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Didactic Sequence oriented towards actions in the anthropocene: Investigating floods around a public school

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ABSTRACT

This work aims to present a process of developing an educational action mobilized by a didactic sequence (DS) on urgent environmental issues, guided by recent discussions referring to the Anthropocene and identified by elementary school students. In this sense, an Actor-Network Theory study is presented, which analyzes socio-material practices that emerge from activities dedicated to observing the causes and consequences of floods that occur around the school. In one of the stages of the didactic sequence, students write documents that demand action from public authorities to resolve the problem studied by the class. In an analysis of these documents, three realities can be identified. In the first reality, the problem situation experienced by the students is articulated in a more localized performance. In the second, students' performances of action and political awareness are analyzed. In the third reality, the problem transcends the local level, with global repercussions related to human action on the planet. Therefore, it could be concluded that there is potential in the development of Didactic Sequences as could be seen above, with possibilities to promote political protagonism among students.

KEYWORDS: Anthropocene; Didactic Sequence; Actor-Network Theory; Science Education.

Sequência didática orientada para ações no antropoceno: investigando inundações no entorno de uma escola pública

RESUMO

Este trabalho tem o objetivo de apresentar um processo de desenvolvimento de uma ação educacional mobilizada por uma sequência didática (SD) sobre questões ambientais urgentes, orientadas pelas recentes discussões que se referem ao Antropoceno e identificadas por alunos do Ensino Fundamental. Neste sentido, é apresentado um estudo do tipo Teoria Ator-Rede que analisa práticas sociomateriais que emergem a partir de atividades que se dedicam à observação das causas e consequências das inundações que acontecem no entorno da escola. Em uma das etapas da sequência didática, os estudantes escrevem documentos que reivindicam a ação do poder público para a resolução do problema estudado pela turma. Em uma análise desses documentos, podem ser identificadas três realidades. Na primeira realidade, a situação-problema vivenciada pelos estudantes é articulada numa performance mais localizada. Na segunda, emergem performances de ação e esclarecimento político dos aprendizes. E na terceira realidade, o problema extravasa o local, repercutindo globalmente e relacionando-se com a ação humana no planeta. Concluímos assim que há potencialidades no desenvolvimento de Sequências Didáticas tal como a elaborada, com possibilidades de promover um protagonismo político dos aprendizes.

PALAVRAS-CHAVE: Antropoceno; Sequência Didática; Teoria Ator-Rede; Ensino de Ciências.

INTRODUCTION

For part of the academic community, the interference of human action on the planet is heralding a new geological era: The Anthropocene (anthropos for "human," cene for "new") (Artaxo, 2014). This new era could replace the Holocene. Although there is no consensus among geologists, for Latour (2020a, p. 183), the term is of particular interest because it allows us to designate the time when "the Earth is becoming sensitive to our actions and we, humans, are becoming somewhat geological."

Living in the Anthropocene means witnessing tragic events that demonstrate that the Earth has been resisting and, inevitably, reacting to the predatory actions of the human species. With the emergence of extreme weather events, various human populations, specifically marginalized and vulnerable ones, are impacted and forced to abandon their territories, or dedicate themselves to an existence of suffering and deprivation (Latour, 2020b). Furthermore, it should be highlight that, due to environmental degradation related to deforestation, we are increasingly subject to events similar to the catastrophic pandemic caused by the SarsCoV-2 virus, which, since its emergence at the end of 2019, has promoted intense social, cultural, and economic changes worldwide. For months, due to a biological entity that spread from caves full of bats in the Chinese territory, we were isolated in our homes, subject to controls and attentive to infection and immunization rates, and often losing close people due to a serious respiratory infection.

In this sense, we advocate for the need to address socio-environmental problems in Science and Biology classes as a way to create opportunities for students to better understand issues related to the exploitation and degradation of the environment, especially when they involve situations in their localities. However, more than just promoting understanding of environmental problems, it is expected that actions will mobilize the political participation of students. According to Coutinho et al., (2016a, p. 381), the school can be a privileged environment for the promotion of democratic political actions, as the school environment contributes to the "formation of citizens capable of identifying problems, perceiving themselves and acting as managers of society, being guided by democratic values".

Based on these concepts, the research presented here was developed. To this end, we dedicated ourselves to thinking about a situation that affects the community of a school located in a medium-sized city in the state of Minas Gerais, Brazil. This community is affected by floods that compromise the lives of inhabitants and highlight the problems associated with the disordered and/or unplanned occupation of territories and works carried out without considering future implications for water management (Figure 1). The possible impacts of climate change on the rainfall cycle in the region are also evidenced.

Figure 1

Records of flooding events on the street of the school

Source: The authors (2023).

In this sense, the present work aims to understand how those involved in the study are impacted by floods, inundations, and other water-related events, integrated into their realities. To this end, we developed a Didactic Sequence aimed at mapping the socio-material networks that emerge in the mobilization of students' knowledge about the problems caused by floods affecting their localities and identifying the realities that emerge when students participate in educational actions of claims related to these problems.

