

A DIDACTIC KIT PROPOSAL ABOUT SOIL TO HELP TEACHING GEOGRAPHY IN SCHOOLS: AN EXPERIENCE IN THE BRAZILIAN SEMIARID REGION

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RESUMO:

A principal forma de difusão dos conteúdos das disciplinas em sala de aula é através do livro didático, no entanto, fazem-se necessárias novas metodologias. No ensino de Geografia, há muitas possibilidades para serem desenvolvidas e o uso de recursos inovadores tem sido amplamente discutido por diversos autores. Considerando que o solo é um dos elementos naturais que mais sofrem com o desenvolvimento da sociedade e, é o que menos recebe atenção das autoridades, a maior preocupação dos que conhecem as vulnerabilidades desse recurso é incentivar as gerações futuras a preservá-lo. Portanto, este trabalho tem como finalidade apresentar materiais de apoio didático de conteúdos sobre solos para professores do ensino básico. Para a construção e desenvolvimento desta pesquisa foi utilizada a metodologia do socioconstrutivismo, sob as ideias de Paulo Freire acerca dos métodos participativos. Foram construídos seis materiais que ajudam na disseminação dos conhecimentos sobre o solo, gerando discussões sobre como acontece sua formação, principais componentes, de onde vêm, como se comporta em diferentes situações, processos de intemperismo e erosão e ainda as principais formas de manejo e conservação. Assim, diante de testes feitos em duas escolas do ensino público municipal de Fortaleza (CE). Durante a aplicação dessa metodologia, foi possível perceber a maior interação e a ativação criativa entre os estudantes.

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INTRODUCTION

This research was conducted in the Laboratory of Geology and Soil Education at the State University of Ceará and funded by CNPq, whose period spanned the years 2017 to 2019, which perfected the theoretical paths of Geography teaching in basic education associating the reflection about the soil as a component of the natural environment that should be properly known and preserved, given its importance for the maintenance of the terrestrial ecosystem as well as the survival of organisms that depend on it.

The Geographical Science is based on the study of space and its socio-environmental attributes, nature and human relations, in order to

contemplate interdisciplinarity. This science, due to the comprehensiveness of its contents, can be difficult for students to assimilate in the classroom.

Lately, the approach of geography contents in schools has gone through a superficialization of its contents. Some researches point out that the development of teaching in a fragmented way, as a mere transmission of contents, has resulted in students' lack of interest, making the classes monotonous, which has hindered the teaching and learning process (BOMFIM, 2006).

It has also been noticed in several surveys that future teachers of basic and high school education suffer constantly with the difficulties of spreading geographic knowledge, and often feel the lack of other resources, besides the textbooks already in use, which could be part of the school environment.

According to Louzada and Frota Filho(2017,p.76),this obstacle is not only with the "use of the textbook in the teaching of geographic content" being the main resource used, but also the training of most teachers working in Brazil that are fruits of the "Movement of Renewal of Brazilian geography" that occurred from 1970, where professionals were influenced by the current of Critical Geography or Radical Geography, which opposes the knowledge produced by the systemic and positivist method, which characterizes the Physical Geography.

According to the works of Costa Falcão (2013), among the various research works, either in monographs and dissertations, Geography at school is treated by students as a subject focused on memorizing information, in the students' view - a term used by them in the classroom.

We believe that the use of teaching kits will help in the training of Geography teachers, encouraging them to build a contextualized teaching. As mentioned by Furlan (2005), didactic resources are capable of creating situations that allow for progression in learning, as they relate the students' basic knowledge about the world, the places where they live and their daily experiences, making it possible to discuss several subjects.

From this reality, the creation of didactic resources becomes fundamental for a better fixation of the contents and for a better didactic relationship of interaction between teacher and student. With this concern, the research aims to present (elaborate) methodologies that can be used in studies that cover Geography, as a strategy to contribute to the teaching and learning process and also to promote discussions about solutions and environmental issues.

Approach to the Contents of Physical Geography in Schools

In elementary and high schools there are several challenges in the teaching-learning process, which makes the higher education courses more responsible for the content taught in the classroom.

The scientific understanding of the environmental crisis in which we are immersed requires much more attention from research related to the subject, demanding a new behavior from universities, as explained by Guimarães and in forsato (2011), it is

necessary to build new ways of passing on content, leaving the chains of traditional paradigms.

For the teacher Bonfim (2006), as mentioned above, it is necessary to analyze, before inserting novelties in the school environment, what is the reality of students socially, how is the truth of the pedagogical situation to which they are subject to only then involve new instruments in the classroom. Regarding this same line of reasoning, Pelizzari (2002, p. 38) points out that "Learning is much more meaningful as the new content is incorporated into a student's knowledge structures and acquires meaning for him/her from the relationship with his/her previous knowledge".

According to Silva and Dias (2013, p. 12), Geography is a science that needs to take body associating the natural and social elements, enabling to understand the transformations of the environment for the social benefit, but putting into discussion how far one can interfere in nature. However, for these integrations of knowledge to be placed in civil society, they must be tied as involvement during basic education and school life. And yet, for them, "it is necessary,[...], to problematized the environmental issues that are in the everyday reality of the students.

Thus, new methodologies become essential for the development of geographic science from the beginning of the entire educational process, especially the content linked to physical geography, which are still tied to the difficult part of the military period (1964-1985), are addressed in a superficial way, hindering learning (LOUZADA; FROTA FILHO, 2017, p. 77). According to these same authors, there is still a great limitation to the use of textbooks, for different reasons, such as "the high number of classes and students, lack of infrastructure by the school, time for lesson planning, as well as lack of knowledge of the subject in question".

