

“Soil” in Basic Education in São Paulo, Brazil: strategies for skill development and construction of geoethical values

Hermom Reis Silva¹, Rosely Aparecida Liguori Imbernon², Clara Vasconcelos³

¹Teacher at the State School Prof. Francisco de Paula C. Jr./ Postgraduate Student – Unicamp, Brazil, (h264268@dac.unicamp.br)

² Associate Professor 3, University of São Paulo, School of Arts, Sciences and Humanities, Brazil (imbernon@usp.br)

³ Associate professor, Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Science Teaching Unit (UEC) & Department of Geosciences, Environment and Spatial Planning (DGAOT), Faculty of Sciences (FCUP) (cvascon@fc.up.pt)

Abstract

The study of the soil in formal education, through the planting of vegetables at school and in the community, involves, in general, the implementation of a school garden. The rational use of soil has taught in Basic Education in Brazil, in accordance with the National Common Curricular Base (BNCC), from the 2nd year of elementary school. However, for the development of specific skills that involve the interaction between reflective teaching, sustainability, problem solving, among other themes, there are few school projects that promote interdisciplinary strategies for such purposes. In carrying out this pedagogical action, it was necessary to develop methodologies that would integrate the student into the knowledge construction process, from the perspective of environmental education and geoethics.

The project involves directly basic education students, 1st and 5th years of Elementary School level I, and 6th and 9th years of Elementary School level II, and indirectly with participation of high school students, as monitors, in activities in the garden and vegetable garden of School Prof. Francisco de Paula Conceição Junior, a state public school of São Paulo, Brazil. Based on the Sustainable Development Objective - SDG 15, of the 2030 Agenda, the project developed behavioral changes in students, based on the rational use of land, while developing a teaching methodology in which the student was the protagonist in the learning process. The construction of learning spaces, such as the school's vegetable garden and garden, and the soil laboratory, were strategies in the Interventions adopted in the form of practical, theoretical, and concluding classes.

Keywords: *Hybrid Teaching, Environ-mental Education, Agroecology, Geoethics.*

1. Introduction

The rational use of soil has taught in Basic Education in Brazil, in accordance with the National Common Curricular Base (BNCC), from the 2nd year of elementary school. However, for the development of specific skills that involve the interaction between reflective teaching, sustainability, problem solving, among other themes, there are few school projects that promote interdisciplinary strategies for such purposes. In carrying out this pedagogical action, it was necessary to develop methodologies that would integrate the student into the knowledge construction process, from the perspective of environmental education and geoethics.

The project involves directly basic education students, 1st and 5th years of Elementary School level I, and 6th and 9th years of Elementary School level II, and indirectly with participation of high school students, as monitors, in activities in the garden and vegetable garden of School Prof. Francisco de Paula Conceição Junior, a state public school of São Paulo, Brazil.

Based on the Sustainable Development Objective - SDG 15, of the 2030 Agenda, the project developed behavioral changes in students, based on the rational use of land, while developing a teaching methodology in which the student was the protagonist in the learning process. The construction of learning spaces, such as the school's vegetable garden and garden, and the soil laboratory, were strategies in the Interventions adopted in the form of practical, theoretical, and concluding classes.

Built by the students and the teacher in charge, the garden and garden spaces corroborated the development of practical learning within the scope of sustainable development, such as recycling (maintenance of the compost bin for the production of fertilizers from waste produced at school); inclusion of the community in the project (use of sawdust and wood ash donated by traders around the school to correct the soil together with fertilizer); maintenance and planting of garden and garden spaces; implantation/use of the soil laboratory for the application of geoscientific knowledge; holding events at school about soil/planting; conducting thematic theoretical classes, conversation circles for decision-making, among others. In addition to the soil theme, the inclusion of other themes such as water resources, air quality/pollution, types and production of energy were approached, so that the student could discuss geoethics, in the use of resources of the Earth system, and man as a geological agent.