THEORETICAL CONTRIBUTIONS

The Actor-Network Theory (ANT), a fundamental theoretical framework for this research, proposes an innovative analytical perspective by breaking with the modern dichotomy between human beings and the rest of nature. With the deepening of Anthropocene studies, it becomes clear that it is impossible to dissociate the action of humans from other agents that inhabit the Earth.

In “We Have Never Been Modern,” a work by Bruno Latour (1994), the author denounces the failure of the contract of modernity, of the “Modern Constitution” which, with its guarantees, intended to divide the world into Culture/Nature.

Figure 2

Representation of the Modern Constitution guarantees

Nature pole / Nature conceived in a laboratory. Immanent 1st guarantee. Nature is ready and waiting to be discovered. Transcendent Society pole / unconstructed society. Transcendent 2nd guarantee: Society as built by us. Immanent 3rd guarantee: Nature and culture poles never mix.

Source: Adapted from Latour (1994) by the authors

Figure 2 represents the three guarantees postulated by the modern constitution: at the Nature pole, even though we are the ones who built it, it exists as if we had not produced it. At the Culture pole, we did not build society, but it exists as if we had built it. And the Nature and Society poles never mix. However, according to Latour (1994), the moderns broke down because:

> Perhaps the modern framework could have maintained itself for some time longer had its own development not created a short circuit between nature, on the one hand, and the human masses, on the other. While nature remained distant and dominated, it still vaguely resembled the constitutional pole of tradition. It seemed reserved, transcendental, inexhaustible, distant. But how to classify the ozone hole and global warming? Where to place these hybrids? Are they human? Yes, because they are our work. Are they natural? Yes, because they were not made by us. Are they local or global? Both. [...] Therefore, both from the side of nature and from the side of the social, we can no longer recognize the two constitutional guarantees of moderns: the universal laws of things, the imprescriptible rights of subjects [...] (Latour, 1994, p. 54).

The critique of this dichotomy present in the thinking/doing of moderns and the attribution of a supremacy of humans in relation to nonhumans in sociological and educational research, denying them agency and interference over us, were paramount for the formulation of the theoretical-methodological foundation of ANT (Sayes, 2014).

This theory emerged in the 1980s and was initially conceived from studies in Science and Technology. Methodologically, it began to stand out with the works of Bruno Latour and Steve Woolgar (1997) when they dedicated themselves to the ethnographic process of a research laboratory. It draws on the ontology of Alfred Whitehead and the post-structuralist thought of names such as Foucault, Deleuze and Guattari, Michel Serres, Garfinkel and Gabriel Tarde (Lemos, 2013). The works of Michel Serres were of great importance to ANT due to the incorporation of the concept of "Translation", considered by many to be the heart of the theory (Freire, 2006). For Serres, translation is a process of building connection, through mediation and communication; it is opening passages, modifying and transforming the actors.

For ANT, the "social" is not given a priori and is not stable. ANT distances itself significantly from classical sociology by questioning the existence of a

"society." Instead of adopting broad social categories as a starting point to justify a given scenario, the theory reformulates sociological practice (Arruda et al., 2025). Its focus lies in following and mapping the associations and connections formed between the various actors, whether human or nonhuman. When we insist on the essence of structures and agents, we lose the formation of groups that emerge from the networked associations of different entities, and therefore, we lose the possibility of understanding how these associations influence, modify, or act in the world. The "social" in ANT is a peculiar movement of aggregation of different actors, which needs to be explained, and is not the pre-existing explanation.

The term "actant" is used by the theory to refer to everything that acts (Latour, 2012), referring to both people and machines, artifacts, things, and any other objects within the network. When actants associate in networks, differences arise from the effects of the actions that some perform on others. The concept of "network," very important in ANT, from the Latour's perspective (2012), is based on interactions between actants that continuously transform each other. For Lemos (2013, p. 53), "it is the space-time itself [...], the network is the associative movement that forms the social".

Also noteworthy for the theory is the importance of the concept of symmetry, developed in the Strong Programme in Sociology of Knowledge, coordinated by David Bloor, which explores both the principles that produce the so-called "true" knowledge and those that are named as "beliefs". However, ANT would broaden this concept of symmetry, encompassing other nonhuman entities and breaking with stabilized poles of Nature and Culture. Latour (2020a) emphasizes that the Anthropocene may be the ideal moment to dissolve the separation of these two poles and to reconcile ourselves in a larger system of union between both, since it is impossible to disconnect the associations of human and nonhuman actions in climate change, these being a product of the hybridization of such associations.

From this perspective, we argue that the study of the environment in which we live can mobilize us to perceive problems that go beyond social issues and are related to the interaction of different entities. In this way, we consider that environmental issues and the associations that coexist in the world should be discussed in the school environment, in order to awaken a more critical view among students about the current situation of the planet. Therefore, it is necessary to think about new practices for science education, because, according to Faria and Coutinho (2015, p. 136), it can be “challenging to find discussions about the use of new instruments and tools to present technical-scientific issues in a comprehensive way that facilitates participation and decision-making by citizens”.