In contrast, Brandão and Mello (2017, p. 83), address that from the historical process submitted in the 1970s, the teaching resources have taken strength and created the prospect that would come to enter autonomously in the school space, being the teacher, the main "mediator of the meeting of the subject (student) with the object (content), instigating the student knowledge of the object". Given this, it began to use specific resources for the transmission of knowledge, such as newspapers, films, globe and different media languages, and can be used in various subjects and also "promote environmental education giving the current importance of nature preservation in the context of globalization" (BRANDÃO; MELLO, 2017, p.83).

For the conceptual approach, using teaching materials, the assumptions should be put on the agenda, for greater reflection by students, until it is possible to ponder the reality in which they are inserted, thus being able to understand the processes and forms of interaction society/nature (ALBUQUERQUE, 2017).

The use of Didactic Resources for teaching Physical Geography.

According to Louzada and Frota Filho (2017), the contents of Physical Geography presented in textbooks continue to be transmitted superficially, which impairs learning. According to Bonfim (2006), one of the difficulties of elementary and high school students in educational institutions is the assimilation of the contents of Physical Geography presented in textbooks.

This situation has been verified by several authors (FELTRAN FILHO et al, 1996; ROMANATTO, 2004; SILVA, COSTA FALCÃO; FALCÃO SOBRINHO, 2007),

who found that the use of textbooks in Brazilian basic education (elementary and high school), instead of being a support material, becomes the only pedagogical resource adopted in the classroom for geography classes.

The productions of didactic resources promote the intermediation of everyday knowledge for a communication with the geographic science. As stated by Callai and Kaercher (2017, p.11-12), "The school is not attractive to the contemporary world, because it is not able to explain and textualize the new readings of life". The school entity is seen as something apart from the students' lives, without crossing the limits of the new forms of knowledge.

The production of didactic materials discipline and facilitates in the context of basic education, develop an alignment between the realities experienced and the geographic science. There is a promotion of motivation and the stimulation of reasoning from the problematizations posed by the issues addressed, causing students to be able to adapt to the perceptions that make it possible to create and solve problems, argue and relate information. (CASTELLAR; VILHENA, 2010).

Also according to Castellar and Vilhena (2010, p.6), "the challenge lies in the mediation between academic knowledge and school knowledge (taught)", since the teacher will have to adapt his or her deeper and more advanced knowledge to a group that needs, initially, to know the small details of the initial scientific geographic base.

With the implementation of resources other than textbooks, the lesson and the contents become more meaningful.

The contents of Geomorphology, Pedology, Geology, Climatology and Biogeography are often dealt with in a fragmented, abstract, descriptive way, which makes learning difficult.

The use of teaching resources brings the option of new learning paths and can contribute to the students' holistic view and help them understand the reality of society and nature (school and living spaces), and can awaken a greater interest in the content presented in the classroom.

Learning content and teaching resources in the teaching of school geography

Among the physics content, it is worth mentioning that the ground, our subject of study, as already presented above, is a very important element, however, very little mentioned in the Geography textbooks.

The soil has several functions: it stores nutrients for plants, as well as filtering, protecting, and storing water, regulating its distribution, drainage and filtration, and also serves as raw material for industries. Unfortunately, the communities forget the importance of soils and there is still a devaluation of the content in elementary and high school. The space reserved inside textbooks is insufficient, which are often misaligned with the reality of Brazilian soils, making the topic even more necessary to be addressed in an environment like the University (Lima MELO, 2007).

According to Silva, Costa Falcão, and Falcão Sobrinho (2007), in general, there are limitations in the textbooks and it is common to find fault with concepts and contents that require, besides the theoretical foundation, teaching materials to be used as facilitators of the teaching and learning process.

Unfortunately, the relationship that the soil has with the current situation of degradation and pollution on our planet is high as you can imagine, because it is impossible to separate the systems that are linked. (MUGGLER et al., 2006, p. 734).

According to Muggler, et al. (2006), soil education allows the progression of knowledge about this element, constituting a new parameter of conditioning learning.

The works of Costa Falcão (2013) presented are a combination of the most varied ways of transmitting soil-related content, therefore, the instruments built in the Laboratory of Soils and Erosive Processes in Geographical Studies (LAPPEGEO) at the State University Vale do Acaraú (UVA), in the city of Sobral/CE, and more recently the research and extension projects developed in the Laboratory of Geology and Soil Education in the Geography Course of the State University of Ceará-UECE, became the basis for the development of our research.

We also have the work developed by the 'Soil in the School Project', from the Federal University of Paraná, which presents a soil-technical experiment using low-cost materials and accessible methodologies that promote and extend many ideas and that will help teachers and students in their extension projects.

It is because of the interdisciplinarity of Geography that the didactic resources have a great value, because they are able to overcome the traditional expositive classes that are theorized through textbooks.

According to Cartozani and Espindola (2005), learning through didactic resources can approach realities and allow a greater correlation with the oral contents inserted in the classroom. If they are produced with practical activities and distribution of the subjects in question, the possibility of success during the fixation of the content covered becomes greater.

Therefore, our goal is to provide some teaching resources to be used in the classroom, during the exhibitions of the physical geography theme, focusing on the sun in the context of the landscape, highlighting its importance in nature and its use and management in a sustainable way.

METHODOLOGICAL APPROACH

We decided to adopt the same theoretical-methodological approach of (Silva, Costa Falcão, Falcão Sobrinho, 2007), the research mentioned above, in which it is based on the foundations of Environmental Education, linked to Soil Education, and uses the constructivist theory, in the ideas of Paulo Freire, using a holistic approach, the participatory methods, and the practice of project pedagogy.

At first, research was conducted to define the process of planning the contents related to the topic under study, among which we used the book 'Soil in the Environment', one of the constructions of the 'Project Soil in School', present at the Federal University of Paraná, and especially the research developed by Costa Falcão (2014), (2019), On account of its contribution and pioneering spirit in the area of Soil Education in the State of Ceará, along with the research already carried out in the Laboratory of Pedology and Erosive Processes in Soil Education - LAPPEGEO of the State University Vale do Acaraú and more recently the Laboratory of Geology and Soil Education - LAGESOLO of the Geography Course of the State University of Ceará-UECE.

