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RELATIONS AND MEANINGS ON STUDENTS' ENVIRONMENTAL LEARNINGS ABOUT THE RIO DOCE¹

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Abstract

This paper presents the results of a study that aims to understand the relations that 9th-grade students establish with the Rio Doce in the context of the Fundação dam rupture. The theoretical and methodological basis is the contributions of Bernard Charlot through a dialogue with the field of environmental education. The data was generated through the inventory of knowledge and interviews. The results indicate the preponderance of affective learning over the school and citizen learning. In turn, it is towards the school that students direct their learning demands, giving them meanings in the context of the socio-technical disaster. The importance of the school for collective decision-making and socially responsible action in the context of the disaster is therefore affirmed.

LEARNING • ENVIRONMENTAL EDUCATION • ENVIRONMENT

APRENDIZAGENS AMBIENTAIS DE ESTUDANTES SOBRE O RIO DOCE: RELAÇÕES E SENTIDOS

Resumo

O texto apresenta resultados de um estudo que visa a compreender as relações que estudantes do 9º ano do Ensino Fundamental estabelecem com o rio Doce no contexto do rompimento da barragem de Fundação. O aporte teórico e metodológico são as contribuições de Bernard Charlot em diálogo com o campo da educação ambiental. Os dados foram gerados por meio de balanço de saber e de entrevistas. Os resultados indicam preponderância de aprendizagens afetivas sobre as aprendizagens escolares e cidadãs. Por sua vez, é para a escola que os estudantes direcionam suas demandas de aprendizagens, atribuindo-lhes sentidos no contexto do desastre sociotécnico. Afirma-se a importância da escola para a tomada de decisões coletivas e para a atuação no contexto do desastre de forma socialmente responsável.

APRENDIZAGEM • EDUCAÇÃO AMBIENTAL • MEIO AMBIENTE

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APPRENTISSAGES DES ÉLÈVES CONCERNANT L'ENVIRONNEMENT DU RIO DOCE: RAPPORTS ET SENS

Résumé

Ce texte présente les résultats d'une étude visant à comprendre les rapports que des élèves de troisième entretiennent avec le Rio Doce après la rupture du barrage minier du Fundão. Le cadre théorique et méthodologique est basé sur la contribution de Bernard Charlot en dialogue avec le domaine de l'éducation environnementale. Les données ont été obtenues par moyen d'un bilan de la littérature et d'entretiens. Les résultats indiquent que les apprentissages d'ordre affectif prédominent sur les apprentissages scolaires et citoyens. Ce sont les élèves eux-mêmes qui demandent à l'école des enseignements qu'ils considèrent significatifs dans le contexte du désastre socio-technique. L'importance de l'école dans la prise de décisions collectives et pour l'action socialement responsable dans le contexte du désastre est soulignée.

APPRENTISSAGE • ÉDUCATION ENVIRONNEMENTALE • ENVIRONNEMENT

APRENDIZAJE AMBIENTAL DE ESTUDIANTES SOBRE EL RIO DOCE CON UN ENFOQUE EN LAS RELACIONES Y SENTIDOS

Resumen

El texto presenta los resultados de un estudio que tiene como objetivo comprender las relaciones que los estudiantes de noveno año de enseñanza básica establecen con el río Doce en el contexto de la ruptura de la presa de Fundão. Las aportaciones teórica y metodológica vienen dadas por las ideas de Bernard Charlot en diálogo con el área de la educación ambiental. Los datos se generaron a través de un equilibrio entre inventarios de saber y entrevistas. Los resultados indican una preponderancia del aprendizaje afectivo sobre el aprendizaje escolar y ciudadano. A su vez, es a la escuela donde los estudiantes dirigen sus demandas de aprendizaje, asignándoles sentidos en el contexto del desastre socio-técnico. Se afirma la importancia de la escuela para la toma de decisiones colectivas y para actuar en el contexto del desastre de una manera socialmente responsable.

APRENDIZAJE • EDUCACIÓN AMBIENTAL • MEDIO AMBIENTE

“D O TODAY’S 15-YEAR-OLDS FEEL RESPONSIBLE FOR THE ENVIRONMENT?”. THIS IS the question on the cover of issue number 21 of *Pisa em Foco* (ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT – OECD, 2012), which discusses the scientific understanding of students on environmental issues. As part of the comparative evaluation proposed by the International Student Assessment Program (Pisa), the questions students were asked about their environmental attitudes and those of their parents included different countries: “Students were asked whether they were familiar with the themes of environmental pollution, energy shortage, extinction of plants and animal species, clearing of forests for other land use, water scarcity and nuclear waste”² (OECD, 2012, p. 1).

Despite the small differences concerning the results in the 54 participating countries in this edition of Pisa, most students declared some knowledge on environmental issues, and schools play a central role as the source of this knowledge (OECD, 2012).

In this article, we are also interested in investigating students’ environmental learning in a context of environmental degradation, extinction of plants and animals, water scarcity and alteration of people’s lifestyle caused by the spilling of approximately 55,000,000 m³ of ore tailings in the Rio Doce

2 In the original: “Perguntou-se aos estudantes se estavam familiarizados com os temas de poluição ambiental, escassez de energia, extinção de plantas e espécies animais, derrubada de florestas para outro uso do solo, escassez de água e resíduo nuclear”.

with the rupture of the Fundão dam, located in the municipality of Mariana, in the central region of Minas Gerais. The dam, under the responsibility of the Samarco/Vale-BHP Billiton mining company, burst on November 5, 2015, and the tailings spread over 600 km of the river, approximately, all the way through its mouth, onto the coast of Espírito Santo. It is estimated that the effects of this socio-technical disaster³ will be felt over the years (MINAS GERAIS, 2016; FREITAS; SILVA; MENEZES, 2016; MILANEZ; LOSEKANN, 2016; LOSEKANN, 2018; ZHOURI, 2018; ZHOURI *et al.*, 2018).

The students participating in this research⁴ live in Governador Valadares (MG), a city with a population of 263,689 inhabitants (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA – IBGE, ca. 2010), considered the most populated in the Rio Doce river basin (COMITÊ DA BACIA HIDROGRÁFICA DO RIO DOCE – CBH-Doce, ca. 2019), and the river is the only source of water supply for the population. The course of action and results shown in this study aimed to understand the relationships that 9th-grade students establish with the Rio Doce as an object of knowledge.

