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Geographic and Contextualized Education in the Brazilian Semiarid: Applicability Proposal

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Abstract

Geographic education in recent years has undergone major transformations in school curricula, moving from a memorization practice to a critical reflection based on the students' local reality. This is included in official teaching documents. On the other hand, the application of this new approach to applicability problems, largely due to the lack of elements focused on teaching resources that facilitate this process or the training of professionalized teachers before this conceptual change. This is present in the Brazilian semi-arid region, with the insertion of coexistence contextualized with the semi-arid region in the quest to work on education along the lines of applicability of the student's knowledge. That said, we have such an objective here, providing some reflections to reach such a path, an active and participatory teaching.

Keywords: geographic education, contextualized education, semiarid

1. Introduction

Geographical education is an educational area that focuses on the study and understanding of the world in terms of space, place, and environment. Its aim is to teach students about the physical-natural characteristics, associating terrain, climate, natural resources, as well as human aspects such as culture, society, economy, and interactions between people and the environment.

This conception of science based on educational aspects seeks to promote students' understanding of the world's diversity, includes the following categories: landscapes, regions, and how humans interact and shape the environment in which they live. Geographical education is not limited to the mere memorization of facts; rather, it seeks to develop intrinsic skills in both the student and the teacher, encouraging a critical view of socio-environmental issues. In summary, the primary goal of geographical education is to develop students' understanding of the interconnection between people and the environment, contributing to the formation of more conscientious citizens capable of understanding and acting upon global challenges. In this contextual perspective, it prioritizes the place. Here, our priority is to seek understanding of the semi-arid region in order to contextualize the individual through the practice of Education.

In this way, education contextualized in the semi-arid region focuses on issues through an educational approach that takes into account the specific characteristics of this arid region, where there is a scarcity of water and adverse climatic conditions, as well as sometimes unsuitable soils for agriculture. It aims to integrate academic knowledge with the local reality, considering the socio-economic, cultural, and environmental context of the semi-arid area.

This educational approach acknowledges the importance of adapting the school curriculum and educational practices to the needs and peculiarities of the semi-arid region. This includes not only teaching about issues

related to water scarcity, water management, and adaptive agriculture but also valuing local culture, promoting environmental sustainability, encouraging technological innovation suitable for the region, and developing skills that are relevant to students' lives in this specific context.

Education contextualized in the semi-arid region aims to empower students to understand and deal with the challenges faced in the local reality while also valuing and strengthening their cultural identities. It seeks to provide education that is meaningful, practical, and aligned with the local reality, preparing students to face the challenges and contribute to the sustainable development of the semi-arid region. In this sense, this article seeks to promote understanding of education contextualized in the semi-arid region through a geographical and interdisciplinary perspective, based on understanding soil and water. This is done through applicable and playful methodologies.

2. Theoretical Reference

The soil and water within the context of geographical and contextualized education in the semi-arid region constitute components of the natural environment that must be properly understood and preserved, considering their importance for maintaining the terrestrial ecosystem and the survival of the organisms it depends on. Soil degradation can be associated with the lack of knowledge among parts of the population regarding its characteristics, importance, and functions, and should be seen as a cross-cutting theme, especially in education, to establish a relationship with natural/social sciences, namely Geography and Biology (Costa Falcão & Falcão Sobrinho, 2014).

Soil is considered one of the essential components of development, remembering its performance, particularly four fundamental functions inherent to this element: it is a source of food; it provides materials and energy; it significantly influences water behavior; and it represents the support for human constructions (Ruellan, 1988).

Despite the evidence, the importance of soil and water as an environmental component is disregarded and undervalued. Hence, one may question: what measures should be taken to acquire knowledge about the conditions of using this natural resource in order to value and preserve it, thereby achieving adequate societal development?

The answer to this question is provided by Ruellan and Dosso (1993), insisting that pedology, the science that studies soil, has the power, in the service of development, to teach and use soils without destroying them, leading to their conservation with the aim of maximizing their food and energy functions, among others. This is associated with the natural components that contribute to its formation.