And it is indeed a challenge, after all, in the school environment, science education is still supported by modern thinking that separates objects from subjects and refuses to extend agency to nonhuman entities (Branquinho & Santos, 2007). Branquinho and Santos (2007) elucidate that extending agency to nonhumans is to promote a more democratic and political education. For Viana et al. (2020), the school should be a democratic space, not just a place for the transmission of concepts, but an environment where students are encouraged to

develop scientific and technological literacy, understanding the world in which they live and making more informed decisions about issues that impact society.

Coutinho et al. (2016a) also emphasize the importance of political action in science education by arguing that the school can be a place of mobilization and knowledge construction, allowing students the opportunity to participate in collective actions and controversial issues that are of interest to them and that affect them. And being affected or allowing oneself to be affected is essential for understanding learning from the ANT perspective. Affectation allows bodies to articulate with the world, expanding their articulations (Melo, 2011).

Gama and Allain (2025) emphasize that interactions mediated by articulated propositions in the school environment create a fertile environment for affectation movements, with the potential to transform realities. For the authors, it is important to note that these processes do not follow a linear path. They develop amidst controversies that, when properly tracked, offer the opportunity to reframe the social and propel us to develop the capacity to be affected.

For Latour (2004), the more connections and mediations a body establishes with the world, the more articulate and sensitized it becomes, and thus, it learns. In this way, the learning process must relate to the effects of human and nonhuman collectives in a sociomaterial network (Silva & Pretto, 2021).

Furthermore, ANT allows us to understand how different realities emerge from the arrangements and negotiations between the actors in associations. That is, distancing themselves from an essentialist understanding, Latourian scholars identify that realities do not precede practices (the set of everyday relations), but are shaped by them. These realities are multiple and random (Law, 2012). Mol (2008) states that, despite being multiple, realities are interrelated. In one example, the researcher states:

> This multiplicity does not arise in the form of pluralism. It is not as if there were separate entities, each in its corner of a homogeneous field […]; therefore, anemia is multiple, but it is not plural. The various anemias performed in medicine have many relationships with each other. They are not simply in opposition to each other, or outside of each other. Each can succeed another, appear in place of another and – perhaps the most surprising image – include the other. This means that what is 'other' is also inside. Alternative realities do not simply coexist side by side, but are also found within each other (Mol, 2008, p. 18).

In the process of developing this research, following the actants in socio-material networks, we realized that different realities emerged in the construction of knowledge about the problem of floods, which is what we will present in this work.

METHODOLOGICAL PROCEDURES

One of the methodological steps of this research was the development of a Didactic Sequence (DS) with approximately 50 students aged 12 and 13 years from the 7th grade of Elementary School of a state public school in the municipality of São João del-Rei, MG. The first author is a tenured teacher and teaches Science at this school.

A didactic sequence is an ordered set of structured activities, with a beginning and an end, aimed at an educational purpose (Zabala, 1998). The production of a sequence is based on organizing a set of lessons following didactic-pedagogical objectives, which are ordered at different levels of complexity. Zabala (1998) presents four suggestions for DS models, starting from a simpler one, with fewer steps and more teacher-centered, to a final one that is more elaborate and engaged in a more comprehensive education of students.

According to Coutinho et al. (2016c, p.9), DS can operate as transition points, allowing teachers to "feel stimulated and guided to open their classes to contradiction and to the different realities that are presented to us daily". In this sense, DS can also be used as tools for science education, enabling students to engage and participate in political issues that address risks and uncertainties, since it is at school that one begins to build democratic skills and commitments (Coutinho et al., 2016a).

Regarding scientific controversy, the theme raised here by this DS aligns with the proposal of Coutinho et al. (2016b, p.191) "[…]; the Anthropocene theme is promising for the development of teaching sequences, as it encompasses various scientific contents, as well as economic, social, political and historical ones". Zordan et al. (2025) propose that DS allows a dialogical approach when working on socially important themes that directly or indirectly affect the daily lives of students. By problematizing the social situations of students, DS can promote collective learning, integrating scientific knowledge with the students' reality. In this sense, the theme brings to light a network of associations between heterogeneous actors, which can be closely investigated from the contributions of ANT, with the objective of mapping the processes of knowledge production in a world that suffers from urgent climate issues.

For the development of the DS, we contextualized the content with what the class had normally been learning in the school curriculum. Thus, the classes did not suffer academic losses, since the teaching content is in accordance with the recommendations of the Reference Curriculum of the State of Minas Gerais, contained in the Skills (EF07CI08): Evaluate how the impacts caused by natural disasters or changes in the physical, biological or social components of an ecosystem affect populations, which may threaten or cause the extinction of species, alteration of habits, migration, etc. (EF07CI42MG) Analyze soil permeability and the consequences of its alteration in different environments.