THEORETICAL AND METHODOLOGICAL CHOICES

As Bernard Charlot (2008, p. 174) reflects on the dissemination of the relationship with knowledge concept in Brazil, states that it would not have been disseminated if “the situation of the Brazilian school did not serve its purpose”, and highlights that “the approach in terms of the relationship with knowledge makes it possible to open [...] debates”. Thus, this text provokes the debate around the concept of the relationship with knowledge and environmental education, by questioning students’ learning about the Rio Doce, which encompasses both the environmental processes experienced by people and the river itself before the dam at Fundão broke and after the event.

Charlot becomes highly interested in learning as he proposes the theoretical perspective of relationship with knowledge. Subjects are summoned to learn in order to become a member of the human species, to live in different groups (family, school, youth groups, among others), thus, getting involved with learning in a unique way, which implies aspects of singularization; The subject who learns is, therefore, human subject, in their anthropological, social and singular condition (CHARLOT, 2000, 2001, 2008, 2009). For this reason,

[...] [the] relationship with knowledge is inseparably social and singular. It is the set of (organized) relationships that a human subject (therefore singular and social) maintains with

3 We recognize the criminal character of the Fundão dam rupture, so we have chosen to use the term proposed by Zhouri *et al.*, in reference to this specific disaster, “to emphasize a process triggered beyond a merely technical malfunction or error, which takes us to the failures of environmental governance, producers of new patterns of vulnerability that have in fact exposed the population to risk” [“para enfatizar um processo deflagrado para além de uma avaria ou erro meramente técnico, remetendo-nos, assim, às falhas da governança ambiental, produtoras de novos padrões de vulnerabilidade que expuseram, de fato, a população ao risco”] (2018, p. 40).

4 Research approved by Research Ethics Committee.

everything that depends on 'learning' and knowledge: object, 'content of thought', activity, interpersonal relationship, place, person, situation, occasion, obligation, etc., linked in some way to learning and knowledge.⁵ (CHARLOT, 2009, p. 15, italics and quotes from the author, own translation)

Based on this perspective, learning is broader than school learning, although it is supported by the school. From the author's texts, one can deduce the importance given school (in the broader sense), which is at the core of his concerns, when he questions the relationship with knowledge and the school of young learners in France and in other countries, such as Brazil (CHARLOT, 2000, 2001, 2009).

As we analyze the importance of the environment for the human subject, without disregarding all other forms of life, we can say that the relationship with knowledge is also a relationship with the environment, for people cannot do without it, likewise, we establish different relationships based on our anthropological, sociological and singular condition. In this sense, it is important to reflect on the intentionality placed on environmental issues in Brazil as part of the education of children, adolescents, young people, adults and elderly people who are in classrooms from early childhood education (kindergarten) to higher education (BRASIL, 2012).

Facing the challenge to educate for environmental issues, the National Curricular Guidelines for Environmental Education (BRASIL, 2012) highlight the intentionality of environmental knowledge at school, recognizing environmental education as a social practice, based on the relationship between the subject, nature, other human beings, and marked by environmental ethic.

Different authors in the field of Environmental Education (EE) emphasize it as a social and political practice, highlighting the importance of the school in the environmental formation of the subjects in a dialogical perspective, committed to the collectivity; one that is ethical and also problematizes the relationships that conceive the environment as a source of resources to be exploited, generating asymmetric accumulation of wealth, ignoring the different living conditions of populations and other species of nature (JACOBI, 2003, 2005; SAUVÉ, 2005a, 2005b; SATO; CARVALHO, 2005; LOUREIRO, 2012; REIGOTA, 2017).

The transversality recommended to the school curricula by the authors of environmental education summons the school to put human formation on the agenda, recognizing the historicity of the subjects, cultural contexts, different knowledge coming from social and environmental movements, environmental agendas and struggles, the complexity of human relations; and, therefore makes environmental education responsible for the "ecological, scientific and political-social knowledge" (LOUREIRO, 2012, p. 84). In this sense, environmental education

5 In the original: "[a] relação com o saber é indissociavelmente social e singular. É o conjunto (organizado) de relações que um sujeito humano (logo singular e social) mantém com tudo o que depende da "aprendizagem" e do saber: objecto, "conteúdo de pensamento", actividade, relação interpessoal, lugar, pessoa, situação, ocasião, obrigação, etc., ligadas de certo modo à aprendizagem e ao saber."

[...] contributes to the formation of a critical spirit and an individual in solidarity with other human beings, other living species, and the Earth when it teaches scientific content about man's relationship with his environment and gives a reflection on the depth, complexity, and ambiguities of this relationship as well.⁶ (CHARLOT, 2013, p. 251, own translation)

As we consider these students' environmental learning we recognize the importance and urgency of the environmental debate at school, the way each person gets involved in the processes of learning, the complexity of the relationships people have with the environment, the anthropological need for human survival in connection with other living beings, the subjects belonging to distinct groups and the socio-environmental conflicts in which this socio-technical disaster is inserted (ZHOURI, 2018; ZHOURI *et al.*, 2018).

Researches that adopt as a theoretical framework the relationship with knowledge in the sense proposed by Charlot also assume methodological options that make it possible to analyze the processes experienced by subjects in different situations involving learning. It is, therefore,

[...] a work of identification, exploration, construction of elements and processes that constitutes the research on the relationship with knowledge - which ultimately makes it possible to understand the (the occasionally contradictory) forms of mobilization in the field of knowledge and learning.⁷ (CHARLOT, 2001, p. 23)

This is the work carried out in this study, whose research field was four schools in the educational municipal system that operate full time in Governador Valadares. The schools were selected intentionally: two riverside schools (A and B) and two schools far from the Rio Doce (C and D). There were 86 Primary 9th-grade students between the ages of 13 and 16, as follows: school A (14 students), school B (24 students), school C (22 students), school D (26 students).

The choice of the 9th grade was intentional because these students had supposedly attended nine years at the Full-Time School (FTS), during an 8-hour daily program. Besides, the environmental theme is transversally presented in the thematic guideline *Sustainability and Protagonism*, which guides the FTS curriculum (GOVERNADOR VALADARES, 2010).

Charlot (2009) inspired us to choose the tools used in the production of the data: “knowledge inventory” and “interviews”.

6 In the original: “contribui para a formação de um espírito crítico e de um indivíduo solidário com os demais seres humanos, as demais espécies vivas e o planeta Terra quando, ao mesmo tempo, ensina conteúdos científicos a respeito da relação do homem com o seu meio ambiente e dá a refletir sobre a profundidade, a complexidade e as ambiguidades dessa relação.”

7 In the original: “um trabalho de identificação, de exploração, de construção de elementos e de processos que constitui a pesquisa sobre a relação com o saber - que, em última instância, permite compreender as formas (eventualmente contraditórias) de mobilização no campo do saber e do aprender.”

