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FUN GEOGRAPHY- A “BOTTLED” TORNADO - CHECKING CLIMATOLOGY CONCEPTS IN BASIC EDUCATION

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Abstract: The focus of this report is on verifying and deepening the basic concepts of Geographical Climatology in Basic Education, in High School classes, looking at its theoretical foundations and its applicability in contemporary times with students from the Federal Center for Technological Education of Minas Gerais (CEFET-MG), Campus I, and the Colégio Sagrado Coração de Maria, both in Belo Horizonte-MG. Content relating to local, regional and global socio-environmental problems was used, selected and structured - constituting both part of the curriculum and culture - requiring didactic action suited to the integral characteristics of the students and seeking the reworking of historically constructed and culturally arranged knowledge, in a critical view of immediate reality. Using different didactic-pedagogical tools with playfulness (construction of a tornado vortex made from a *PET* bottle; books by Anita Ganeri - *Horrible Geography: Caught in the Climate*, *What a Desert Drought*; *Horrible Knowledge: Bad Weather* -; satellite photographs, climatological/meteorological data and debates, among others), connections were made between everyday life, climate change on the planet and the Sustainable Development Goals (SDGs - Agenda 2030 - UN). The students' previous conceptualizations were verified and, at the end of the work, they were able to assimilate the subjects covered, with play as the driving force behind teaching and learning.

Keywords: Geography Teaching, School Climatology, Agenda 2030 - UN, High School.

INTRODUCTION

The practice was based on the virtue of articulating the study of the topic of climate change in a global and interdisciplinary way, in the disciplines of Geography and Physics in Basic Education, in three 1st year Integrated High School classes at the Federal Center for Technological Education of Minas Gerais (CEFET-MG), Campus I, and one 3rd year class at Colégio Sagrado Coração de Maria, both institutions located in Belo Horizonte-MG. For the former classes, the focus was on introducing basic concepts of school climatology, and for the latter, on reinforcing previously acquired notions.

The teaching work was carried out with a distinctive character in the sense of advancing the training and gnosis of the related students with critical convictions in relation to an increasingly intricate reality.

Faced with this opportunity, the teachers initially planned their work with a keen eye on the curriculum and what should be done in the classroom, with what intentions, mechanisms and methodologies, opting, at an undeniable time of worsening climate conditions in the world, to delve into local, regional and global socio-environmental problems selected with the help of the students and structured jointly with the intermediation of the teachers.

In this way, part of the chosen curriculum was validated as an integral element of culture, requiring, as an induction, didactic action suited to the integral characteristics of the students, seeking to re-elaborate historically constructed and culturally arranged knowledge in a circumspect analysis of the students' immediate existence. There was also the precaution of verifying the information/data collected and identifying its veracity, sources and influences, so that the following debates were marked by teaching and learning that generated new knowledge.

In this way, a balance was made between the planning outlined by the teachers and their aims, the screening of the phenomena being investigated - their circumstances/causes - and the careful use of the students' prior knowledge (through previous diagnostic assessments).

As a result, the teachers have jointly designed their pedagogical actions based on methodologies that place the students at the center of the educational process, not in terms of "speed" and/or superficiality, but in terms of significance, aware that deductions cannot be made without a minimum knowledge base. The multidimensionality and complexity inherent in the distinctive nature of climate change require an equally plural and contextualized framework.

With this prerogative, we have Bergdahl and Langman's (2022) assertions regarding the imposition of new attitudes and concrete actions by collectivities/worlds, because although climate change is one of the most serious adversities facing our planet today, in addition to the accumulation of diligence and scientific facts concentrating on corroborating global warming and the loss of biodiversity, for example, at the present time, there is a latent passivity as a mark of our civilization - notably the Western one.

Bergdahl and Langman quote Greta Tunberg: "*We are now facing an existential crisis - the climate crisis, the ecological crisis - which has never been treated as a crisis before*"¹ (Tunberg, 2019, p. 55 *apud* Bergdahl and Langman, 2022, p. 407). They also point out that pedagogical spaces should encourage young people to respond critically to the hermetic challenges of climate change, as well as to the existential dimensions of the present moment through precise political attitudes in

the here and now.

In line with the understanding of the indivisibility of the local/global scales in the deepening of any Geography themes in the National Curriculum Parameters - Secondary Education (1996) - without being detached from their internal dialectical association, we have, according to Fialho (2014, p. 93), that:

Valuing place makes it possible to question totalizing visions, as well as to value the plurality of discursive power through the play of language where each group can generate, from place, different codes and meanings, in order to understand the connections/mediations between the things of nature and the social objects and actions that are fundamental for a more comprehensive understanding of the world we build and, if we pay attention, also for education.