Therefore, it is evident that the need for water and soil conservation and their study is essential for human survival. Their knowledge in daily life is of paramount importance due to their diverse functions. Moreover, only through the dissemination of their information can their maintenance be ensured and consequently harmony in a healthy and sustainable environment.

Within the context of contextualized education in the semi-arid region, the teaching of soil and water progresses slowly, and its production is less significant compared to other areas. In basic education, students do not have access to appropriate, technically useful, or suitable information for the Brazilian reality, which is confirmed by the deficiencies and flaws in the currently available teaching materials. It is also noted that when mentioned in textbooks, it is presented in a limited manner in terms of content in Geography and Biology disciplines.

It is speculated that this situation was observed by Romanatto (2004), with the author affirming that the use of textbooks in Brazilian education, instead of being employed as a supportive material, becomes the sole pedagogical resource adopted in the classroom.

Following this context, Silva et al. (2008), while analyzing Geography textbooks, pointed out that the current content does not contribute in a clear and coherent manner to the understanding of soil within the landscape paradigm, overlooking the recognition of its importance as an element within it. In an attempt to simplify the exposition of the soil formation process, they fail to address some significant topics, such as types of origin materials, susceptibility, erosion, among others.

Additionally, the methodologies adopted by educators in the classroom make the content, as perceived by students, appear as mere "rote learning," as the teaching occurs mechanically, only developing the skill of memorizing these contents, hindering the act of reasoning, imagining, and creating (Costa Falcão & Falcão Sobrinho, 2014).

On the other hand, it is emphasized that in the focus on the teaching and learning process, the presented concepts are produced and adapted by humans, meeting the interests, social, cultural, and political needs of different times.

These considerations involve the educator's intervention in the pedagogical process, whether in constructing a pedagogical resource, its applicability, or in analyzing the results.

In summary, the work and flexibility of the teacher become essential in adopting methodologies and didactic resources that can correlate content, aiming to expand the students' reasoning, systematizing their knowledge, and arousing their interest.

3. Method

During this stage, the aim is to analyze and develop themes focused on contextualized education in the semi-arid environment, related to the creation of educational materials and their applicability in Basic Education. From this perspective, there is an understanding of studying soil and water through direct contact with didactic support materials, aiming to stimulate student participation (Costa Falcão, 2014).

Initially, we chose the categories to be worked on, that is, plate cisterns, flood cisterns, erosion simulators and painting with soil pigments.

Plate cisterns are usually used in semi-arid environments and are accessible to students, as they are sources of rainwater and collected for human consumption during droughts (Falcão Sobrinho, 2020).

Biodigesters are used to transform animal feces waste into natural fertilizers for agricultural soil, as well as to produce energy for use in household stoves.

In addition to these resources, there is the proposal to understand the local soil itself and its function in retaining water in the soil, as stated in Costa Falcão (2014) when he transforms soil pigments into colored paints.

Given the above, it was necessary to measure the knowledge of basic education students, precisely at the Ayres de Souza School, located in the municipality of Sobral, in the state of Ceará, to illustrate the information.

That said, a 12-hour workshop was held with 45 students distributed in the 10th, 20th and 30th years of high school, based on knowledge of soil and water in semi-arid environments.

In the theoretical part of the workshop, models were also used, illustrating terraces with vegetation and mandalas. After the technical workshop, the practical part took place, where it was possible for students to explore knowledge about the semi-arid region through paintings with soil pigments.

With discussions sequenced through the illustrations, students discussed the understanding of soil and water, according to the tables on display.

4. Results and Discussion

The development of practices stemming from educational technologies in the semi-arid environment has contributed to a concrete assimilation and visualization of reality. This is achieved through visual activities in the classroom, such as the creation of models and erosion simulators. Additionally, field trips and experiencing the local reality are elements to be explored in teaching, such as exploring cisterns, mandalas, and greywater reuse. Lastly, through playful activities, there's an aim to spark students' interest in understanding the dynamics of nature.