The inventory of knowledge consists in the production of a text prepared by the subjects, based on the premise that the “content of consciousness [is] enunciated through language” (CHARLOT, 2009, p. 25) which is achieved through writing. The invitation for the elaboration of the text is made by means of a formulation that composes the instrument:

Since I was born, I have learned many things at home, in the neighborhood, at school and elsewhere... What? With whom? So, what is most important to me? And now, what am I waiting for?⁸ (CHARLOT, 2009, p. 18, own translation)

This version used by the author has been adapted⁹ for the purposes of this study, and we seek to maintain the regularities present in the statement by putting the question in terms of processes which allow the subject to enunciate different learnings, to specify those learnings, to indicate the source of those learnings and to put in future perspective their wishes for a learning generated from their life contexts.

*A journalist from an important Brazilian newspaper is producing a report on the importance of water for our survival and the Rio Doce. Imagine that you were invited to be interviewed. In the interview, the journalist wants to know what you have learned about the water and the Rio Doce, who has taught you the things you know, where you have learned them, what you would still like to learn and who you would like to learn from. The journalist is very curious and also wants to know what you consider important in all these learnings. And then, what will you tell this person? It's a great newspaper, with hundreds of thousands of readers, so elaborate your text really well.*¹⁰ (own translation)

The text was elaborated in class after having contact with the subjects for two months during school activities. The adhesion of subjects who voluntarily elaborated the texts was high – from the group of 9th-grade students, 86 out of 99 elaborated the inventory of knowledge.

The inventory of knowledge allows us to deal with the regularities of a group. Although the texts indicate intersubjective relations they are not deeply investigated, since aspects of uniqueness can only be captured through

8 In the original: “Desde que nasci, aprendi muitas coisas, em minha casa, no bairro, na escola e noutros sítios... O quê? Com quem? Em tudo isto, o que é mais importante para mim? E agora, de que é que estou à espera?”.

9 The adaptation took Souza's (2016) article as a reference.

10 In the original: “Uma jornalista de um importante jornal brasileiro está produzindo uma reportagem sobre a importância da água para a nossa sobrevivência e sobre o rio Doce. Imagine que você foi convidado para ser entrevistado. Na entrevista, a jornalista quer saber o que você aprendeu sobre a água e o rio Doce, com quem aprendeu as coisas que você sabe, onde aprendeu, o que ainda gostaria de aprender e com quem gostaria de aprender. A jornalista é muito curiosa e quer saber, também, o que você considera importante em todas essas aprendizagens. E aí, vai responder o quê para ela? Capriche, é um grande jornal, com centenas de milhares de leitores.”

interviews (CHARLOT, 2009). The interviews give importance to the processes experienced in a singular way by the subjects, enabling this study to better understand the relationships that the students establish with the Rio Doce as an object of knowledge, as they contribute to the production of “intelligibility about ‘concrete’ situations and ‘concrete’ students” (CHARLOT, 2009, p. 149, highlights of the author). Therefore, it takes into account the meanings that the subjects give to their own histories, based on their own anthropological, sociological and singular condition.

Thus, the corpus of analysis consisted of 23 interviews that were conducted with six male and six female students at riverside schools; and other six male and five female students at schools away from the river. The selection of subjects was intentional. The students invited to take part in the interviews were those that presented reflections on the Rio Doce that could be deepened such as repertoire and source of learning, knowledge about the dam disaster, personal and family reactions about the lack of water and river conditions after the dam rupture, their own future expectations as well as their families’ (how they perceive life in the city). The interviews were led by these students’ experiences regarding the Rio Doce and the quality of water treatment it received.

Throughout the analysis of the empirical material, we sought the contributions of Charlot (2009) to categorize learning and attain the processes involved in the environmental knowledge of the students, which are presented in the next section of this text. In the sequence, we will discuss the interviews in which we sought “resonances” (CHARLOT, 2009) that allowed us to broaden our understanding of the relationships and the meanings of the learning that we captured from the inventories on knowledge.

INVENTORY OF STUDENTS’ ENVIRONMENTAL LEARNING

In an attempt to grasp the environmental learning of students, we adopted the framework presented by Charlot (2009) on the process of grouping and interpreting the texts. In his arguments, the author clarifies: “for the answers to make sense it is necessary to regroup them, categorize them, which supposes that choices have to be made – so that categorization is also linked to the relationship with the knowledge the researcher possesses”¹¹ (2009, p. 18). Thus, to avoid the burden of subjectivity on the researcher, the work of analyzing the inventories involved the team of researchers (in reading and scrutinizing the texts) and sought to understand the text as a whole, with attention to “what might provide intelligibility about how the universe ‘of learning’ is organized” (CHARLOT, 2009, p. 20). Thus, the inventories of knowledge should be read as a single text, in which regularities are sought in order to identify processes (CHARLOT, 2009).

Based on Charlot (2009), we draw a general picture of the learning evoked in the inventories about the river Doce and its water, the places and the source

11 In the original: “para que as respostas façam sentido é preciso reagrupá-las, categorizá-las, o que supõe que seja preciso fazer escolhas – de forma que a categorização está igualmente ligada à relação com o saber do próprio investigador”.

of this learning, what the students consider important and what they expect. We also take into account the form, the tone and the dominant theme in the texts. While reading the inventories, we consider it pertinent to reflect on the location of the student's residences, so that we may be able to understand whether the proximity or distance from the river modifies the relationship established with it.

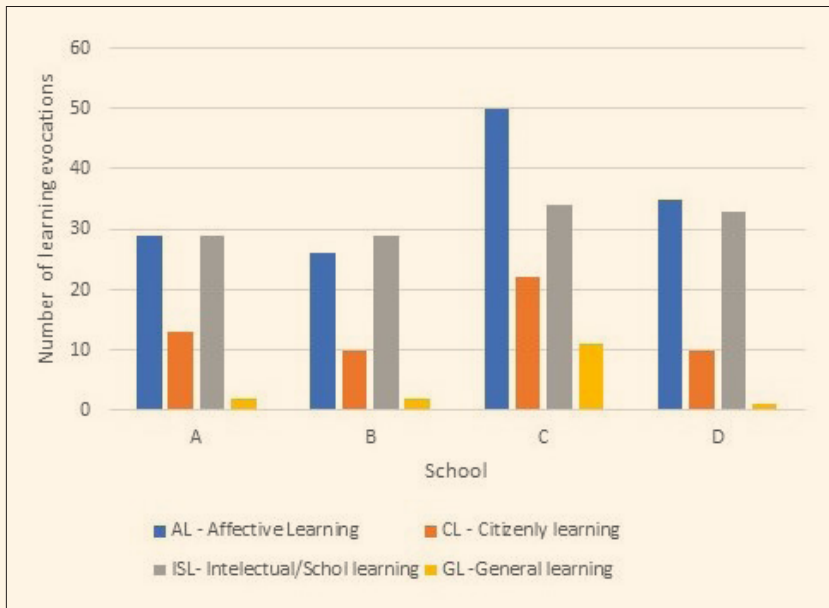
Based on the contributions of Charlot (2009)¹² and the studies we have undertaken on environmental education, we have categorized the learning – although we recognized them as being integrated – for analytical purposes into Affective Learning (AL), that is, learning marked by affective-emotional relationships with the river and the environment in general, Citizen Learning (AC) as learning that reflects ethical and political action in relation to the environment and the Rio Doce, Intellectual and School Learning (ISL) which is the learning that evokes systematized school knowledge about the environment in general and about the Rio Doce in particular, and Generic Learning (GL) related to when the student says he has learned many things about the environment and about the Rio Doce but does not specify them.