To do this, we chose to use different didactic-pedagogical tools based on playfulness (building a "vortex" of a tornado made out of a *pet* bottle; curious and interesting books by Anita Ganeri from the collection *Geografia Horrível: Apanhados do Clima* and *Que Seca de Deserto*, from the collection *Saber Horrível: Bad Weather*; satellite photographs, maps, research in numerous media, climatological/meteorological data and debates, among others), making connections between everyday life, climate change on the planet and the Sustainable Development Goals (SDGs²) of the Sustainable Development Agenda 2030 of the United Nations (UN).

In the teaching of Geography, the use of didactic-pedagogical accessories interposed in practices is essential for commendable learning to take place. However, this choice should never be accidental, just as their use does not guarantee immediate learning or unconditionally guarantee it. However, pedagogical opportunities are enhanced when

1. "We are now facing an existential crisis - the climate crisis, the ecological crisis - that has never been treated as a crisis before," (Tunberg, 2019, p. 55 *apud* Bergdahl and Langman, 2022, p. 407).

2. The SDGs, short for the Sustainable Development Goals, are part of the United Nations (UN) 2030 Agenda, a global agreement endorsed at the UN Summit in 2015 and signed by the 193 member countries at that time.

the resources used have a specific connection with the subjects being taught.

With the unhindered intervention of the teacher, students can be encouraged to recognize events linked to a specific tone from these instruments and beyond, exercising more analytical examinations.

What's more, students' momentary curiosity and attention to these devices can turn into real interests, which the teacher should use pedagogically to benefit their learning. Part of this initial motivation, like "a leap of the cat" or "a rabbit in the hat" for the teacher (although it's not magic and has no confirmation of success), refers to the usefulness of pleasure and affectivity combined in educational practices. In this respect, we draw on the thoughts of David Paul Ausubel (1980, 2000), John Dewey (1979) and Jerome Seymour Bruner (1997, 1998, 2001).

At the start of the activities, the students' previous conceptualizations were assessed and, at the end of the work, the refined incorporation of the assertions discussed was seen, with playfulness as the driving force behind teaching and learning, with expressive learning of the conceptions of weather and climate - with the construction of hypotheses in the face of the events researched, meditations that were detailed in the debates.

THE IMPORTANCE OF GEOGRAPHY AND THE CONCEPTS OF CLIMATOLOGY

For Helena Callai (2005, p. 235-238), from the perspective of the discipline of geography: "This is the reading of the world of life, but which is not methodologically exhausted in the characteristics of a living and current geography (...). In this process of learning to read, reading space, there is no rule, no method established a priori (...)":

Pedagogically, therefore, what matters is the establishment and continuous exercise of dialogue - with others (teacher, colleagues, school staff, family, people we live with); with the space (which is not just the stage, but also has life and movement, since it attracts, enables, is accessible to the outside); with nature and with society, which interpenetrate in the production and generation of the configuration of space. (...) What the landscape shows is the result of what happened there. The materialization of what happened makes what happened visible, perceptible. The dynamic nature of social relations and man's relationship with nature unleashes a play of forces, the results of which are concrete and visible. Describing and analyzing these landscapes therefore means seeking the explanations that such a "portrait" allows us.

Research-based teaching was chosen because, with the help of research, students will acquire skills and strengthen abilities that will promote transpositions in the face of their knowledge, creating their own in correspondence with their peers, witnessing their development and appropriation as a social entity in a given historical period.

Adding to this argument, John Dewey (1979, p. 166) announces the role of reflection in experience:

Thinking is the careful and deliberate act of establishing relationships between what you do and its consequences. (...) Existing links become apparent in the form of relationships. The stimulus of the act of thinking appears when we want to determine the significance of an act that has been done or is about to be done. Through thinking we foresee the consequences. This implies that the situation as it is, both in itself and for us, is incomplete and therefore indeterminate. In order to perfect this hypothesis, the existing conditions and the content of the hypothesis adopted must be carefully analyzed - an act called reasoning.

We therefore need to imagine teaching-learning strategies in which we can see

the relevance of the content that has been perfected with its pertinent cultural aspects and the students' autobiographies (Bruner, 1997, 1998, 2001), carefully chosen in the curriculum, raising cognitive demands for renewal accompanied by the intellectual tidying up that has already taken place.

Ausubel's Significant Learning theory (1980, 2000), as well as Joseph Novak's (1981, 1999) concept mapping, substantially helped to show that the climatological definitions that were verified were reached more easily when they were linked to the students' know-how and their usual lives.

This theoretical and methodological precedent was listed as a possibility for a stimulating and effective teaching practice in the understanding of climatological and geographical events, since it explains how individuals create meanings and, in this way, outlines possible paths that facilitate meaningful student learning.