The elaboration and making of the teaching aids

As mentioned above, the research aimed at developing and making teaching aids as resources to facilitate the teaching and learning process, together with the intention of contributing to the importance of the proper use and management of soils.

The conceptual approach focused on the origin and formation of soil, soil composition and functions, soil morphology, and soil management and conservation.

The kits were first developed in the laboratory, with tests on the quality of the material, and later applied in two schools together with the team from the Extension Project: "The university and the school: discussing the environmental theme".

For the production of teaching materials, disposable materials were used, such as pet bottles, glassware, containers, scissors, pens, and colored pencils.

After the production of the teaching kits, we tested some of the materials produced in two schools.

As Antunes (2002, p.37) states, "never think of using pedagogical games without rigorous and careful planning, marking them by very clear stages and effectively following the students' progress".

The application of the materials in schools

It was not the objective of this research to evaluate the materials produced, but we decided to do at the invitation of the scholarship holders of the extension project "University and School: Dialoguing the Environmental Theme " and " The Art of Painting with Earth " of the Laboratory of Geology and Soil Education - LAGESOLO, as well as the students of the Institutional Program of Scholarship for Initiation to Teaching - PIBID of the Degree Course in Geography of the Itaperi campus, which already knew the project and showed great interest in applying in schools where they developed the program.

The evaluation was performed by using the prototype and applying a questionnaire to the students of high school from two public schools in the city of Fortaleza (CE). It was applied in classes of 8^o year composed by 25 and the other with 35 students, respectively, with an average time of 45 minutes for the development of the activity. The objective of the questionnaire was to verify if the materials fulfill the purpose of helping in the basic concepts of soil.

RESULTS AND DISCUSSIONS

The Programmatic Contents directed to the Physical Geography in the Elementary School

As previously explained, one of the great difficulties of students in elementary and high school Geography school is the assimilation of Geography contents presented in geography textbooks. (Silva, Costa Falcão, Falcão Sobrinho, 2007). In many cases the classes are merely expository and do not present applicability in the students' reality.

Furthermore, in the analysis of the authors mentioned above, in many textbooks, mistaken discourses and definitions about soils are found, and most of the time, the few existing topics are focused on the context of the agronomic approach, focused on techniques and impacts.

Researchers such as Cavalcanti (1998), Botelho (1998) and Simielli (1999) state that the excessive use of textbooks in Brazilian schools to work on the contents implies serious consequences for the students, since they are unable to understand the basis of geographic science in an autonomous and creative way.

Selecting content: Identifying problems

For the execution of the proposed materials, we started the process with the selection of the contents, seeking to work with an environmental focus, emphasizing the soil element in the landscape context.

Observing the many problems we live and that are already rooted in society, whether by lack of knowledge or mismanagement of resources. Seeking to promote the approach and insertion of the student in the context that involves the theme of "SOIL", among the various topics of global relevance addressed in Agenda 21, we seek to develop information and reflections based on data from the United Nations Organization (UN), FAO (*Food and Agriculture Organization*), the Intergovernmental Panel on Climate Change (IPCC) of 2019, to underpin the importance of the content addressed.

According to the latest information, agriculture and land use account for 23% of greenhouse gas emissions, air emissions can halve crop yields, the planet loses 24 billion tons of fertile soil every year - with intensifying desertification, and more forced migrations, increasing pressure on fertile soils, and the risk of food insecurity.

In 2019, desertification generated a loss of between 10% and 17% of the global Gross Domestic Product (GDP). And yet, according to the FAO (Food and Agriculture Organization of the United Nations), 33% of global soils are degraded.

According to COSTA FALCÃO (2013), the appropriate management of land in agriculture and cattle-raising, deforestation, consequent erosion, flooding, and the decrease in subsoil water reserves are problems related to water conservation and should be mentioned. Hence the need to discuss and propose ways of solving this impasse.

And also according to Louzada and Frota Filho (2017), one of the main difficulties of students in elementary school (1st to 9th grade) and high school (1st to 3rd grade) in educational institutions in Brazil is the assimilation of the contents of Physical Geography presented in the textbooks of Geography, as already mentioned above.

In this sense, our research aims to help the work of teachers by suggesting adding the didactic support materials proposed in the research to enable students to understand the importance of Geography in their lives.

Each resource becomes important to treat not only a single subject, but to make an interconnection with other contents that generate several discussions when presented in the classroom, allowing the student to interpret and understand their local environment and through the suggested activities can prove to be conducive to a teaching model that integrates multidisciplinary and innovation, allowing a better development of the learning process.

We see that the use of alternative pedagogical teaching materials has been highlighted in several authors' planning and organization of the content to be taught. Be it in the teaching of geography, biology, chemistry, mathematics, and other related areas. Alternative didactics have been used as relevant tools so that the contents are assimilated and learned in the best possible way by the students.

With the same purpose of the production of educational materials mentioned so far, our research aims to present the development of some alternative materials to help in the teaching of physical geography and to raise awareness of the importance of the debate about environmental problems.

Based on the idea of making science present for the students, teacher aid kits have been produced for the better transmission of current content.

Production of didactic materials

During the development of the research, teaching aids were developed so that the students could produce their own instrument, manipulate and visualize the content, enabling experimental learning.

The materials are intended to be produced and used in the classroom by the students themselves, after the content has been presented, considering the sun element as a natural resource and an element of the landscape and of great importance to nature, as well as its use and conservation in a sustainable way.

To start producing the resources, we previously did a field class to collect soils, rocks, and minerals, following the methodology described by Costa Falcão (2019).