After reading the texts, tables were constructed with the learning and its occurrence, which means the learning unit that appears in the inventory of knowledge, was accounted for whenever it appeared in the inventory. Therefore, some learnings were inserted in the tables more than once. This procedure allowed us to deal with the learnings in relation to the “weight of a particular type of learning in the set of learning evoked” (CHARLOT, 2009, p. 24) and the strength of the occurrence was considered since the listing of similar learnings is taken as “insistence” (CHARLOT, 2009, p. 25).

The following graph presents a general picture of the evocation of these learnings in the data set analyzed:

12 Categories used by the author: learning linked to everyday life (specific everyday knowledge, such as family tasks), intellectual and school learning (basic school learning, such as reading, writing, norms, methodology), relational and affective learning and learning linked to personal development (relationships of harmony, solidarity, trust, friendship, common life, conformity, conflict, etc., or personal skills), professional learning (references made to profession, future, behaviors and codes in the work world, etc.) (CHARLOT, 2009).

CHART 1
ENVIRONMENTAL LEARNING DECLARED BY STUDENTS (CL, ISL, GL, AL) IN EACH OF THE SCHOOLS



Source: Research Data (2018).

The AL is predominant over the others and was identified in the references made to the river as part of the memory. They are related to aspects of identification and proximity of the subject to the river, insecurity about the water after the dam rupture and phrases showing indifference about the river. The following fragments, taken from the texts, illustrate these learnings:

*I know the River Doce is a part of us, a piece of life that not everyone sees.*¹³ (E¹⁴, f¹⁵, school A)

*Many say it (the water) will give cancer, others say it will affect our future family (descendants).*¹⁶ (E, m¹⁷, school B)

*Nobody has the confidence to drink that kind of water.*¹⁸ (E, m, school C)

*I honestly don't feel very interested in the River Doce.*¹⁹ (E, m, school D) (own translation)

The ISL was identified when the student evoked specific knowledge about the river throughout the text; such as river basin, an increase of metals in the

¹³ In the original: "Eu sei que o rio Doce é uma parte de nós, um pedaço da vida que nem todos veem."

¹⁴ E - student. In the first section of the text, it was chosen not to name the students. The fictitious name will be given only to the subjects interviewed, because we were allowed to know a little more about their history in relation to the Rio Doce.

¹⁵ f - female.

¹⁶ In the original: "Muitos falam que vai dar câncer, outros falam que vai afetar os nossos futuros familiares."

¹⁷ m - male.

¹⁸ In the original: "Ninguém tem confiança de beber esse tipo de água."

¹⁹ In the original: "Eu sinceramente não sinto muito interesse no rio Doce."

water after the rupture of Fundão dam, geo-historical aspects related to the river, among others, as shown in the following excerpts.

*Well, the only thing I know is that the river before the largest environmental disaster in the country did not have crystal clear waters, but it was partially clean compared to its condition today.*²⁰ (E, f, school A)

*Now the river is heavily contaminated, full of toxic substances that have been released by the dam break, and they harm human health.*²¹ (E, f, school B)

*I think Rio Doce is "gone" because its water is full of mud, metals, and bacteria.*²² (E, m, C school)

*This name, Rio Doce, was given to it because of a little town called Rio Doce, which was also built by the Carmo River, which became Rio Doce.*²³ (E, f, D school) (own translation)

In turn, the CL is presented in the text through the claims, duties, search for information, rights, related to environmental protection and environmental care:

*People didn't take care of it before, and I don't think they will now. The lack of information and the importance that is not given to environmental care worries me.*²⁴ (E, f, school A)

*We must all fight to bring it [the river] back.*²⁵ (E, f, school C)

*Society would like to know what will happen to our river, and whether the river will return to normal, or at least how to get the heavy metals out of the water.*²⁶ (E, m, school D) (own translation)

General learnings (GL) were highlighted in the texts when the student did not specify what he learned about the water and the Rio Doce, for example: "I learned several things" (E, m, school A); "I know many things about the river" (E, m, school C).

Chart 1 shows that the results are common to all schools, regardless of their geographical location, which reveals a consistent pattern: the AL and the ISL were evoked more frequently than the CL, and the GL was the least evoked.

20 In the original: "Bom, a única coisa que eu sei é que o rio, antes do maior desastre ambiental do país, não chegava a ter águas cristalinas, mas era parcialmente limpo comparado ao estado que ele se encontra hoje em dia."

21 In the original: "Agora o rio está muito contaminado, cheio de substâncias tóxicas que foram liberadas pelo rompimento da barragem e prejudicam a saúde do ser humano."

22 In the original: "Eu acho que "já era" para o rio Doce, porque a água está toda cheia de lama, metais e bactérias."

23 In the original: "Esse nome, rio Doce, foi dado assim, por uma cidadezinha chamada Rio Doce, que também era banhada pelo rio Carmo e se tornou rio Doce."

24 In the original: "O povo não cuidava antes, e acho que não cuidará agora. A falta de informação e a importância que não é dada para cuidados ambientais me preocupa."