Learning in this environment is concatenated with the inclusion of procreations on the part of the students in order to second their applicability, i.e. their realization in numerous conjunctions. Ausubel corroborates this understanding of the students' prior knowledge, since it enables new mental orderings thanks to representative maps which, in turn, ensure other structuring of thoughts, establishing satisfactory and meaningful learning; proven in this exhibition.

METHODOLOGY

The following steps were followed for this praxis:

- Diagnostic assessment of classes on climatological and related concepts;
- Analysis of diagnostic results;
- Bibliographical research on the topics covered in this study (theoretical references, teaching resources, methodologies, etc.);

- Joint planning and its dismemberments;
- Talking to the students and choosing the participating classes;
- First contextualization of the physical/socio-environmental factors and the history of the occupation of the urban site of Belo Horizonte-MG and the constitution of the Metropolitan Region of Belo Horizonte - RMBH itself (with the support of aerial photographs, the *Google Earth* application, maps...), in an integrative vision (historical, economic, political, cultural aspects...);
- Division of groups to research climate issues and their consequences in the municipality of Belo Horizonte-MG and the RMBH (depending on where each student lives), in order to understand their spatialities, causes, and possible solutions to the problems found;
- Provision of complementary materials for the students and access to the recommended books (*Horrible Geography: Caught in the Climate and What a Desert Drought*; *Horrible Knowledge: Bad Weather* - by Anita Ganeri) with the definition of the deadline for shared readings of the passages marked;
- Some of the phenomena/events correlated and investigated by the groups: rainfall (distribution, rates, floods); risk areas and landslides, irregular occupation of the urban site and slope, precarious housing and socioeconomic exclusion of part of the urban population, urban quality of life (IQVU); heat islands, atmospheric pollution and air quality in the urban environment, diseases linked to high temperatures, poor atmospheric air and water quality, groups most susceptible to these diseases and at what times of year they occur; loss of vegetation cover, "invisibility" of urban rivers and occupation

of river valleys; atmospheric circulation and interference from urban densification and verticalization;

- Comparison of what was investigated with similar events in other urban areas of the country and the geographical/socio-environmental factors that intervened in the spatialities outlined in these events (examples: figures 1, 2 and 3);

The students built a vortex representing a cyclone³ using *pet* bottles in the physics laboratory, with the assistance of the physics teacher (figures 4, 5 and 6);

48 patients a day are hospitalized for respiratory diseases in Belo Horizonte

Requests for hospitalizations for respiratory diseases reached the highest rate of the year in July

By Isabela Abalen Published on August 9, 2023 | 00h46

Figure 3 - News about respiratory diseases in BH-MG (July)

Source: <https://www.otempo.com.br/cidades/por-dia-48-pacientes-sao-internados-por-doenças-respiratorias-em-bh-1.3139781>.



CLIMATE CRISIS: SEVERE DROUGHT IN THE AMAZON IS AGGRAVATED BY DEFORESTATION AND FIRE

16 outubro 2023

Figure 1 - News about drought in the Amazon

Source: <https://www.wwf.org.br/?87003/Crise-climatica-seca-severa-na-Amazonia-e-agravada-por-desmatamento-e-fogo>

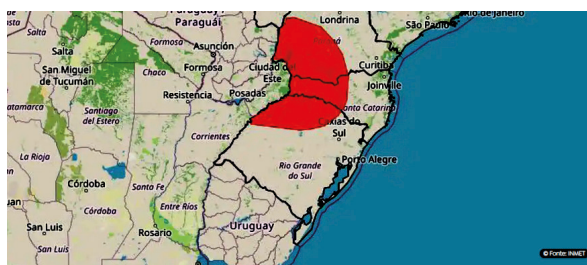


Figure 4 - Drilling the lids with a 9 mm drill bit

Source: Authors' collection.

Cold front and extratropical cyclone increase risk of storms in the South

Inmet warns that rainfall in the region could exceed 100 mm per day

Figure 2 - News about an extratropical cyclone in the south of the country

Source: <https://agenciabrasil.ebc.com.br/geral/noticia/2023-11/frente-fria-e-ciclone-extratropical-elevam-risco-de-tempestades-no-sul>



Figure 5 - Visible vortex

Source: Authors' collection.

3. The two *pet* bottle tops used to make the cyclone “vortex” were glued together with epoxy putty and drilled after they had fully “cured” (24 hours), and prepared by the students beforehand. The drilling was done by the teachers, i.e. the adults.