Initially, three teaching kits were produced: a mini-library, a collection of mineral cakes and soil texture, secondly, experiments on Soil infiltration and retention, water and wind erosion, and lastly, a memory game.

The goal is to assist the teachers' planning and offer the use of new tools to contribute to the applied contents, creating a diversity of situations that explore the student's various abilities, because according to (Costa Falcão, 2014) the use of teaching resources has caused a significant knowledge besides illustrating the concepts, making the class more interesting and the content more enjoyable, developing the ability to work in groups, stimulating the autonomy in the construction of knowledge.

Initially, we created a mini collection of soil pigments in order to clarify the constituents that give color to soil and encourage students to learn about soil content. According to Costa Falcão (2019), the use of mineral pigments allows us to produce a soil-based paint to be used as a teaching and artistic resource, its application in the extension projects in schools "University and School: dialoguing the environmental theme "and the project "The art of painting with earth "have consisted of great interest from students goes from thematics, which has contributed to the simulation of contents, making the teaching and learning process more dynamic and pleasurable, and has also succeeded in developing new skills with the realization of free painting on A4 paper and on canvas.

In the beginning, it is important to make correlations between sedimentary, metamorphic, and igneous rocks and soil formation, proposing to the students themselves to bring to the classroom samples of rocks that they find in the streets, in the surroundings of their homes or schools. It is also up to the teacher to make the school's own collection.

At the third moment, after presenting the source material, one of the elements that will form the soil, we put together a soil texture kit. Using soil from the school itself or from the surrounding area, this step aims to understand the soil's constitution and to identify the textural class of the soil: clay, silt, fine sand, coarse sand.

The fourth and fifth material has a similar proposal, to demonstrate through experiments the soil water filtration and retention process and the wind and hydroelectric erosion process.

Our soils and that will allow us to awaken the senses to the discussions that involve environmental issues.

Finally, we worked with playfulness through the production of a memory game, focusing on soil management and conservation techniques. According to (Silva, Costa Falcão and Falcão Sobrinho, 2007). Teaching through playful resources has shown very positive results in the development of the senses, affectivity, social relationships, and the experience of blackness.

The development of didactic resources, using playfulness, generates activities that have the principle of recycling materials and can be used to broaden the students' view of the world, besides approximating realities in such a way that

Therefore, introducing audacity in the education of children and young people is something that is being brought slowly to school reality, (...) still with a little resistance. (MENESES, 2009, p.15)

The following were produced: a memory game, with the objective of dealing with the issues of proper handling of the soil; composition and texture of the soil, to demonstrate the grain size fractions; a collortic, for the discussion of the different colors present in the soil and what they represent; a collection of mineral rocks for the understanding of the importance of minerals in everyday life; an experiment on infiltration and retention of water in the soil, where it is possible to explain the water storage system; painting with the soil, where it is possible to have more interaction and promote questions about the constituents that give color to the soil.

Also in our work, it is possible to verify bibliographic suggestions so that the teacher can have an even deeper foundation on each content.

The Didactic Kits Produced

Colorteca: Soil Color Collection

The collection of soil colors (colorteca) is based on the search for some soil profiles that appear as a colored material and can be found on the base

In addition to the low cost, it does not affect the environment and contributes to sustainability. Besides the low cost, it does not affect the environment and contributes to sustainability. The students are encouraged to participate from the collection, along with the whole process of preparing the pigments, making the activities more participatory and dynamic, and contributing to the learning of the content.

Figure 1 - Mini colorteca composed of eight little glasses with soil



Photo: The author himself.

Elaboration of the Colorteca:

Objective: To allow the recognition of the constituents that give color to the soil and to awaken the students' interest in interpreting the soil's colors.

Materials: Transparent glass tanks, soils of different colors, and screens of various mesh sizes.

Procedure: Collect soil of different colors in the field; Sieve to the finest possible grit; Separate the colors into transparent containers.

Questions: What are the causes of the different colors? Main soil constituents? Why protect soils?

In order to deal with soil colors, the main differences and causes of the recorded colors are discussed and interpretation is made on the basis of what its components make available.

It is possible to identify the constituents of the soil through its different blossom colors, reddish and yellowish colors have a high concentration of iron oxide, and in environments with a high drainage capacity the soils tend to be yellow or red.

The gray soils indicate hydro orphic environments (waterlogged areas), which are usually present near water courses or in areas with poor drainage, where they are subject to being waterlogged for a long period of the year.

In an ecosystem environment, the presence of these soils indicates an intense process of removal of past iron.

Dark colors, such as brown or black, indicate the presence of organic matter in the soil - vegetation residues and the composition of forested areas.

The soil pigments are also used for the production of paints, employed as a didactic and artistic resource. Helping to discuss several themes, this resource stimulates the students' artistic side, making them even more interested in the theme.

Figure 2 - Drawings made by the workshop 'The art of painting with earth' with the students of the Geography course.



Photo: The author himself

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Collection of Rocks and Minerals

The study of minerals is particularly important. Both because of their economic use as raw materials, which is indispensable in our society, and for the understanding of the origin and evolution of rocks.

It is important to explain the origin of the rocks, the main differences and characteristics between igneous, metamorphic and sedimentary rocks.

It is possible to address the process of soil formation through weathering-physical, chemical, and biological-and erosion, as well as the phenomena involved.

To go through the involvement of the parent rock and correlate it with time, climate, relief, and organic matter.

Figure 3 - Rock and mineral collection of the Geology and Education Laboratory at Soils



Photo: The author himself

Elaboration:

Objective: To make students recognize the building blocks and their applicability, differentiating the main rocks and minerals in their regions, and to highlight the importance of minerals in our daily lives.

Materials: Sample of rocks (magmatic, metamorphic, and sedimentary) **Procedures:** Collect rocks and minerals through field classes with the students; assemble a collection; assemble a panel with the main uses of different minerals.