The development of activities allowed the transversality with other curricular components, the inclusion of local environmental problems, since the proposal is based on the construction of knowledge committed to the conservation, preservation, and rational use of resources, regarding geoeconomics. The spaces built during the project have become pedagogical instruments for the promotion of environmental, social, cultural, scientific, and intellectual knowledge.

2. Strategies

Soil, as a natural resource, is extremely important for human life and other living beings. For terrestrial ecosystems, it is a source of various products and inputs, from feeding terrestrial life, including humans, to the production of medicines, which configures it as a notable divider between social strata. Such a statement imposes intrinsic attention related to the exploration, degradation, use and pollution of the soil, requiring action and responsibility from all.

According to Vicente et al. (2020), "among the different contents related to the area of Natural Sciences in the BNCC curriculum, the approach to soils in textbooks is basically restricted to two moments of Basic School: 3rd and 6th years". In High School, the approach to soil is centred in the 1st year at basic school, and in the Geography textbooks that are distributed in the 2018/2020 by the National Textbook Program (PNLD) "that from a total of 40% to 70% of the total content is destined to these themes, and, in the study on soils, the approach is carried out mostly in a very succinct way and, in some cases, non-existent, as will be detailed later" (Souza et al. 2021).

The strategy initially started with a diagnostic evaluation, using a questionnaire based on environmental indicators on the "soil"; later we held practical and theoretical classes. For the development of this study, qualitative research was adopted as a methodological reference, dealing with the contribution of interventions to promote learning aimed at the target audience (Thiollent, 2011). Therefore, we believe that the conversation circles will provide substantial conditions to rescue and promote intended skills and the resumption of projects at school based on the work developed with students (Martins, 2004).

Thus, the soil theme presents a diversity of approaches that can be directed to ecosystemic, geosystemic and anthropic aspects. In this perspective, it is necessary to promote "the strengthening of pedological studies, seeking to awaken the feeling of sustainability, awareness and, above all, integration of the other elements of nature [...] especially with regard to the soil component" (Ramos & Montino, 2018 p. 76).

For the student to build values and attitudes in relation to the environment that surrounds him, higher order cognitive skills of systemic thinking will be required, the development of which requires the implementation of a holistic approach to the earth system, emphasizing the study of the cyclical pattern of the transformation of matter and energy between the subsystems (Vasconcelos & Orion, 2021 p.5).

The teacher, by also assuming the role of an educator in environmental training, as an intellectual and transforming actor in the context of training for citizenship, involves in this protagonism "taking on active responsibilities by raising serious questions about what they teach" (Giroux, 1997 p. 161).

3. Objectives

This study proposes to develop a program of classes on soil education, with the 2 curriculum references: the National Common Curricular Base (BNCC) and the São Paulo Teaching Curriculum. The target public Students involved in the program: 195 students, aged 8 to 10 years, from the 3rd and 4th years of elementary school at São Paulo public school. The project proposal considered that some themes, when treated in an interdisciplinary way, corroborate for the understanding of local and global problems, such as pollution and soil degradation.

4. Methods

The strategy initially started with a diagnostic evaluation, using a questionnaire based on environmental indicators on the "soil"; later we held practical and theoretical classes. The 120 students answered a questionnaire with four questions to analyze knowledge about the soil:

- question 1 - What is "soil"?
- question 2 - Are there different types of soils?
- question 3 - What do we use the soil for?
- question 4 - What is the importance of soil for life?

The initial diagnosis allowed the teacher to verify whether the students participating in the project had appropriated the contents in previous school years, as defined by the BNCC and the São Paulo Teaching Curriculum.

The action-research, as the conduction method adopted by the teacher/researcher, provided dialogic research, in which interdisciplinarity characterized the interventions, with the project as a transverse generator theme in all disciplines involved.

Applied jointly to action-research, we adopted the conversation wheel as an interventional methodology in the classes. Conducting conversation circles during classes allowed students to expose their ideas, discuss content not yet learned, developing individual and collective protagonism.