4.1 Mockups

Can we assert that the use of models is a technological innovation because it allows manipulation and visualization in the third dimension?

In this regard, the model as a didactic resource can be used as an essential educational tool by correlating it with the reality in which the student is situated, engaging in the exercise of contextualization. It provides a distinct way within the classroom to mediate knowledge and a sense of belonging.

Contextualized education is a necessity in the Brazilian semi-arid region. However, an understanding of coexistence with the semi-arid region can only be fostered if students are given the opportunity to become acquainted with the existing possibilities.

In education, presenting models representing the aforementioned social technologies and conservation practices during classes, lectures, and events enables the dissemination of this knowledge among students in public schools, educational institutions, and the community at large.

This underscores the importance of developing effective educational actions to disseminate sustainable technologies through educational representations, aiming to promote the reduction of degradation of natural systems through environmental education."

Figure 1. Model representing coexistence with the semi-arid region, highlighting the plate cistern technology and the biodigester

This representation showcases an integrated way of sustainable coexistence with the semi-arid environment, utilizing resources from cattle farming to produce biogas, highlighting the social technology of meeting basic needs such as cooking and drinking, capturing and storing rainwater for use during eight months of drought.

A model representing contour planting and stone lines. Through this educational technology, it's possible to demonstrably show the efficiency of contour planting, preventing soil loss in agricultural areas in the semi-arid region. Data obtained from research has led to the conclusion that conservation practices like contour planting combined with stone lines have the potential to reduce soil losses due to water erosion, especially in soils naturally more susceptible to erosion like Lithic Neosols. Building stone lines at ground level has proven to be an alternative for retaining sediment and preserving the natural rockiness of the soil. The viability of this technique is substantial enough that it has been expanded to non-experimental production areas, showcasing the project's extension efforts as well.

Figure 2. Model representing plantation on contour line and stone cordon.

Associated with soil conservation practices, second water technologies like the courtyard cistern enable production during the dry season, contributing to water and food security. These technologies are exclusively designed for small-scale production and animal husbandry, ensuring small farmers can produce and generate additional income.

A model representing the PAIS system – Sustainable Integrated Agroecological Production and cultivation in

Mandalas. This model characterizes sustainable practices for family farming. It's organized in concentric circles, emphasizing sustainability and the active role of the farmer through this system. It allows for the cultivation of crops like bananas, vegetables, and poultry farming. These crops provide additional income to the farmer.

Figure 3. Model representing PAIS system

4.2 Erosion Simulators

The soil stands as a crucial component of the natural environment, one that demands adequate understanding and preservation due to its pivotal role in maintaining terrestrial ecosystems and the survival of organisms reliant upon it. Soil degradation often correlates with the widespread lack of awareness regarding its characteristics, importance, and functions among the majority of the population.

Educational technologies directed toward soil conservation aim to instill conservation awareness among students and the broader community, highlighting the importance of undertaking actions to protect it. Within this spectrum, these technologies also aim to foster a critical perspective on socio-environmental impacts.

For effective learning, it's essential to merge pedagogical content with an understanding that allows for dynamic soil classes, enabling reflection on soil knowledge within the context of the students' surroundings. Soil should be viewed as a cross-cutting theme capable of establishing connections with Natural Sciences and Geography, primarily, encouraging interdisciplinary relationships.