The table below shows the number of classes in each DS stage, along with the titles and activities carried out:

Table 1

Didactic Sequence Stages

Moments/number of classes	Title	Didactic Sequence Activities	Objects of non-human mobilized knowledge
Previous phase: (February and March)	"Becoming sensitive to the environment."	Presentation of the research, terms of participation, and guidance for the preliminary phase.	Rain; Smartphone; WhatsApp; Student
First Moment: (1 class)	"Identifying a problem situation caused by rainfall and proposing solutions"	Lesson to identify the problem situation, presenting the records submitted by the students.	Rainfall; Floods; Videos; Photos; Video projector; Student; Memories
Second Moment: (1 class)	"Composing theoretical-conceptual frameworks"	Lecture on the topic and concepts that will be covered during the research.	Water; Video projector; Students; Notebook; Concepts; Anthropocene; Television news
Third Moment: (1 class)	"Extending the place"	Class focused on contextualizing and materializing the problem.	Video projector; Floods; Students; Notebook; News reports; Climate change
Fourth Moment: (1 class)	"Division into groups and search for information"	Division into groups, with a search for sources of information and answers to the problem.	Students; Rain; Internet; Websites; News reports; Floods; Computer lab; Computers; Chairs; Curtains
Fifth Moment: (2 classes)	"Drafting conclusions"	Presentation, by the students, of the conclusions reached	Students; Video projector; Anthropocene;

Moments/number of classes	Title	Didactic Sequence Activities	Objects of non-human mobilized knowledge
		regarding the problem.	News reports; Rainfall; Floods; Principal; Memories
Sixth Moment: (1 class)	"Generalization of conclusions and synthesis"	Class involving analysis of student presentations and generalization of conclusions.	Video projector; Article; Anthropocene
Seventh Moment: (1 class)	"Forwarding a political action"	Producing a text based on the conclusions reached.	Students; Letters; Rainfall; Floods; Politicians; Infrastructure projects; Anthropocene; Memories

Source: The authors (2026).

The entire development of the DS stages was recorded, in audio and/or video, along with a field notebook and through participant observation in classroom activities.

Participant observation, according to Gil (2008, p. 103), can be "natural, when the observer belongs to the same community or group that is investigating the problem; and artificial, when the observer integrates into the group with the objective of carrying out an investigation". In this sense, the participant observation in this research is "natural", since the teacher-researcher is a member of the group under study, participates in situations, but without allowing the other participants to perceive her position and opinions.

We emphasize that, for this research, we will only present data referring to the seventh moment of DS, from which we develop a sociomaterial network with the students' reports present in documents. In these reports, the associations resulting from the mediations between the different objects of knowledge mobilized during the different moments provided by the DS emerged.

At this stage, students were asked to propose a political action (Coutinho et al., 2016a), since being situated in these realities of rainfall and flooding compromises us, humans (Latour, 2020a), and it is up to us to react to the actions of Gaia. As suggested by the school principal, we chose to mobilize the students to address political authorities of the city. Thus, each student wrote a short text, in letter format, explaining the knowledge acquired, their conclusions, and their positions.

The main mediating actors who performed in the five student letters were grouped into tables and exported to the Gephi, a network analysis software. The associations between them were expressed by graphs, in which the nodes are sets of points, connected by lines, called edges. To organize the network, the Force Atlas 2 algorithm was used because, according to Recuero (2017), it distributes the nodes with the highest number of connections in the center of the network, leaving the less connected ones to their surroundings. To highlight the groupings, Modularity statistic was applied, which highlights the main groups formed in the network with different colors. To adapt to the software, some terms were merged, in a technical way, without altering their meaning.

The process of choosing and developing the DS with participants was based on ethical guidelines, with the approval of the project No. CAAE53876521.9.0000.5151, by the Research Ethics Committee Involving Human Beings - Educational Units of São João del-Rei (CEPSJ).

"FORWARDING TOWARDS A POLITICAL ACTION"

In this section, we present a discussion of data related to the seventh stage of the DS development, analyzing the documents written by the students and the translations evidenced between the different actants in these reports.

The five letters that were sent to the authorities are transcribed below for further analysis:

> **Letter from G. J. G**
> *São João del-Rei, June 9, 2022*
> *Dear Mayor,*
> *I hope this letter finds you well.*
> *There are many cases of flooding in our city. I know that the blame, in part, may be ours, for the garbage we throw and clog the drains, but could you put more drains in the city? And inspect the houses on the banks of the rivers? I, for example, have already experienced floods and it's very bad. I lost everything! Even my cockatiel died. I think that more drains are needed and raise awareness among people not to throw garbage in the drains and to throw it in adequate trash cans, so as not to cause flooding.*
> *Sincerely,*
> *G. J. G*

> **Letter from S. A. F**.
> *São João del-Rei, June 9, 2022*
> *Dear Mayor Nivaldo José de Andrade,*
> *I am requesting information regarding the lack of infrastructure and investment on the Luiz Giarola Avenue (the avenue where the school is located), as the school suffers constant flooding due to rains.*
> *The installation of storm drains and manholes to facilitate water drainage would greatly help the school stop experiencing these financial difficulties and material losses. Replanting trees would also be excellent.*
> *Humanity is going through the Anthropocene and a sixth mass extinction could occur, so a water drainage plan is very important to prevent further damage to our city.*
> *Dear Mayor, can I count on you to change this situation? Thank you in advance for your understanding.*
> *Sincerely,*
> *S. A. F.*
> *(Student at Brighenti Cesare State School)*

> **Letter from N. M.**
> *São João del-Rei, June 10, 2022*

Dear Mayor of São João del-Rei
I would like to report the vulnerability of my school in relation to rains and floods. I have studied at the Brighenti Cesare State School since I was 6 years old, that is, since 2015, and during these seven years, I have witnessed my school being a victim of heavy rains several times. Lights went out, we were trapped in the classroom waiting for our parents. Parents had to carry their children in their arms, trying to prevent them from getting wet in the contaminated water. Many of us, including myself, had nightmares about the rains for days. All this chaos is due to heavy rains, lack of concern for the drainage system, and the unfulfilled promises to solve these serious problems.
The responsibility of councilors, mayors, and government officials, is to prevent this type of situation from occurring, especially in public schools, where children and adolescents, who do not always have favorable financial conditions, study in pursuit of education.
A safe place to study is the right of students, and of all those who seek education.
Sincerely,
N. M.