The protagonism of the students participating in the project occurred from their speeches, recorded by the researcher/teacher, considering the demands of the interventions defined for each class. The conversation circles allowed developing the construction of autonomy, discourse, critical-reflective thinking, linguistic expressions, and family involvement during the project's implementation period. As Freire (1983) points out:

It is not to say that one is uncompromisingly dialogical; is to experience the dialogue. Being dialogical is not invading, not manipulating, not organizing. To be dialogical is to commit oneself to the constant transformation of reality. This is the reason why, since dialogue is the content of the way of being proper to human existence, it is excluded from any relationship in which some men are transformed into "beings for others" by men who are false "beings for themselves". Freire (1983, p. 43).

In the intervention process in the form of classes, the student is an inseparable part in the construction of knowledge. According to Freire (1996 p. 47), ... *teaching is not transferring knowledge, but creating the possibility for its own production or construction... Thus, the interactions proposed during the study aimed at developing environmental awareness, student autonomy and protagonism.*

5. Discussion

The initial diagnosis is summarized in Table 1. The diagnostic evaluation showed us the lack of knowledge of the students about the soil and the pedogenetic processes, and, mainly, they associated the knowledge about the soil only with the use and anthropic interventions.

The large number of "I don't know" answers indicated the need to assess whether the students actually "did not know" how to respond due to lack of specific knowledge, or whether the students were unable to associate previously learned knowledge with everyday questions.

In this way, we adopted a 3-step class program: Diagnostic evaluation to assess gaps in learning about soils; Practical and theoretical interventions (classes); Concluding evaluation, a post-intervention evaluation to analyze the knowledge learned and the skills and competences developed. This stage lasted for 2 months.

Table 1 Summarized answers related to the questionnaire applied.

	Don't know (n)	Partially know (n)	Know (n)
What is "soil"?	84	Is it the ground we walk on, the earth, or is it used to plant (33)	3
Are there different types of soils?	YES (n) 76	Don't know (n) 13	NO (n) 31
What do we use the soil for?		Partially know (n) 40 (to plant); 5 (to walk on)	Don't know 75
What is the importance of soil for life?	Don't know (n) 87	Recognize the importance of soil on some aspect (n) - To plant (13) - For breathing, planting, and living beings (6) - Clean (de-pollute) the air (8) - To Walk on (4) - To provide food (1) - Several tinks (1)	

We emphasize an important stage, the replicability of the project with other teachers at the school. An intervention as a training teacher of the 3^o e 4^o about soil curriculum component was the strategy adopted for replicating and disseminated the methodologies.



The classes (as interventions) with the students are developed by the science teacher from the 3rd and 4th years of elementary school 1. As activity monitors, students from the 6th and 7th years of elementary school 2 participate together.

Three types of classes were held with interventions: thematic theoretical classes, field classes and laboratory classes. The theoretical classes with students on soil content: pedogenetic processes, rock cycle and source rock, soil profile, environmental impacts due to human intervention (slides, erosion, etc.), preservation of life, multiple uses. several doubts of the students were observed.



The field class's objective to investigate the soil around the school, as an activity of the teacher and student as researchers, learning to differentiate types of soil and their functions.



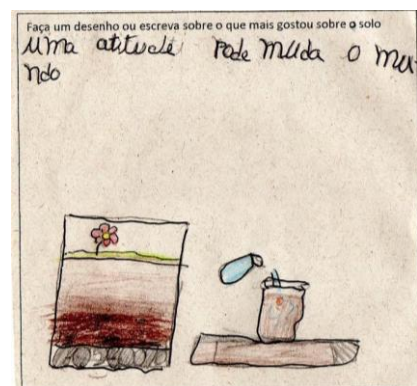
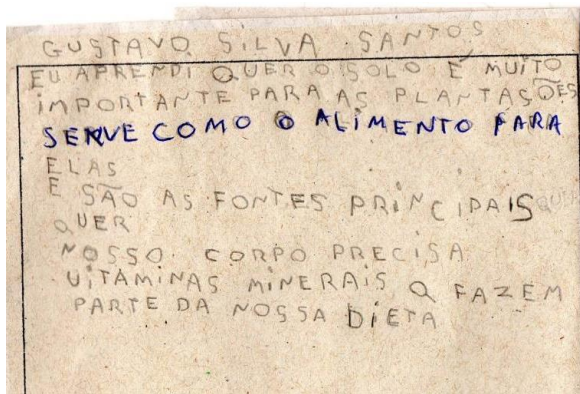
The laboratory classes are based on experiments and samples collected in field classes, when we discuss the evolution of the soil profile from the parent rock to the surface, samples of different types of soil were presented, reflection on the concept of "soil as a finite natural resource", and why preservation is necessary.