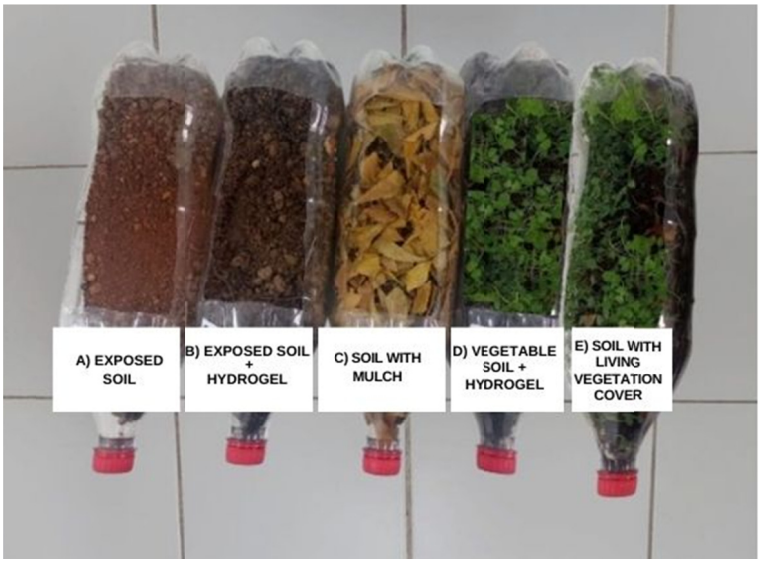

Figure 4. Erosion simulators present themselves as didactic educational technologies

Erosion simulators serve as didactic educational technologies. They demonstrate exposed soil, unprotected and thus more susceptible to erosive processes, due to the direct impact of rainfall causing soil particle detachment.

An erosion simulator with vegetated soil prevents erosive processes, conserving nutrients and reducing the direct impact of rainfall. Soils enriched with organic matter partially mitigate the impacts of rain, thereby reducing erosive processes.

A simulator representing soil treated with hydrogel, a soil moisture-retaining polymer, shows how, in prolonged semi-arid drought conditions with high evapotranspiration rates, the use of hydrogel becomes increasingly efficient. It also enhances the dissolution of essential nutrients for seedling growth and improves soil drainage.

4.3 Cisterns

The coexistence with the semi-arid region is facilitated through social technologies (Falcão Sobrinho, 2020a), which are products, techniques, or methodologies with potential for replication, developed and/or applied in interaction with a community. These technologies represent solutions for social transformation, promoting the sustainable use of local resources (Almeida & Sobrinho., 2020), aiming to enhance the quality of life for the population in the hinterlands.

In the perspective of coexistence with the semi-arid region, the Program for Training and Social Mobilization for Coexistence with the Semi-Arid Region: One Million Rural Cisterns (P1MC) stands out. It was established by the Articulation of the Brazilian Semi-Arid Region (ASA) in the early 2000s, initiating the implementation of concrete water cisterns.

Figure 5. Cisterns

The plate cisterns are simple rainwater harvesting and storage technologies designed to provide access to water for the rural population in the Brazilian semi-arid region. This technology aims to support the interests, potential, and needs of local communities, especially smallholder farmers. Its actions are based on:

a) Conservation, sustainable use, and environmental restoration of natural resources in the semi-arid region. b) Breaking the monopoly on access to land, water, and other means of production, ensuring these elements together promote sustainable development in the semi-arid region.

In 2007, according to the ASA report (2014), a milestone was the creation of the "One Land and Two Waters" program (P1+2). Its purpose was to increase the water supply for families, rural communities, and traditional populations. The "1" represents the land, and the "2" signifies the second water, designated for family agriculture and small animal husbandry. This program includes technologies such as floodwater cisterns, underground dams, courtyard cisterns, among others.

One of the numerous benefits provided by these social water harvesting technologies is reflected in the ability to produce various foods such as papaya, tomato, gherkin, vegetables, medicinal plants, and rear small animals. The productive backyard is irrigated using water from the P1+2 technology. These practices demonstrate that despite the limitations imposed by the environment, it's possible to coexist with the climate and biome of the semi-arid region. These practices are sustainable as they do not harm the environment, while also contributing to the family's income (Assis et al., 2022).