Letter from R. M. S.
São João del-Rei, June 9, 2022
Dear Councilor Weriton José Andrade,
We, students of the Brighenti Cesare State School, have some complaints and suggestions to improve the Luiz Giarola Street.
During rainy periods, due to a lack of adequate drainage systems, our street always floods, causing water to enter our school. In addition to affecting residents, it makes it impossible for us to go to school.
We request the installation of adequate drainage systems and the inspection of nearby works, which cause a lack of places for water absorption in the soil.
We hope you will do a good job and resolve these problems before the rainy season returns.
Sincerely,
R. M. S

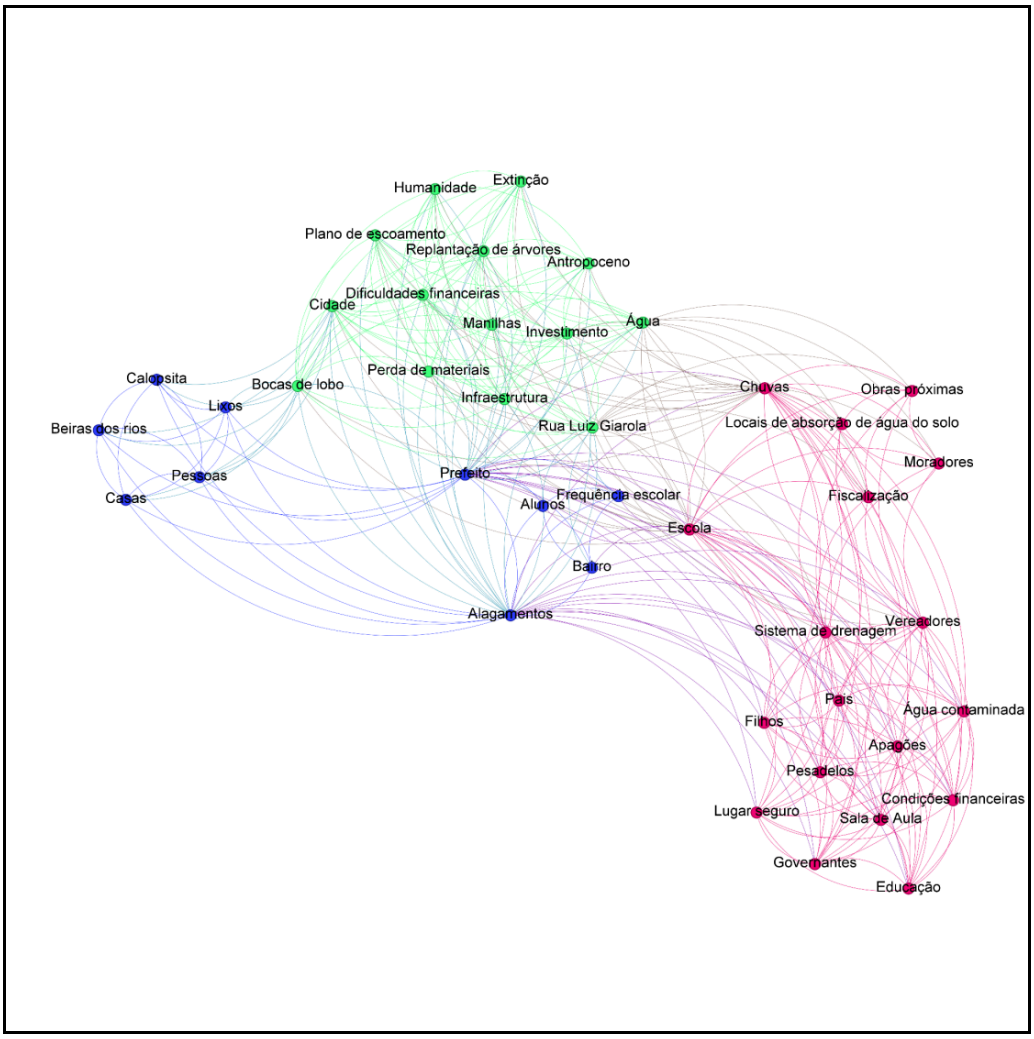
Letter from M. C.
São João del-Rei, June 9, 2022
Dear Mr. Mayor, I have observed very serious flooding problems in my neighborhood at the school entrance. This makes it difficult for students to pass through, interfering with school attendance, as it is impossible to cross the street amidst so much flooding.
I request that you take the necessary measures so that we no longer have this type of problem.
Certain of your understanding and commitment to this task, I thank you in advance.
Respectfully,
M. C. (7th Grade Student)

In the documents written by the students, it was observed that the main demand was for structural changes in the neighborhood, related to the drainage and permeability of the school street to avoid flooding and consequently educational losses. In their requests, the students related the problem of flooding in the neighborhood to the hybridization of society and nature, in which various actors (rain, planet, Anthropocene, climate change, garbage, drainage, streams, laws, politicians) are intertwined in a sociomaterial network, in moments of translation, in which mediators induce others to do things (Latour, 2012).