25 In the original: "Todos nós devemos lutar para trazê-lo [o rio] de volta."

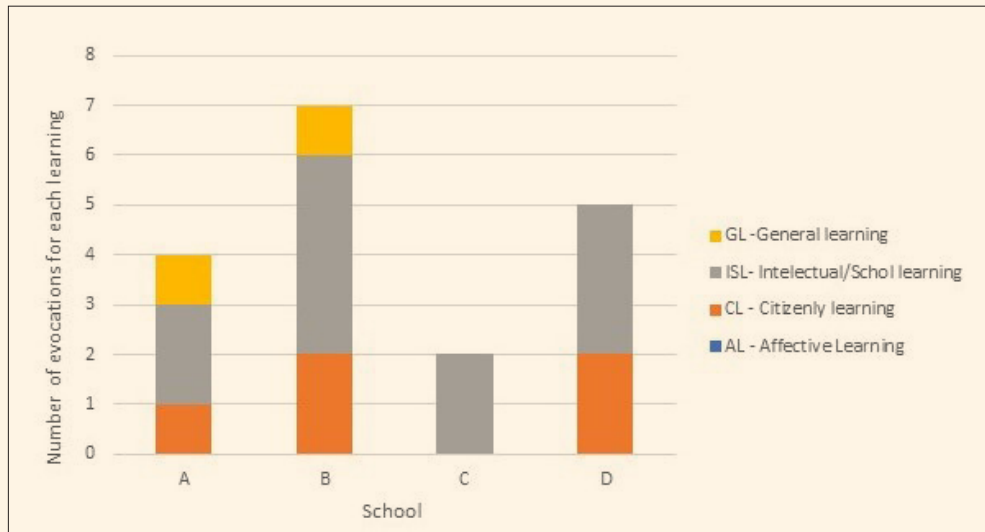
26 In the original: "A sociedade gostaria de saber como vai ficar o nosso rio, e se pelo menos o rio voltará ao normal, ou pelo menos tirar os metais pesados da água."

Therefore, these results show that the proximity to the river, whether as a student in a riverside school or as a resident of the riverside neighborhood, does not pinpoint learning differently (from students in schools in the city outskirts).

Readings of the data presented in Chart 1 shows that a large number of students already know about intellectual and school aspects. The data also indicate a strong presence of AL in all schools, as well as their prevalence over other learning in three schools. These learnings were more cited than ISL, always totaling more than 80% of what the students already claim to know. The generic component was the least stated in all schools, and never reached 5% of what students acknowledge to know.

Although ALs are mostly evoked, when we analyze the answers in the inventory of knowledge about what the students would still like to learn, we see a preponderance of the ISLs, as can be seen in Chart 2.

CHART 2
ENVIRONMENTAL LEARNING DESIRED BY STUDENTS (CL, ISL, GL, AL) IN EACH OF THE SCHOOLS. THE AFFECTIVE LEARNING WAS NOT MENTIONED



Source: Research Data (2018).

As noted, students state that they know more about the AL (totaling almost half of the occurrences in all schools), therefore this type of learning is what students least want to learn as evidenced in the chart above. This result has important implications that add to the fact that in one of the riverside schools the indifference to learning about the river also stands out, in a mixture of anger, revolt, and disinterest.

*I don't care if I learn about the river anymore.*²⁷ (E, f, school B)
*I don't want to learn any more of this shitty River.*²⁸ (E, m, school B) (own translation)

²⁷ In the original: "Para mim tanto faz aprender ou não mais sobre o rio."

²⁸ In the original: "Não quero aprender mais nada dessa merda do rio Doce."

The desire for Generic Learning about “rivers, water and the world” have been noticed in a school, as well as about the origins of the Rio Doce:

*I intend to learn a lot about the river and its origins.*²⁹
(E, f, school A)

*I wanted to know more about the rivers, the waters, the world.*³⁰ (E, f, D school) (own translation)

In all schools, the ISLs are mostly remembered in the students' desire for learning, even overriding the CLs. This takes us to the role of environmental education and the responses to be given, especially to students and communities affected by the dam's rupture, and their need to establish 'new' relationships with water – not only regarding preservation and combating scarcity, but now also by understanding heavy metal contamination, which poses a new challenge for environmental education (EE).

The need for this approach is present in the texts of the inventory of knowledge through the desire to learn “how the river can be cleaned up again” (E, f, school A), or “how pollution can be removed from the water” (E, m, school C). It is worth to mention the absence of a desire to know about the causes and consequences of this socio-technical disaster. The demand for citizenly learnings (CL) to reflect on the necessary collective engagements on behalf of the river is lacking in the inventories of knowledge, and the attribution of responsibilities to the public authorities and the companies involved in the mud waste as well, in its different instances, which silences or strengthens the dismantling of the environmental agenda in the country.

Among the students, the desire to know whether the river will return to “being as it was before” appears in different ways ranging from curiosity about the future (four evocations at school B and one at school D) to those forms that include risk perception when students declare that they would like to know about the metals and consequences of disaster (two evocations at school D). The texts highlight a desire to know “bout the future”, both regarding people and the environment.

*And I was wondering if one day the River Doce will go back to the way it was before.*³¹ (E, m, school B)

*I would love to know more about the metals that were exposed in the waters and the problems caused by them from the science teacher and a professional on the subject. (In order) to know what is happening with the River and the consequences of the disaster.*³² (E, m, D school) (own translation)

29 In the original: “Pretendo aprender muito sobre o rio e suas origens.”

30 In the original: “Eu queria saber mais sobre os rios, águas, sobre o mundo.”

31 In the original: “E queria saber se um dia o rio Doce vai voltar a ser como era antes.”

32 In the original: “Eu adoraria saber mais sobre os metais que ficaram expostos nas águas e os problemas causados por eles junto com o professor de Ciências e um profissional sobre o assunto. Saber o que está acontecendo com o Rio e as consequências do desastre.”

There is also an interest in technical aspects such as those related to the water treatment and supply process (school B, three evocations; school D, one evocation).

*I would still like to learn how they clean the water for use and I would like to learn by seeing how they do it.*³³ (E, m, school B)
*How's the water I'm drinking and using?*³⁴ (E, f, school A)
 (own translation)

These evocations refer to an environmental perspective as a problem to be solved, and the river, hit by mining tailings, becomes perceived as a source of environmental problems. The challenge presented here is to become “aware that environmental problems are essentially associated with socio-environmental issues linked to games of interest and power, and value choices”³⁵ (SAUVÉ, 2005a, p. 318, own translation).