The interventions made possible both the development of learning and skills related to the soil theme, as well as the development of students' understanding of geothics and geothical behaviour from the perspective adopted in the classroom.

We observed that some of the concepts questioned in the initial diagnosis were applied by the students in the interventions, which in fact demonstrated that many of the "I don't know" answers could be associated with the student's lack of understanding in correlating the knowledge acquired with everyday life.

This finding became more evident when we applied the concluding evaluation as an individual assessment. The option at this stage was to adopt drawings and free texts so that students could express their knowledge. In this way, the protagonism and autonomy, initially intended, would be maintained at this stage.



6. Conclusions

The results are indicative that although the curricular bases indicate the contents to be developed in the classroom, such as the ground approach, skills and abilities are not consolidated in the students' education, since they are unable to establish a correlation between the knowledge they have learned and everyday life.

The importance of teaching the soil including SDGs from 2030 Agenda-ONU is a possibility when we organize a diversified class program. Therefore, the strategies adopted show us that it is possible to develop skills on preservation and rational use of soil, also of other natural resources.

By promoting reflection on the use and occupation of the soil, and the need for preservation, as it is a finite resource, geothics emerged as a transversal theme in the construction of values and in the development of non-cognitive skills, in the formation of citizens as part of nature, in a systemic relationship.

Acknowledgements: Thanks to the school management of E. E. Francisco de Paula C. Jr, to the school's partner teachers, to the research advisor Rosely Aparecida Liguori Imbernon and Clara Vasconcelos, to the students of the 9th

grade Plantio Monitorado Monitores project, to the 3rd and 4th grade teachers and students' year, finally, to the 6th and 7th year students who effectively contributed to building the knowledge of the target audience.

References

- Freire, P. (1983). *Pedagogia do oprimido*. São Paulo: Paz e Terra.
- Freire, P. (1996). *Pedagogia da Autonomia: Saberes necessários à prática educativa*. São Paulo: Paz e Terra.
- Giroux, H. A. (1997). *Os professores como intelectuais: rumo a uma pedagogia crítica da aprendizagem*. Trad. Daniel Bueno. Porto Alegre: Artes Médicas. 528p. ISBN 85-7307-301-2.
- Martins, H. H. T. de. S. (2004). *Metodologia qualitativa de pesquisa*. *Educação e Pesquisa*. São Paulo, v.30, n.2, p. 289-300, maio/ago. 2004.
- Ramos, M. R., & Montino, M. A. (2018). *Solo in school project: awakening soil awareness, approaching the university of society*. *Revista Extensão*, v.2, n.1, p. 74-82.
- Souza, A. S., Furrier, M., Lavor, L. F. (2021). *Solos nos livros didáticos: contextualização e proposta de mapas didáticos*. *Terræ Didática*, 17: 1-13 e021010. doi: 10.20396/td.v17i0.8663686.
- Thiollent, M. (2011). *Metodologia da Pesquisa-ação*. 18 ed. São Paulo: Cortez.
- Vasconcelos, C., & Orion, N. (2021). Earth Science Education as a Key Component of Education for Sustainability. *Sustainability* 2021, 13, 1316. <https://doi.org/10.3390/su13031316>
- Vicente, M. C., & Bertholoto, D. M. (2020). *O ensino de solos nos anos iniciais do Ensino Fundamental: uma abordagem baseada em livros didáticos de Ciências após aprovação da Base Nacional Comum Curricular*. *Revista Educação Pública*, 20(39). doi: 10.18264/REP.