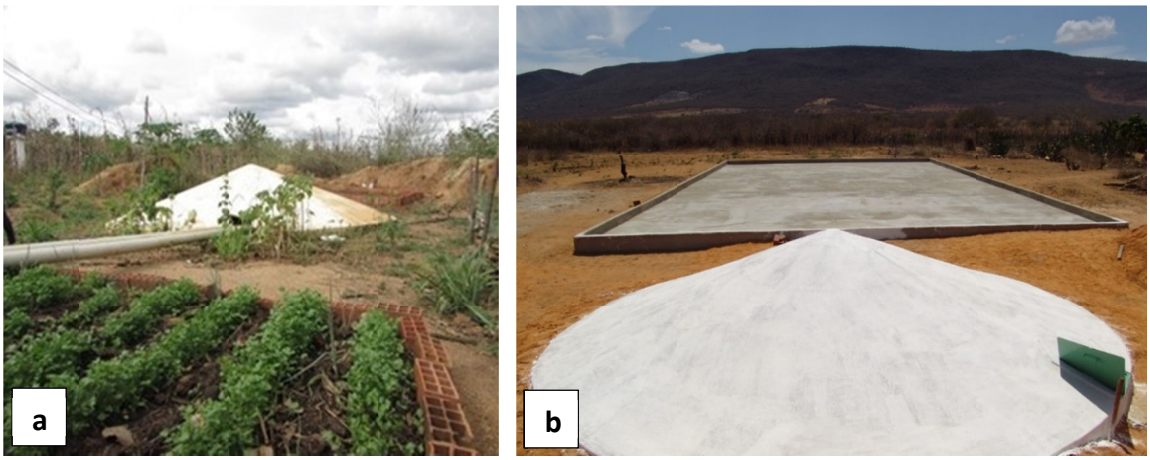

Figure 6. A – corresponds to a flood cistern; B – corresponds to a flood cistern with space for agricultural practice

Subsurface dams enable the storage of rainwater within the soil profile for irrigation of agricultural crops and fodder. They are considered an effective tool for supplementing water needs in semi-arid climate regions. These dams have structures for planting beds, facilitating agricultural cultivation.

4.4 Gray Water Reuse

A Social Technology of Gray Water Reuse involves a system primarily aimed at reusing household water from showers, kitchen sinks, and laundry that would otherwise be wasted. Through a gravity-based water collection system, the water containing residues and chemicals is directed into a piping network where the initial "cleaning" of the water occurs. This treated water then enters the second phase of "purification," facilitated by a worm farm, which serves as the final stage of water treatment. After this entire process, the water becomes suitable for agricultural food production.

Figure 7. A – Biodigestor: sediment accumulation tank; B – natural waste tank transformed into fertilizers

It's an alternative for managing renewable energy sources. The biodigester technology consists of harnessing organic matter from animal waste. In this system, organic matter undergoes anaerobic digestion, producing biogas that is channeled to the owner's stove.

4.5 Earth and Water: Soil Becomes Art

The soil, like other elements, should be seen as a collective resource, an essential component of the environmental system. Teaching about soils aims to provide students and educators with a comprehensive analysis. There is often little emphasis on this subject in education, particularly regarding soil as a pedagogical tool in an inclusive perspective that encompasses all elements of nature and their interactions (costa Falcão & Falcão Sobrinho, 2014).

Utilizing the contextualization of geographical concepts and individuals' perception of the local landscape favors a sense of belonging among students regarding reality. The study of soils and their use as a didactic resource in Geography education, through activities like soil painting workshops, allows for the sensitivity of students and acknowledges the relevance of knowledge about this natural resource, fostering a collective environmental consciousness.

The educational proposal of soil painting constitutes a pedagogical initiative aimed at providing students and educators with unique experiential opportunities while sparking students' interest in Geography. Consequently, teaching about soils linked to environmental education is directed towards shaping citizenship, experiential learning, and collective participation in fostering environmental awareness.