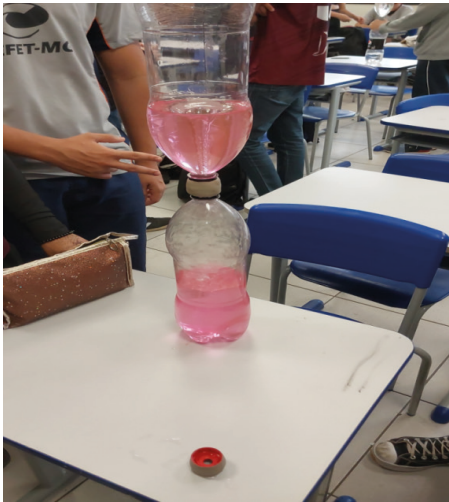


Figure 6- Visible vortex with added aniline

Source: Authors' collection.

- Round table based on the reading of books from the collections Geografia Horrível and Saber Horrível, and their parallels with practiced studies;
- Discussions with the presentation of some of the material researched/ conducted by the groups (tables, graphs, maps, satellite photographs...) - varying from class to class -; further discussion of the points made;
- The students' observation of the qualitative learning achieved through the development of research and dialogues in the classroom; linking the collection of data/research (for a period of at least 30 years) and daily observations with the methodological principles of Geography (analogy, connection, extension, causality, activity) and its categories (place, region, landscape, geographical space, territory), and the students' ability to carry out the investigation of climatological episodes - fulfilling conjectures, illusions and projections;
- Activity evaluations.

RESULTS AND CONCLUSIONS

The activities reinvigorated the mastery of climate teaching. The planning, tools and didactic-pedagogical methodologies have given rise to the accuracy of the value of the agnition of abstractions, of sharing, of the perception and readings that the students formalize of the lived space that they experience on a daily basis.

The interpretation of the world begins with the intercommunication in front of landscapes and the absorption of place, initially in an empiricist format; later, in the classroom, with the action of teachers towards systematized school knowledge, but always having as a prelude the life history of each one and the bases with which they support their elucidations, adding and reworking these axioms continuously through experiences.

The teacher-educator's performance in the classroom, always with the determination to teach appropriately, moves dialectically between his didactic-pedagogical attributions, his desires, the ends of his daily exercises and the bonds built with his students, aiming to intensify learning through the students' mastery of reasoning.

On the other hand, and no less importantly, it aims to create an arbitrated path that is always procedural and incomplete, so that the students, through the conceptual conceptions acquired, can analytically grasp the reality that is close to them. Teaching implies the dynamic of carefully weighing up educational processes of a reflective nature so that they culminate in the self-determination of students as thinking beings, on the part of the teacher.

It's not enough for students to have a range of knowledge if they don't have the skills to use it to "unveil" the world around them. This is why excellent education is so revolutionary and threatens the stability of the established and institutionalized conventions and/or dictates of civilizational systems.

Climate change education encompasses different fields of knowledge due to its degree of complexity. These different areas complement and enrich each other (Applied Human and Social Sciences, Languages and their Technologies, Mathematics and its Technologies, Natural Sciences and their Technologies). When we diligently provide teaching and learning strategies that promote the completion of foundational thinking, preferably what is desirable, they should be interdisciplinary in nature; which, unfortunately, does not always happen due to a number of variables that are sometimes beyond our control. In this arrangement, the subjects have been enhanced between the disciplines of Geography and Physics.

Climate issues should not be addressed solely by taking the locality as a focus; it is the starting point for reaching the global level and making balanced generalizations. The concepts, the various teaching aids and the methodologies used enhance the teaching-learning process, providing a better understanding of what has been recommended.

We are heading towards a new paradigm in education - complex thinking - in which the:

awareness of multidimensionality leads us to the idea that any one-dimensional vision

is poor. (...) In another sense, awareness of complexity makes us understand that we can never escape uncertainty and that we can never have total thought: totality is non-truth. (Morin, 2005, p. 69)

Thus, within this horizon, we realize that “we are capable of thinking in these dramatic conditions” (Morin, 2005, p. 69). This can lead us to action, which “is also a challenge. (...) In the notion of challenge there is an awareness of risk and uncertainty”. Thus, according to Morin (2005, p. 79, emphasis added):

Action is strategy. The word strategy does not refer to a predetermined program that you simply apply *ne variatur* over time. Starting from an initial decision, strategy makes it possible to foresee a number of scenarios for the action, scenarios that can be modified according to the information that will arrive during the course of the action and according to the chance events that will occur and disrupt the action.(...) Action presupposes complexity, that is, chance, the unforeseen, initiative, decision, awareness of drifts and transformations.

In the educational panorama, in the classroom, the introjection of complex thinking by teachers and students results in autonomy combined with awareness, a fact that can be seen in this assertion.

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