Questions: Which natural element starts the soil formation? How can we differentiate between rock types? How are rocks formed? What is the predominant rock type in the region? Where do we originate minerals? How are different minerals used? What is the importance of weathering for soil formation? Do different rocks with different minerals give rise to different soils?

In this activity, it is possible to ask students to collect rocks and minerals seen in the project "home school", or even during other demonstrations they make in their daily lives. In addition to increasing the school's collection, it stimulates even more student participation inside and outside the classroom.

Table 1 - Main uses of the selected minerals.

	Calcite	Gypsum	Quartz	Graphite
Use	It is a source of calcium and salt, and is also important as decorative stone (marble-onyx) and in optical instruments (when it is an Olympic and colorless stone).	Used in the manufacture of cement, ceramics, fertilizer, paper, paint, insecticide, beer, plaster, chalk, glass, and enamel.	Used in watches, radio equipment, fiber optics, ceramics, scientific instruments.	It is used in pencils, electrodes, reactors, batteries, the iron and steel industry, and in paints.
	Mica	Hematite	Feldspar	
		In industry for		
	For the production of	Iron making,	Used in glass,	
	electrical insulators,	In the manufacture of	Enamels, ceramics,	
	filling of	pigments,	home binder	
	papers, rubbers,	screws, nails,	abrasives, cements	
Use	plastics, paints,	pans,	soaps and	
	wallpapers and	tools, axes	decorative objects.	
	of windows and doors	motors, in		
	phosphorescence.	jewelry, material		
		For polishing and in		
		Catalysts.		

Source: The author himself

This table can be used to show students the need for mineral knowledge in our society and can be adapted according to each teacher's needs.

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Building Texture Soil kit

Soil texture refers to the proportions of clay, silt, fine sand, and coarse sand.

The soil contact allows the student, through touch, to feel the soil particles and to define the clay content proportion by the sensation between the fingers of the clay soil collected.

It is important to study the texture of the soil to identify the best use and management of the soil, aiming at the appropriate use according to its permeability and resistance to erosion.

When handling the soil samples, you can work with soil samples of different textures, such as: sandy soil will be drier to potato; silty soil will have a higher degree of stiffness when in contact with water, and softness; clay soil tends to leave scratches because it does not stick easily when in contact with the hands.

Elaboration of the Kit:

Objective: Handle a portion of moist soil with your fingers, in an attempt to investigate the soil's constituents (sand, silt, and clay) by sensitizing the touch.

Materials: Trays, soil of different consistencies, water.

Procedures: Separate the grains in order of grain size in trays; make a board containing the granulometric measurements; wet the or to decide of each sample so that the students can feel the different textures.

Questions: What can students feel when they touch the ground? Considering the granulometry mentioned, which soils have the highest water infiltration?

Figure 4 -Table Granulometric



Photo: The author himself

Granulometric chart that explains the main differences between gravel, coarse sand, fine sand, silt, and clay. Produced from recycled material, it facilitates the students' understanding of the soil components.

Figure 5 - Soil samples.



Photo: The author himself

To further activate the senses, separate the gravel, fine sand and clay. In this way, the student also uses touch when handling the soil portions, to make the connection to the content about soil texture and soil deformation processes.

Box 2 - Template for adding information

TEXTURE

Sample	Sandy Clay	Medium Moderately Clay Silty
1		
2		
3		
4		
5		
6		

Source: The author himself

The model table can be adapted according to the teacher's needs, to be used for organizing the information about the collected samples.

In this activity, the teacher can collect soil samples from around the schools, together with the students, stimulating attention to this much-mentioned course.

The following experiment will allow you to check the water availability in relation to the defined samples.

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Soil Infiltration and Water Retention Experiment.

The increasing loss of fertile soil layers creates deserts, poverty and affects the economy of countries like Brazil, which has a large agricultural production. Reduce the number of springs and the volume of water supplied to a watershed.

There is also the fact that the infiltration of water into the ground is directly connected with life. The fauna and flora are part of the natural environment and need the available water capacity.

The use of these soil mini conditioners, collected and placed in PET bottles, helps to understand the importance of vegetation for soil protection, to incorporate biological issues (soil fertility and nutrients), and to talk about the types of weathering in each environment.

It is possible to relate this to the activity on grain size and how this factor can interfere with the retention time of the water capacity, the importance of the soil-water-plant relationship, and how it makes it available to plants and other organisms.

In this activity, it is also possible to assimilate the types of erosion and the siltation process, especially in the approach to river erosion and how the natural cycle of rainfall is connected to the water table, and also to relate it to the life present in the soil.

Figure 6 - Infiltration experiment and retention



Photo: The author himself

Elaboration of the experiment:

Objective: To demonstrate the infiltration and water retention capacity of soil in a comparison between a soil covered with vegetation, one with mulch, and one completely covered, showing students how the erosion process becomes even more intense.

Material: three PET bottles, soil sample, water, paper filter or pieces of cloth, plastic cup.

Procedures: Cut the bottles with scissors in half to hold the samples; Collect soil in the field or around the school; Place a cloth to filter the water; commonly, pour some water, distribute each different cover and trim it in a plastic container.

Questions: What is the importance of vegetation cover in the soil? What problems can a soil cover develop? What types of weathering occur in each of these environments? What is the importance of the soil in the natural water cycle? How can we relate these situations to the fauna and flora in the soil? How can an unprotected and uncared for soil facilitate the siltation process?

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Water and wind erosion

As mentioned earlier, erosion can reduce crop yields by half and the planet loses 24 billion tons of soil every year (nature needs up to 5,000 years to form 1cm of soil), further intensifying the desertification process.

With this work, it is possible to relate the weathering processes up to the point of erosion, discuss the causal factors and the effects of erosion.