To represent and, consequently, visualize the sociomaterial associations, a network was developed from the students' considerations.

Figure 3

Network of Sociomaterial Associations



Source: Prepared by the authors using Gephi software (2023).

In the network, we can see how the different actors associate for the occurrence of floods. These associations are expressed in graphs, in which the nodes are sets of points, connected by lines, called edges.

Following the ANT vocabulary, the actors are represented by the nodes and the relationships between them are represented by the edges. Some similar actors were merged into the same node to facilitate the visualization of associations. Thus, the actor "street," "Luiz Giarola," and "avenue" were merged into "Luiz Giarola Street" because they characterize the same location. Actors "flood," "inundation," and "flooding" were merged into "flooding" because they represent the same identified problem situation.

Although there is no central actor in the formation of the sociomaterial network, Figure 3 shows a quadrangular element of centrality, represented by the mediating actors: "street," "mayor," "school," and "flooding." These mediators mobilized the students and allowed us to understand that, for the students, the issue of flooding on the school street is intertwined with a social and political dimension.

By applying the modularity metric, as a statistical calculation to detect the groupings in the network and how they connect to each other (Recuero, 2017), the formation of three groups or communities is observed, represented by the colors of the nodes (blue, pink, and green, Figure 3).

The first group, represented by the blue node, connects students G. J. G. and M. C. The second group, represented by the pink node, connects students N. M. and R. M. S. The last group, represented by the light green node, leaves student S. A. F. isolated from the others.

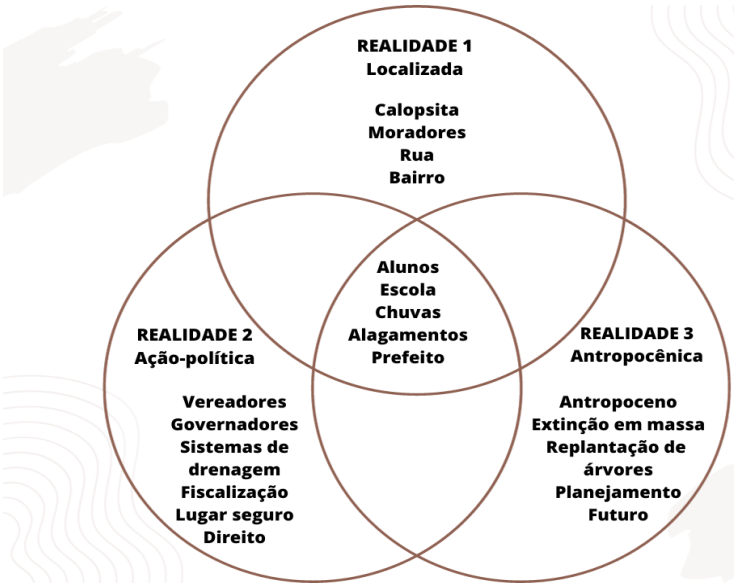
PRODUCTION OF REALITIES

From the three groups formed in the network, with performances by different actors, it was observed that three realities emerged (Law, 2012; Mol, 2008).

The three realities visualized in the network demonstrate the dialogue and participation of various entities that, by going beyond the human social sphere, strengthen the Latour's (2012) third source of uncertainty, which elucidates that objects also act. Although the performances of the actors are different and originate multiple realities, they converge and share common elements (Mol, 2008), which coexist in the students' letters. Figure 3 shows the three realities that emerged in the Network with their common elements.

Figure 4

Realities that emerged with the Network of Sociomaterial Associations



Reality 1: Localized / Cockatiel / Resident / Street / Neighborhood. Students / School / Rainfalls / Flooding / Mayor

Reality 2: Political action / Councilor / Governors / Drainage system / Surveillance / Safe place / Right

Reality 3: Anthropocene / Mass extinction / Tree replanting / Future planning

Source: The authors (2023).

In the first reality, called "Localized," the problem was directed to a more local issue, of the street and neighborhood of the "students" as actors. The second reality, "Political Action," presents a greater mobilization of actors associated with the political spheres of a society. The students who create it demonstrate that they recognize their rights as citizens and the duties of their political representatives. However, they still confine the problem to their territories, as in the first reality. And the last reality, "Anthropocene," shows the problem overflowing from the students' local area to the global, emerging in other locations on the planet as a consequence of human action. Similar to the other realities, there is also a demand from politicians for a solution to the problem.