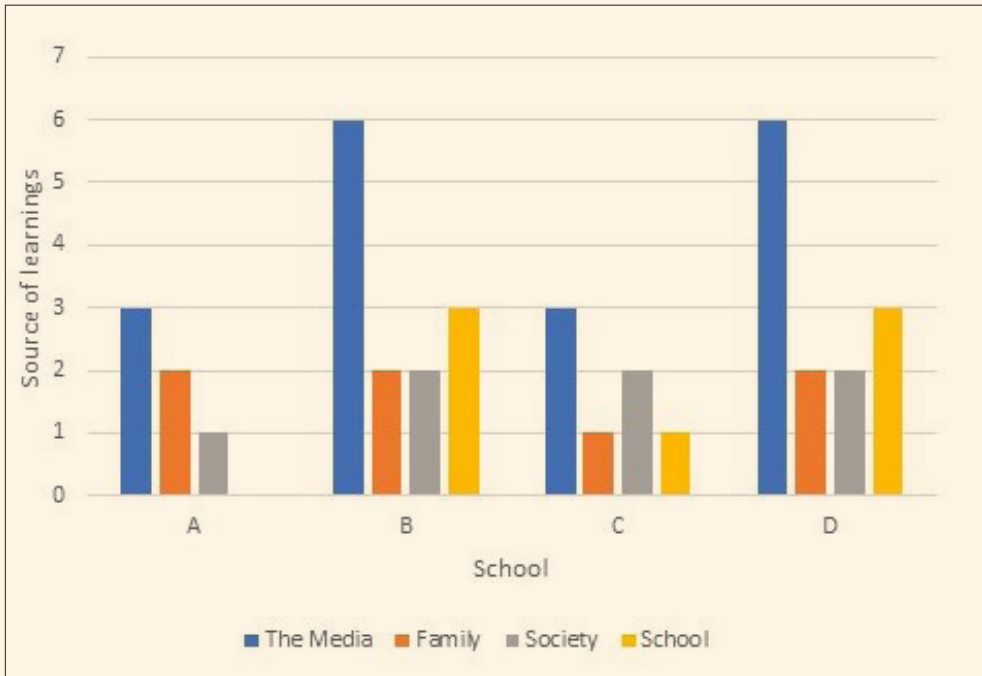
In this sense, the students presented demands for ISL that can unfold into reflexive Citizenly Learnings (CL) in search for collective solutions to the environmental problems these communities face. This demand is presented in statements on: “how to get the water back to being pure” (E, f, school B); “how to get the mud out of the river” (E, m, school B); “are we going to have fish again?” (E, m, school C); “I would like to learn whether they are going to get the mud out of the Rio Doce and if we are going to have fish again” (E, m, school C).

The source of learning is an important aspect of studies on the relationship with knowledge (CHARLOT, 2009). Then, we might pose the questions: what is the source of the environmental learning of these students? Who do they learn it from and who do they want to learn from? We counted the references made to people and places of learning in 32 texts and we identified the media, the family, and society and school in a broader scope, as shown in Chart 3.

33 In the original: “Ainda gostaria de aprender como eles limpam a água para o uso e eu gostaria de aprender vendo como eles fazem.”

34 In the original: “Como está a água que estou bebendo e utilizando em outras coisas?”

35 In the original: “consciência de que os problemas ambientais estão essencialmente associados a questões socioambientais ligadas a jogos de interesse e de poder, e a escolhas de valores”.

CHART 3**SOURCES OF ENVIRONMENTAL LEARNING FOR STUDENTS IN EACH OF THE SCHOOLS**

Source: Reseach Data (2018).

Media is recognized as the main source of learning. Society, family, and school are also recognized as places of learning. However, in all cases, the latter has not reached one-third of the mentions. It is also noted that in one of the schools no students mentioned the school as a source of learning.

However, students state what and from whom they want to learn, so the school and the teachers become a reference for the desired learning, reaffirming the school as the place where “things are taught that cannot be taught anywhere else, whether these things be content, ways of reasoning, or [...] ways of relating to others or to oneself”³⁶ (CHARLOT, 2008, p. 179, own translation).

In the context of this socio-technical disaster, the school assumes a relevant place in the affected communities, promoting a debate that recognizes “our identity as a living being among other living beings”³⁷ (SAUVÉ, 2005a, p. 317, own translation), and problematizing the limits of an approach that treats the Rio Doce exclusively from a conservationist/recursive perspective (SAUVÉ, 2005b), in which nature is taken as something to be managed and shared (water and fish for human consumption) to another perspective that considers the right to exist of all living beings, despite their usefulness to human life.

If so far we have drawn a general picture of the learning analyzed from the inventories of knowledge, in the next section we present the singularities of the subjects through their relationship with the Rio Doce. It should be noted

³⁶ In the original: “ensinam-se coisas que não podem ser ensinadas em outros lugares, sejam essas coisas conteúdos, modos de raciocínio, sejam [...] formas de se relacionar com os outros ou consigo mesmo”.

³⁷ In the original: “nossa identidade de ser vivo entre os demais seres vivos”.

that, in the theoretical sense of the relationship with knowledge, issues related to signification acquires centrality. For this reason, we try to grasp the meanings that students give to school learning during the interviews, both those referring to what they declare they know and what they wish to know.

RELATIONSHIPS AND MEANINGS OF SCHOOL LEARNING

As we seek to understand the relationships and meanings of school learning, we welcome the recommendation made by Charlot (2009) on the exercise of a reading in “resonance”, in which “each interview is read and studied by registering memory (i.e. also a written clue) of the questions and the elements of response from the reading of the previous interviews”³⁸ (p. 23, own translation).

Thus, it was possible to “identify, explicit, conceptualize the processes that produce and structure the unique history of these young people”³⁹ (CHARLOT, 2009, p. 23, own translation) in their relationship with the Rio Doce. Acknowledging these young people in their anthropological, sociological and singular condition provokes us to listen to what they tell us about their places of life, and how the learnings happening in these places produce meaning.

The students interviewed either attend riverside schools and live in neighborhoods near the river or study in schools located in peripheral regions. They make up the usual profile of students from public schools regarding housing and family financial conditions: children of service providers, informal workers, owners of small businesses, retirees, beneficiaries of social programs, all facing the hardships of daily life in order to seek resources to meet family needs. This condition also marks their relationship with water, which at first became unfit for human consumption, and since then became an extra expense added to the household budget as a consequence of the sludge of ore rejects that struck the Rio Doce since.

Therefore, it is from the perspective of those affected by the burst of the Fundão dam that these students’ meanings of school learning can be read, and one can capture in their reports the search for the construction of what Charlot (2001) calls inter signifying logics, “when learning at school allows for a better understanding of life”⁴⁰ (CHARLOT, 2001, p. 150, own translation), at which time connections are established between school learning and out-of-school learning.