The paint preparation process is quite simple, involving the mixture of two parts sieved soil, two parts water, and one part white glue, thoroughly stirred with an agitator. The quantity of ingredients may vary slightly based on the soil's texture, which might require a bit more water for complete dissolution. Clayey soils may require more water, while medium-textured soils might need a bit less. Depending on the paint's intended use, educators can adjust the proportions to achieve a denser or less dense paint.

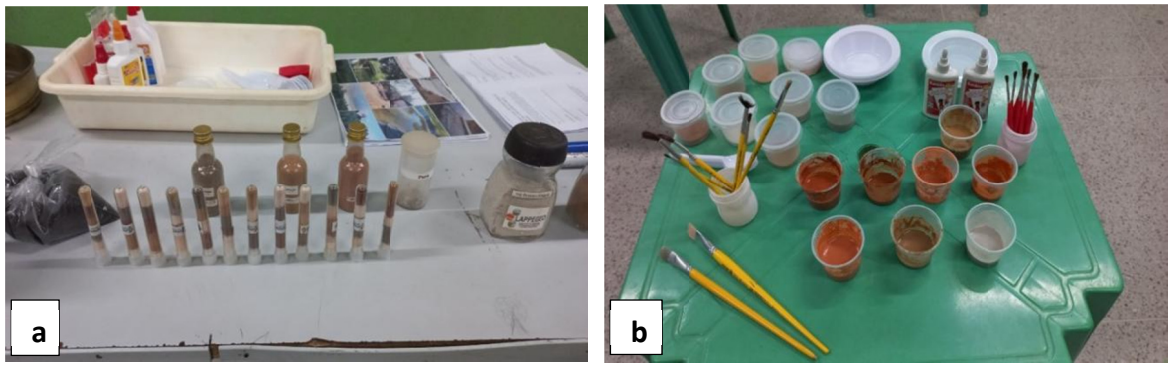

Figure 8. A – painting material made from soil pigments; B – brushes and soil paint in different colors

In regard to painting, as described by Oliveira and Sobrinho (2020), it can be proposed to create paintings with specific themes, allowing students to express themselves freely. Alternatively, students can be provided with pre-drawn sketches and asked to paint them using colors they feel are fitting for each representation, which becomes a personal choice for each individual.

In practice, students are given a paper or a drawing and encouraged to depict the local landscape. The aim extends beyond aesthetic aspects, seeking to understand the meanings behind landscape representations, bringing students closer to their local reality. These practical teaching activities are considered crucial tools for the teaching-learning process, offering a deeper understanding than mere verbal activities.

The students who took part in the workshop showed significant enthusiasm, indicating a promising outcome for the proposal. The research aims to spark interactive knowledge construction among students, fostering greater interest and engagement in Geography classes.

Figure 9. A and B – representation of the landscape; C and D – students painting a representation of the landscape

The students who participated in the workshop exhibited significant enthusiasm, indicating a promising success for the proposal. The research objective is to awaken interactive knowledge construction among students, fostering increased interest and participation in Geography classes.

In summary, one of the educator's responsibilities in school is to cultivate participation, creativity, and critical thinking in education, serving as a mediator of knowledge and demonstrating to students the ability to develop their cognitive skills. This approach aims for harmony in classes, promoting essential interaction between school, teachers, and students (Falcão Sobrinho et al., 2019). Thus, this workshop aims to stimulate in students the awakening of interdisciplinary knowledge construction, fostering greater interest and engagement in Geography classes, which contributes to the formation of active citizens committed to the educational process.

5. Final Considerations

Considering the importance of studying the local environment in its natural and social aspects through student involvement and field experience becomes evident when allowing an understanding of the local reality within formal education.

Geographical education, involving physical-natural and social aspects, enables this understanding and immersion in the local reality. In the semi-arid environment, contextualized education opens new pathways to make teaching more engaging.

The models of techniques for coexisting with the semi-arid environment and their illustrations through mock-ups, combined with playful activities, tend to instill in students the necessary motivation to discuss geographical concepts

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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