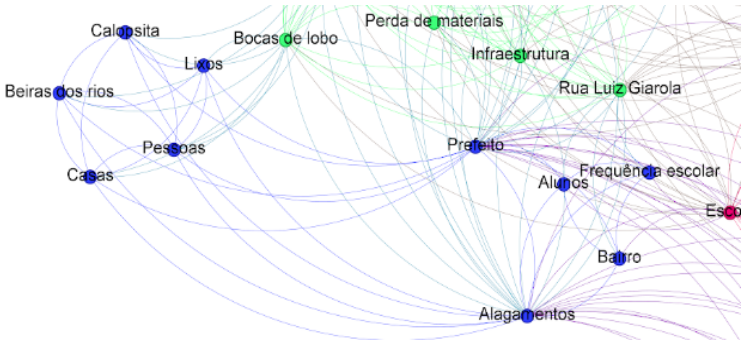
Therefore, it could be inferred that in the three performed realities, a world of multiple articulations stands out, but which relate to each other in a political and social aspect. Below, the three realities will be analyzed in more detail.

FIRST REALITY: LOCALIZED

A The first reality, the blue node (Figure 5), demonstrates a more localized performance of the actor "flooding".

Figure 5

Network section representing the blue node



Source: Prepared by the authors using the Gephi software (2023).

Os Both students relate this mediator to individual and local problems in the neighborhood, emphasizing the importance of the "Mayor" as the political authority responsible for improving the local infrastructure. Student G.J.G., in writing his letter, makes an emotional appeal to the political authority, reporting a significant and traumatic event in his life, involving material losses and the death of a beloved animal, the actor "cockatiel": "[...] I, for example, have experienced floods and it's very bad. I lost everything! Even my cockatiel died. [...]". The student requests improvements to the neighborhood's infrastructure from the Mayor and emphasizes the importance of individual actions by residents, such as proper waste disposal: [...] and raising awareness among people not to throw garbage into storm drains and to throw it into the trash can, so as not to cause flooding."

Another student, M.C., although not basing his request on a personal issue, also requests improvements for the "neighborhood" and "school" from the political authority, defining and locating the problem: "[...] I have observed very

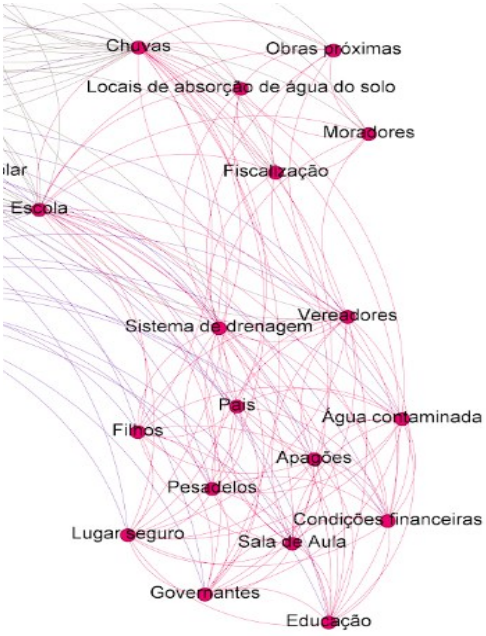
serious flooding problems in my neighborhood at the school entrance. This makes it difficult for students to pass through, interfering with school attendance, as it is impossible to cross the street amidst so much flooding [...].” (M.C.)

SECOND REALITY: POLITICAL ACTION

In the second reality, the pink node (Figure 6), it was observed that other political actors, in addition to the "Mayor," are mobilized to respond to and contribute to the resolution of the problem, such as "councilors" and "governors": "[...] It is your responsibility, councilors, mayors, governors, to prevent this type of situation from occurring, especially in public schools, [...]." (N.M.)

Figure 6

Network section representing the pink node



Source: Prepared by the authors using Gephi software (2023).

In this reality, a greater political understanding emerges among students, as they understand the role and function of other political spheres in resolving social conflicts. These students are more objectively demanding changes to the neighborhood's infrastructure, mobilizing the actors "drainage system" and "surveillance," who, when mobilized, can contribute to solving the problem: "[...] We request the installation of drainage systems and inspection of nearby works, which cause a lack of places for water absorption in the soil [...]" (R.M.S.).

The students evoke, in a moving way, the actor "safe place" for "students" to have access to "school", and thus have the "right" to "education": "[...] It is your responsibility, councilors, mayors, and governors, to prevent this type of situation from occurring, especially in public schools, where children and adolescents, who do not always have favorable financial conditions, study in search for education.

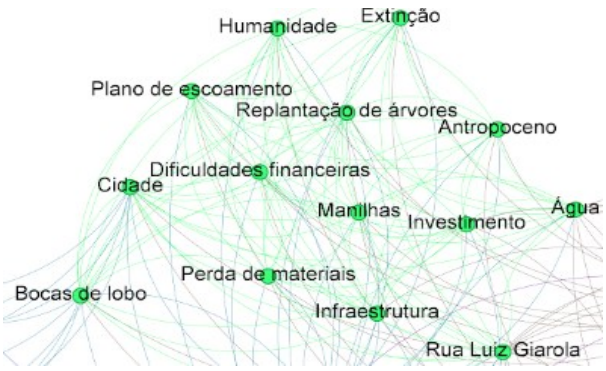
A safe place to study is a right of students, and of all those who seek education [...]" (R.M.S.).

