, book chapters, sketches of sustainability equipment, elaboration of several projects based on said pedagogical experience, participation of students in scientific fairs at the local and state level, in addition to the academic motivation of the participants, who began to have more interest in scientific research and had their school results improved in all disciplines (see figure - 5).

Figure - 5: presentation of results for the school community and participation in scientific fairs

Source: author file, 2015
Image A: presentation of the project at a regional scientific fair, 2014
Image B: presentation of the project at a state fair, 2014
Image C and D: presentation of the project at a local event, 2015

The "sustainable school" Project encouraged students to develop practical and interdisciplinary actions of school research, where they learned techniques of proper management and preservation of water resources and soils throughout their execution, through the construction and operation of a tank for the collection and treatment of gray water with the use of aquatic plants and fish, and an evapotranspiration basin (ecological trench) linked to a banana cycle, in the premises of the school itself, whose effectiveness consisted of separating and reusing the effluent produced in the school's food sector in a practical and sustainable way, without costs or environmental damage.

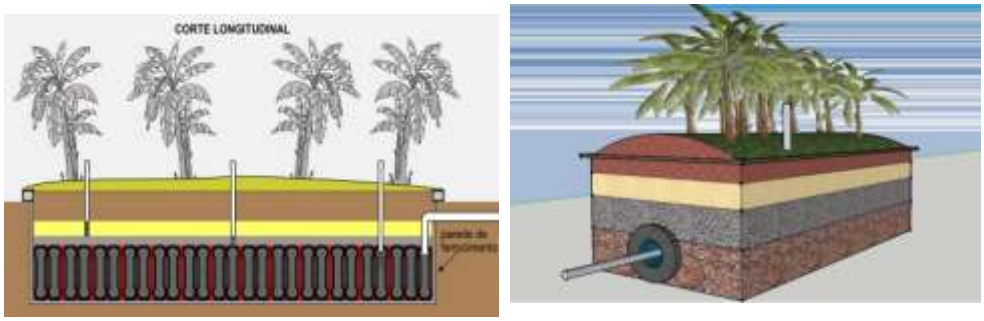
The system is formed by a collector tank for the gray effluent and an evapotranspiration basin for the treatment of black effluent, associated with a banana cycle, which works in an integrated manner, so that the domestic sewage produced in the school was separated and destined for their respective systems, where they initially went through a filtration process, absorption, treatment and biological perspiration.

The construction of the evapotranspiration basin consisted of an excavation of five meters long, by two meters wide and one meter deep (5x2x1), resulting in a volume of 10m³; as described below.

The material used was 90% recycled. It consisted of the use of ten (10) used car tires, size 12; gravel and construction debris; one (01) cubic meter of gravel type 2 for concrete; two (2) 100 mm pipe parts for sewage; three (03) bags of cement and ten (10) square meters of nursery screen. After gathering all this material, the equipment was mounted as follows: the hole was fully waterproofed in its internal walls. In the central part a horizontal cylinder

was formed with the used tires, where the discharge of black water is applied, as shown below (figure - 6).

Figura – 6: ilustração do perfil transversal da fossa ecológica



Source: internet. Available in: https://br.pinterest.com/adeiltob/fossa-s%C3%A9ptica/

With regard to the assembly of the equipment followed the following sequence, from the bottom up: 1) 50 cm of gravel, 10 cm of gravel and 40 cm of earth from the whole itself, so as to land it completely. At the top were planted banana trees and other plants of great power of evapotranspiration, such as some species of ferns, for example.

Inside the tyre cylinder, dark-colored water containing feces goes through an anaerobic decomposition process, where most bacteria are eliminated at this stage. As the trench fills and the water goes up, it is filtered from the bottom up until it is reached by the roots of the banana trees, which i have fulfilled the final stage of this process, through the evapotranspiration of the plant itself.

The collection tank and treatment of gray effluent consisted of an excavation in the soil of 4m², waterproofed in its internal walls with cement. The water from the dripping water fountains, air conditioning equipment and school sinks was connected by means of connection with 32 mm pipes (figure -7). Effluent treatment occurs through perm culture techniques, using biological filtration elements. After treatment, the water is pumped through an electric pump into an elevated water tank, and then distributed by gravity through low pressure irrigation system to water plants and use in other activities in the school.

Figure - 7: sustainable effluent treatment system

Source: author file, 2015
Image A: collection tank and biological treatment of working gray effluent
Image B: high filtration system and storage of treated effluent
Image C: distribution of effluent treated by low pressure irrigation

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