By presenting the entry of students into this logic, Charlot (2001, p. 150, highlights of the author, own translation) argues that the subject takes advantage “of specificities, heterogeneity, tensions, to ‘learn’ ‘in life’ and ‘at school’ at the same time”.⁴¹ In the author’s reflections, the subjects’ entry into this logic is fundamental to establish the meaning of being at school. This logic seems to

38 In the original: “cada entrevista é lida e estudada guardando a memória (ou seja, também uma pista escrita) das perguntas e dos elementos de resposta oriundos da leitura das entrevistas precedentes”.

39 In the original: “identificar, explicitar, conceptualizar os processos que produzem e estruturam a história singular destes jovens”.

40 In the original: “quando aprender na escola permite compreender melhor a vida”.

41 In the original: “das especificidades, da heterogeneidade, das tensões, para ‘aprender’, ao mesmo tempo, ‘a vida’ e ‘na escola’”.

conform to the learning demands that the subjects of this study present to school in relation to the water and the Rio Doce.

The Rio Doce as the only source of water collection and city supply carried to the inventories of knowledge tones of concern, complaint, and claims that prevail in the interviews. On the other hand, there remains a gap in understanding the citizens' engagement and the different levels of responsibility of mining companies and public authorities. Two movements can be read in the relationship with the water and the river: one movement that focuses on the population's coexistence with the lack of drinking water, right after the dam broke, when the toxic mud, following the river's course, reached the city; the other movement that concerns the consequences of this mud on people and the environment.

The interruption in the supply by the Autonomous Water and Sewage Service (SAAE) occurred on November 8, when the tailings mud arrived in the city. The supply was resumed on "November 16, with the treatment of raw water with black acacia polymer,⁴² capable of separating the water from the mud, before the conventional treatment"⁴³ (CAMPOS *et al.*, 2017, p. 22, own translation).

During this period, the population's access to drinking water was restricted to the long lines of mineral water distribution by the mining companies, where all the students from the riverside and peripheral schools and their families were constantly present. Another place to obtain water during this period was in the wells found in the nearby neighborhoods, as reported in the interviews.

In the interviews, the interruption of water supply is a recurring theme that lives in the memory of these students: waiting in lines, the number of people who depended on drinking water at home (twenty families have more than four people), the small trips to the distribution stations (mostly far from these subjects' homes), the means of transport (on foot, by bicycle, by bus), the Family collective efforts in the search for water (father, mother, uncles and aunts, older siblings), the search for water in other cities or in underground wells, the lack of water to drink while water distribution did not begin, the imbalance between the amount of water that could be obtained in these water stations and the demands of family consumption.

The effects of the dam's rupture are present in the students' reports:

My parents had to get (water)... we had to stand in line for water, getting the water bottles. There were a lot of people. One day we couldn't even get it (because) so many people in line. My father sometimes went to another city to get water. A nearby city. There were several places, many distribution points. Sometimes [...] here in the neighborhood, or in other neighborhoods. Then, when possible, because my father worked until five, when

42 Information on the technology used in the text of Scirea (2015).

43 In the original: "dia 16 de novembro, com o tratamento da água bruta com polímero de acácia-negra, capaz de separar a água da lama, antes do tratamento convencional".

*possible, we got it, but when it wasn't we just didn't have any.*⁴⁴ (Ana, School B, own translation)⁴⁵

Ana, who lives with her father, mother, and sister, exposes her saga in search of water not always successful – sometimes she just “ran out of water” because she could not reconcile her own schedules with the distribution schedule. Alan (school C) along with his mother braved the lines of water distribution – “when [she] got to know” about the presence of the truck, and each managed to pick up “two packs”, totaling 12 liters of water for the family of five people, which was insufficient to meet family needs.

For five students at school D, located in a peripheral neighborhood and far from the central supply, water was already a scarce commodity, even before rupture of the Fundão dam. Water as a fundamental human right (ORGANIZAÇÃO DAS NAÇÕES UNIDAS – ONU, 2014) is not guaranteed on a daily basis to the residents of the neighborhood. Paradoxically, fetching the water distributed free of charge allowed the access to water, even in this difficult moments. “*gee, we got in line to get water, we live here and had to go to the water distribution station to get mineral water, in Planalto [a reference to another neighborhood] ... gee, too much work*”⁴⁶, reported Brian (school D), who went with his father and brother in search of water for a family of six people.

Initially, the river stands out as a source of supply in the interviews. This is perhaps due to the fact that the students remember the interruption of the water supply in the city. The concerns resulting from the arrival of mud, the absence of drinking water, the dependence on water distribution by the mining companies, the insufficiency of mineral water distributed and the uncertainties brought by the scenario of socio-technical disaster expose the fragility of this population in relation to the mining companies and reflect the unequal power relations between both groups (ZHOURI, 2018).

Therefore, it is in this context of water shortages that the river appears as a source of supply, and the relationship with knowledge is limited to water as a resource:

*Ah! I know that it supplies Governor Valadares, right? Then I know that Samarco's tragedies happened there and contaminated the water. It was a disturbance for Governor Valadares, many people ran out of water, they had to keep fetching the water they were distributing, and they stopped distributing it, that's what happened, right?*⁴⁷ (Adão, school D, own translation)

44 In the original: “Meus pais tinham que buscar... a gente tinha que ficar em fila de água, pegando água. Tinha um monte de gente. Tinha dia que a gente não conseguia nem pegar de tanta gente que tinha na fila. Meu pai, às vezes, ia buscar água em outra cidade. Cidade vizinha. Tinha vários lugares, vários pontos. Tinha, às vezes aqui no bairro, tinha nos outros bairros. Aí quando dava, porque meu pai trabalhava até às cinco, quando dava a gente pegava, mas quando não dava, a gente ficava sem.”

45 The literal transcription of the interviews has been preserved, and the discursive excerpts of this article respect orality.

46 In the original: “Ih, nós entrava em fila pra pegar água, nós mora aqui e tinha que ir no posto de água mineral pegar água lá, no Planalto [referência a outro bairro]... nossa, trabalho demais.”

47 In the original: “Ah! Eu sei que ele abastece Governador Valadares, né? aí eu sei que aconteceu as tragédias da Samarco lá que deu na contaminação da água aí. Aí foi um transtorno pra Governador Valadares, muita gente ficou sem água, teve que ficar pegando água que estava distribuindo, e eles pararam de distribuir, e teve isso aí, né?”

Adão's understanding of water as a source of supply is reaffirmed in the evocation of the knowledge of other students, reinforcing the perception of the environment as a resource – *“the Rio Doce is the only form of supply here in Valadares”* (Jane, school B); *“because it is the only river that supplies our entire city. Without the river, we can't live”* (Leo, B school); *“I learned that the Rio Doce, that [...] many people drink from it”* (Ruan, D school).