The presence of vegetation on the ground protects it from the action of the sun, rain, and winds, and helps keep the soil fertile and healthy. Instead of running off, the rainwater penetrates more easily and does not remove organic matter.

It also discusses the speed of agricultural productivity and how agriculture and cattle breeding in Brazil have been cared for with the correct methods of soil use and conservation.

It explains how water erosion can be even more damaging on a bare soil, due to the impact of the large rainfall drops and the precipitation energy that breaks up the aggregates with the "splashing" that generates erosion in furrows and even gullies of great depths, when the erosion process is not stopped in time.

In this work, it is possible to discuss factors that cause and effect erosion, as well as to address correct erosion control and combating practices to observe rainwater action on deforested and overgrown soils.

Figure 7-Experiment from Erosion



Photo: The author himself

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Elaboration of the experiment:

Objective: To simulate the process of water and wind erosion, discuss the factors that cause erosion and the types of weathering. Discuss ways to contain erosion and its effects.

Materials: Plastic tray, plastic watering can, water, grass, and plastic tube

Procedure: Collect the soil; Separate 2 different trays; Add the program to one of the trays; First, ask the students to help you blow on the tubes over each of the platforms; finally, add the water with a watering can.

Questions: Why wind erosion is more intense in vegetation cover? How does hydro wind erosion occur? What type of erosion is predominant in the region where you live? How can you protect the soil to keep it healthy and fertile?

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Memory Play: Management and Conservation

For the theoretical structuring of the game, we drew on the lectures of Margarida Pentado for the necessary understanding of the concepts. The result was a game composed of 9 concepts: reforestation, pasture, sub soiling, mulching, burning, fertilization, contour lines, and crop rotation, ending in 18 pairs.

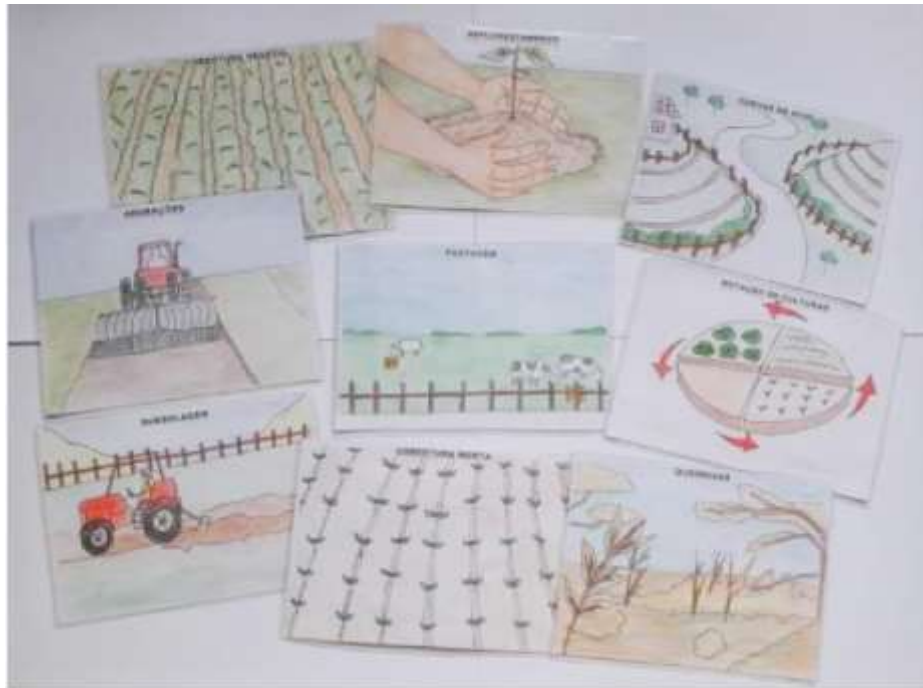
A handmade memory game that allows a better understanding of the main ways to preserve and conserve soils correctly and also a fun and practical interaction in the

classroom. The contents that can be covered are: Reforestation, pastures, sub soiling, vegetative cover, ground cover, burning, fertilization, contour lines, and crop rotation.

The soil can be degraded in several ways, the main ones being: Soil erosion or desertification; Use of inappropriate technologies; Lack of soil water conservation practices; Deforestation.

In order for soil management to take place properly, it is necessary to consider the main physical, chemical, and biological properties.

Figure 8 - Game from memory



Drawing: Mayara Almeida.

Game Development:

Objective: To make the students learn some of the practices and techniques of soil conservation and preservation, correlating them with other subjects that can be discussed.

Materials: A4 paper, scissors, pictures to be used as a base for the drawings, and colored pencils.

Procedures: Encourage students with drawing skills to produce images that the teacher should keep as a basis; Draw on A4 sheets; Try to cut out equal sizes. Use a 15cmx12cm square.

Questions: How can these techniques contribute to the sustainable use of soil elements? How can soil be degraded, besides the process of erosion? What are the consequences of losing a large area of soil for Brazilian agricultural production?

Reforestation

The practice of reforestation restores the natural vegetation of the hillsides, riparian forests and gallery forests. One should comment on the "planting of eucalyptus" in many reforestation campaigns, and explain the risks of planting non-native species. (Fig. 9)

Pastures

In Brazil, according to EMBRAPA, around 95% of the beef is produced in a pasture regime. This technique is used because it provides lower production costs and does not compete with human food. For this practice it is necessary to carry out studies with the use of fertilizers and grass species adapted to the region. (Figure 10)

Subsoiling

Sub soiling is used as a way to combat soil compaction and not specifically erosion. It is considered an expensive technique, because it requires an agricultural machine capable of breaking up the compacted layer of soil. Fertilizer use is recommended, as it favors growth at greater depths and avoids the return of the area. (Figure 11)

Vegetal Cover

The vegetative cover has a very important role in soil protection, as maintaining the vegetative cover is cheap and efficient in combating the erosive process. (Figure 12).