THIRD REALITY: ANTHROPOCENE

Finally, in the third reality, represented by the green node (Figure 7), student S.A.F., unlike the others, presents what can be considered a broader and more global view of the problem, drawing attention to the actors "planning," "structuring," and "Anthropocene".

Figure 7

Network section representing the green node



Source: Prepared by the authors using Gephi software (2023).

The student associates local floods in the neighborhood, experienced by the community, with a possible occurrence of larger, more challenging events in a future scenario of a planet undergoing climate change. By mobilizing the actors "drainage plans" and "investment", he demonstrates an understanding of the need for care and preservation of the city: "[...] Humanity is going through the Anthropocene and a sixth mass extinction could happen, so the water drainage plan is very important, so as not to cause more damage to our city [...]." (S.A.F.).

In this reality, actors “extinction” and “humanity” were mobilized by the student. These mediators shift the actor “flood” to an external level, and in this way, modify the previous argument that delimits and locates the problem, as in the first reality. From the letter, it was observed that the student seems to have been affected and associated that, due to human action, the planet is undergoing transformations and that the local flood problem is a small sample of what could occur in the future, with the possible extinction of humanity itself.

Implications of the Emergence of these Multiple Realities

It was observed that the realities that emerged with the sociomaterial network demonstrate the participation of different entities in mobilizing the educational process of students. With the analysis of the realities that emerged with the network, the manifestation of a sociopolitical dimension was observed, which is one of the objectives of the DS, and in this way, we believe that we are beginning to mobilize, in the students, a potential for reaction to the New Climate Regime.

Latour (2020b) draws our attention to the importance of combating immobility in the face of climate change, highlighting that it is not enough for ordinary people to gather in a classroom and discuss the issue, believing that the facts stand on their own. According to the author, it is important to understand that we share a common world, the same Gaia, which remains attentive and reacts to our actions, and, in this way, all inhabitants share the same future challenges.

We believe that the students, in their letters addressed to political representatives, took their first steps towards being affected (Latour, 2015) by the urgent environmental issues that impact the realities where they live and study. After all, in the DS development, and especially in the writing of letters, it was observed that they (re)acted by mobilizing themselves regarding the effects of climate change. Thus, the actors "student" request and "claim" from public authorities, improvements in the school surroundings to drain rainwater and, in this way, solve the problem of flooding in the neighborhood. Therefore, it was observed that through didactic practice in science education, "students" mobilized their roles as political citizens.

Coutinho et al. (2016a) emphasize the importance of educating citizens who participate in and decide on the direction of society. For the authors, science education can be involved with controversial issues that are focused on the social context of students. In this sense, they reinforce that,

> [...] the separation between science education and citizenship education, mentioned in the introduction of this article, becomes obsolete. Since the issue is dealing with the uncertainties and risks disseminated by the production and circulation of scientific and technological knowledge, the role of the school, in general, and of science education, in particular, is to contribute to the formation of citizens capable of collaborating in consultation spaces (Coutinho et al., 2016a, p. 392).

The authors emphasize the importance of school activities that enable engagement and manifestation of socio-political action, allowing "consequences for education in wanting to live in a fairer, egalitarian and democratic society" (Coutinho et al., 2016a, p. 400).

In this context, thinking about science education implies being attentive to the different realities that emerge when we mobilize content, objects, and people in teaching-learning processes, which, being hybrids of nature and culture, are at the same time contributors to the democratization of socio-environmental education, based on a more sustainable society. According to Branquinho and Santos (2007, p. 118), the Actor-Network Theory, by articulating science and environmental education, makes it impossible to "conceive science of nature or of social as produced only by subjects who study and produce technical-scientific objects". According to the authors, in this mobilization of knowledge, the possibility of the composition of the social, also by objects, must be considered.

CONCLUDING REMARKS

This work aimed to analyze data related to the seventh stage of the development of a Didactic Sequence on the theme of the Anthropocene, in light

of the Actor-Network Theory. The chosen Science content, "Human Interference in the Water Cycle," was placed in the context of climate change and the marks of human exploitative action on the environment.

The realities that emerged from the network in this DS, mobilized by the letters, demonstrate the formation of hybrids from the mediations and performances of the actors. These realities, despite being multiple, overlap, and when the problem is identified, it reveals the sociopolitical issue, politically affecting the students and allowing them to mobilize democratically. They also helped to elucidate human exploitative action on the planet and its consequent contribution to catastrophic events, hallmarks of the Anthropocene.

In this sense, it was observed that didactic sequences, when guided by local issues of students, can contribute to the development of their autonomy and provide greater participation in the educational process. When focused on issues of collective interest, DS can also politically engage students in the construction of opinions, judgments, and decisions, enabling them to be affected by the entities that populate this planet. Educational practices like this can significantly contribute to producing ways of seeing and (re)existing in the context of climate change and the Anthropocene.

The analyses indicate that the DS approach in local rainfall performances allowed students to be affected by issues urgent to the planet. We hope that the DS developed here can inspire and contribute to other practices in the field of education, focused on socio-environmental issues that affect us and that may somehow impact us in the New Climate Regime.

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NOTAS

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