Dead Coverage

This technique is used in the off-season periods, right after the harvest, as a variation of the mulching technique, and also has the objective of protecting the soil from erosive processes. (Figure 13).

Burning:

Unfortunately, the practice of burning is one of the most common in Brazilian agriculture. It kills the organic matter and kills the soil microorganisms that are important for maintaining a healthy and protected soil. In this case, it is necessary to control burning to avoid exposure of large areas of land and a large process of water and wind erosion. (Figure 14)

Fertilization:

Few farmers understand that the fertilization and soil correction technique is important and that it helps to avoid erosion. This technique aims at maintaining and improving soil fertility, understanding that the harvest process implies loss of soil nutrients. (Figure 15)

Contour lines:

The main objective of contour planting is to prevent the accumulation of water on the surface through obstacles to surface water. Respecting the contour lines, it can be done manually or mechanically. (Figure 16)

Crop rotation:

It should be used in areas subject to intensive use. In this technique, either you change the uses or the area is used for a certain period of time (fallow). (Figure 17).

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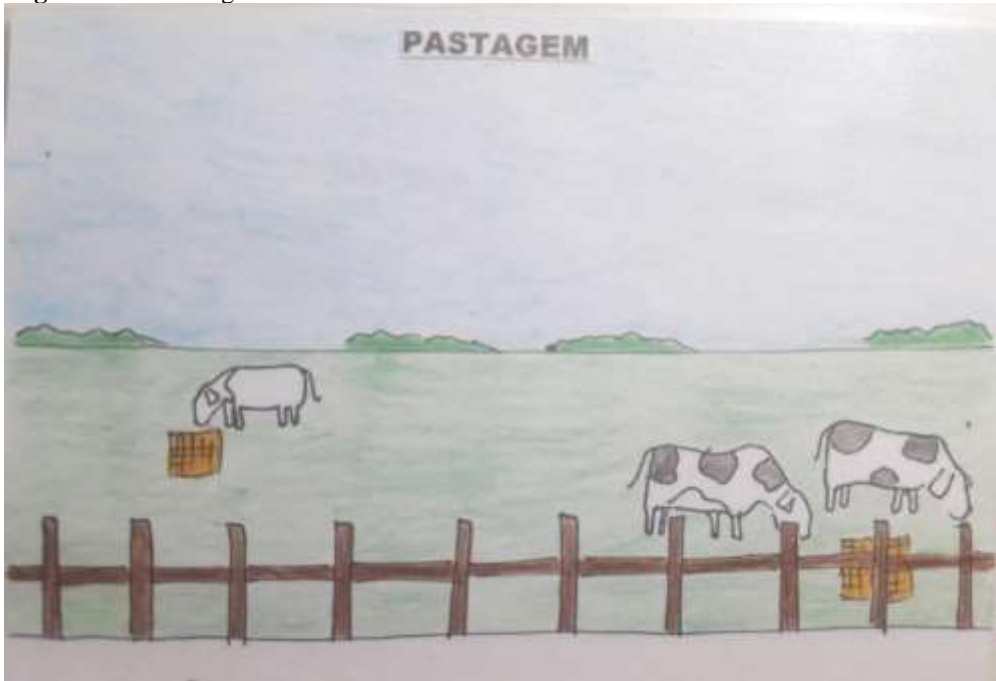
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Figure 9 - Representative drawing of reforestation



Drawing: Mayara Almeida.

Figure 10 - Drawing of Pasture



Drawing: Mayara Almeida.

Figure11 - Drawing of Subsoiling



Drawing: Mayara Almeida.

tive drawing of Vegetal Coverage



Drawing: Mayara Almeida.

Figure13 - Covering Representative Drawing Dead



Drawing: Mayara Almeida.

Figure 14 - Drawing of Burns



Drawing: Mayara Almeida.

Figure 15 - Representative drawing of reforestation



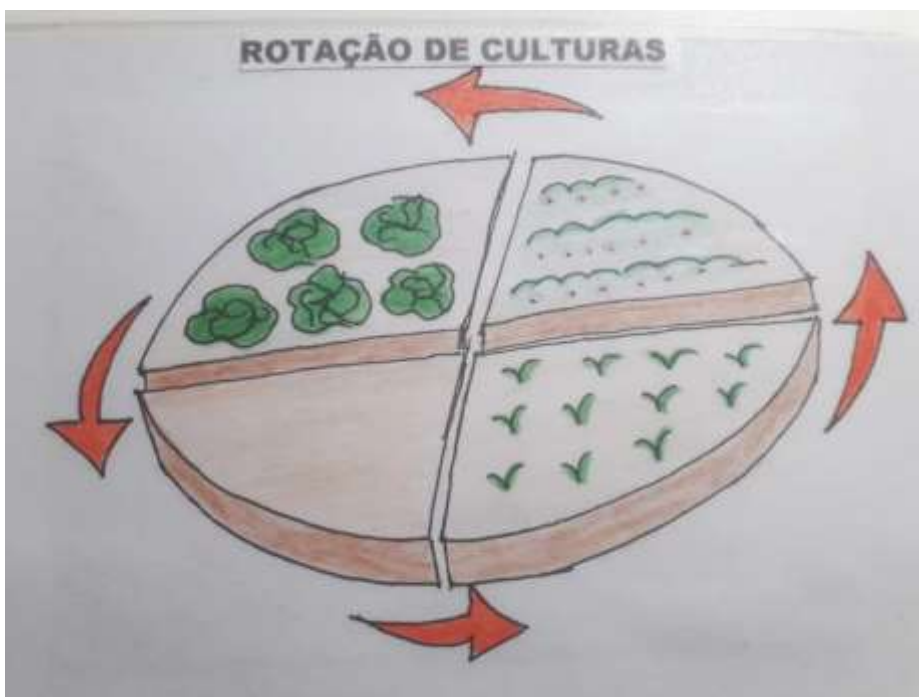
Drawing: Mayara Almeida.

Figure 16 - Representational drawing of the level curves.



Drawing: Mayara Almeida.

Figure 17 - Representational Drawing of Crops



Drawing: Mayara Almeida.

EVALUATION OF THE MATERIAL IN TWO PUBLIC SCHOOLS IN FORTALEZA

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The evaluation was conducted through the use of the prototype of the materials and the application of a questionnaire with the students. The resources were applied in two classes of 8^o year, composed by 25 and the other with 35 students respectively, with a time of 50 minutes for the development of the activity.

The objective of the questionnaire was to verify if the didactic materials fulfill their purpose of helping with the basic concepts of soil. This instrument was adapted from Costa Falcão (2013), was applied at the beginning of the activities and after the activities to analyze the students' performance, and was composed of three open questions: What is soil?

The first school was the E.M.E.F Odilon Braveza, located at Alberto Avenue Craveiro-Castelão, Fortaleza -CE, an 8th grade class with 25 students and 40 minutes for presentation. This school was part of an invitation by the students of Pibid - Geography.

The second school was E.M.E.I.F Waldemar Barroso, located at Street Cônego Lima-Sucupira - Serrinha, Fortaleza-CE, 8th grade class, with 35 students and we had a time of 50 min.

The elementary school students in the mentioned schools belong to an age group between 12 and 16 years old.

Before going to the schools, we tried to contact the teachers of the subject about the contents that were already being covered in the classroom, to make a connection with what was going to be presented. Thus, we considered the contents of soil granulometry and pigments.

When entering into contact with these students, our aim was to analyze the use of paint, based on soil pigments and the Soil Texture Kit. Our team brought along some paintings and the materials, which helped to attract the students' curiosity and attention.

Activity 1: Soil texture kit

We have made an introduction to the content. We talked about the factors of soil deformation, the types of weathering, how erosion occurs. And then the first teaching material was presented.

We explained how to differentiate between silt, clay, and sand through the use of small pesticide bottles and the granulometric label. From this exercise, questions arose that contributed to the development of the class. (Figure 18).

Activity 2: Painting with Soil Pigments

In the second moment, we used the paints made with soil pigments so that we could analyze the intellectual development of the students as authors of their own art.

The activity consists in producing earth paint, from its natural pigments, to be used for painting on canvas or A4 paper. With only water, glue and pigments added in containers, the students had a more relaxed and fun time. (Figure 19)

From the production of paints with soil, it is possible to organize a whole context to talk about the importance of soil and its conservation.

After the activities, it was possible to make some perceptions: The attention of the students increased by perceiving the materials didactic; the first school, one of the students was a Down syndrome sufferer. At the beginning, it was noticed that he didn't have the help of a tutor and there was a distance between him and the other students; In the second school, we also worked with another student with special needs, this one being a carrier of Autistic Spectrum Disorder, being much better received by his classmates; During the earth painting activities, it was noticeable an even greater interaction between all the teams.

Figure 18 - Presentation of the didactic kit



Photo: Naiquiane Nascimento.

Figure19 - Students drawing with the soil pigments



Photo: Naiquiane Nascimento.

It is possible to conclude that the didactic resources facilitate the understanding and conception by the students in a practical and effective way. It increases the self-esteem

of students and teachers because it makes the teaching-learning process more enjoyable and effective. It increases awareness about caring for the soil and the environment, since it contributes to maintaining the relationship between the objects and functions that depend on good soil preservation. It stimulates interest in knowledge from the creativity of the resources demonstrated in the classroom and helps to place man in society and how he should act correctly with environmental resources.

FINAL CONSIDERATIONS

In Geography, teachers can make students get to know the geographic space and allow them to perceive the action of man in its transformation and in the organization of the physical and social space. This comprehensiveness allows them to work with experiments and educational games, making adaptations to the contents they want to work with. Oportunizing the educators to work with the contents of textbooks and enrich with practical activities, allowing reflection on the theme allowing familiarization and contextualization with the theme.

The extension projects of the Laboratory of Geology and Soil Education, entitled "The University and the School: Dialoguing the Environmental Theme" and "The Art of Painting with Earth", were essential for the application of the didactic materials in schools, which, judging by the short time in the classroom, became comprehensive and effective.

The performance of the activities in schools has allowed us to verify that the content and the content passed on in a playful way allow for greater interactions and much more interest from students in learning about soil and everything that the theme involves. The approaches are more practical and efficient, as they are able to interweave several paths in a single material, facilitating the preparation for future contents to be addressed.

For the teacher, there is the stimulus of searching for teaching techniques to improve the students' performance in the classroom and a better absorption of information.

The use of teaching aids leads to greater interaction with students and teachers. The materials are able to stimulate cooperation among students and improve communication. The game can help to break egocentrism and facilitate the understanding of the concepts covered. The other materials help to integrate, through formal and basic knowledge, the issues mentioned with their own reality. The student will be able to make a more attentive observation of society and nature.

Team activities, such as ground painting, were a good example of increased interaction among students and include the participation of students with learning disabilities and those with some kind of impairment. The previous analysis of the students' level of knowledge allows for even more efficiency and effectiveness in the transmission of the contents.

Play and its frequent playfulness act on intellectual, affective, and psychomotor development and contribute to greater sensory conditions. The learning materials allow a better development of the content, better individual development, better interaction with classmates, facilitates the understanding of the content, allows the student to understand the relationship between society and nature and the importance of soil, managing to cover the various contents that are related to the theme.

We hope that, in fact, this research can contribute to the formation of future Geography undergraduate teachers and students, as well as stimulate the need for further work to be developed, with new activities and proposals for active interaction that can achieve a more efficient learning process.

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