It is also water as a resource that is evoked in the environmental care learned at school, as can be seen in Nayla's reaffirmation of her school learning about the Rio Doce:

*Cause water is very important, right? Water can't be dirty, it has to be clean, healthy so we can drink it. Here [at school] I learn what they tell us, I mean... to take care of the Rio Doce and its water too. Not throwing out garbage in the Rio Doce, not littering the Rio Doce, throwing out everything right so we don't get the water dirty.*⁴⁸ (Nayla, school C, own translation)

When referring to learnings about water and the river at school, a recurrence of environmental care terms such as *“do not waste water”, “do not throw garbage”, “do not pollute”, “take care of the water”, “learn to turn off the faucet”, “you have to keep what you have, because otherwise we may run out of it and everyone will suffer wanting water, and go looking for any hole (well) because we won't find it”*⁴⁹ (Pedro, school A).

The conservationist or recursist perspective that values environmental care reaffirms individual positions, which, although being important from the conservation point of view, are insufficient to critically understand this scenario of “an imbalance between extensive exploitation of mineral resources and actions to preserve and prevent environmental and human harm, which are essential to reduce the impacts caused”⁵⁰ (RODRIGUES *et al.*, 2016, p. 89, own translation).

In general, students say they have learned “little” or “almost nothing” about the Rio Doce at school. Besides the focus on resources or care, knowledge about the river appears in three of the interviews. In them, the focus is *“the history of the river [...] we study the cities where it goes through, where it flows”* (Bruno, school A).

Knowing the history of the river is a type of knowledge evaluated by Lia (school C) as important.

48 In the original: “Porque é muito importante a água, né? A água não pode estar suja, tem que estar sempre limpa pra gente poder bebê-la saudável. Aqui [na escola] eu aprendo o que eles falam pra gente, é... cuidar do rio Doce e cuidar da água também. Não jogando lixo no rio Doce, não jogando papéis no rio Doce, jogando tudo no lixo direitinho pra não sujar a água.”

49 In the original: “economia de água”, “não jogar lixo”, “não poluir”, “cuidar da água”, “aprender a fechar a torneira”, “tem que guardar o que tem, porque senão depois que acabar vai todo mundo sofrer querendo água, saindo procurando por qualquer buraco porque não vai achar não”.

50 In the original: “desequilíbrio entre a extensa exploração dos recursos minerais e as ações de preservação e prevenção de danos ambientais e humanos, essenciais para a redução dos impactos causados”.

[...] River Carmo. I didn't know, so it was the geography teacher who explained. I was always curious to know why the Rio Doce [is called that]. It's a tiny little thing that makes a difference.⁵¹ (own translation)

A student named Davi says he learned where the Rio Doce “passed and its hydrography, and only that” (Davi, D school). He states that the river “goes through Valadares, Mariana, from here it flows through the Espírito Santo, and from there it flows into the sea”.

The expression “only that”, used by Davi, makes sense when he answers the question on whether he knew the history of other rivers:

Davi - The Tiger River, the [river] Euphrates that is in Europe [sic], the Ganges River in India, the Volva River in Asia, the Yellow River in China and several others.

Researcher - What have you learned about these rivers, for example, the Tiger and the Euphrates?

Davi - I learned about their locality and some historical facts about it.

Researcher - An example of a historical fact.

Davi - Ah, a story from Greek mythology, they said there was a hero who brought the two rivers together.

Researcher: What about the other rivers that you mentioned?

Davi - the Ganges River was a sacred river for the Buddhists [sic], the Volva River I only learned the location, and the Yellow River in China I learned about its course.⁵² (own translation)

Davi also demonstrates ISL on some historically important rivers, identifying their geographical location, their course, and the cultural relations that civilizations establish with the waters. However, this young man recognizes that he knows little about the Rio Doce, which goes through the city where he lives. The student Lia demonstrates knowledge about the formation of the Rio Doce as a former Carmo river, and like Davi, she states that she knows little about it. She expresses her interest in broadening her knowledge and suggests the school subjects that she considers appropriate for the promotion of such learning – “geography, history, and science”.

51 In the original: “rio do Carmo. Eu não sabia, então foi a professora de Geografia que explicou. Eu sempre tive curiosidade para saber por que o rio Doce [é chamado assim]. Isso é uma coisinha tão pequenininha que faz uma diferença.”

52 In the original: “Davi - O rio Tigre, o [rio] Eufrates que está na Europa [sic], o rio Ganges na Índia, o rio Volva na Ásia, o rio Amarelo na China e vários outros.
 Pesquisador - O que você aprendeu sobre esses rios, por exemplo, o Tigre e o Eufrates?
 Davi - Eu aprendi a localidade deles e fato histórico que tem sobre ele.
 Pesquisador - Um exemplo de um fato histórico.
 Davi - Ah, uma história que, da mitologia grega que falavam que tinha um herói que juntou os dois rios.
 Pesquisador - E sobre os outros rios que você citou?
 Davi - O rio Ganges era um rio sagrado para os budistas [sic], o rio Volva eu só aprendi a localização, e o rio Amarelo na China eu aprendi o caminho por onde ele passa.

The contents for science and geography subjects, which are transversed by environmental education, are part of the Sustainability and Protagonism axis in the ETI curriculum. The focus of this axis is

[...] to enable students with conditions for critical analysis of everyday situations and facts so that they can make more assertive choices for themselves and their social groups in order to become conscious and supportive citizens, who are able to act and positively change their own realities.⁵³ (GOVERNOR VALADARES, 2010, p. 4, own translation)

In this way, the knowledge about the Rio Doce explicitly composes the ETI curriculum, attributing to the disciplines and contents of this axis the commitment of the generation of AIE as well as AC. In the context experienced by FTS (Full-time School) students, it is necessary to understand the importance of “educational practices that strengthen the participation of subjects and groups in public spaces, the social control of public policies and the reversal of asymmetries in the use and appropriation of natural resources”⁵⁴ (LOUREIRO, 2012, p. 89).

It is important to reflect that, the relevance of the CL is reaffirmed in order to understand the predatory actions of the mining companies, the technical and legal terms that have become part of the daily life of the population, the proposals to repair and mitigate environmental and social damage, the silencing of public authorities and the regulatory frameworks of environmental policy as we consider the environmental education in a scenario of vulnerability and environmental risk that prevails in groups and communities affected by the socio-technical disaster. On the other hand, it is essential to be guided by the precautionary principle, as Rodrigues and Lenza suggest: “it must be seen as a principle that precedes prevention: its concern is not to avoid environmental damage, but to avoid any risk of damage to the environment instead”⁵⁵ (2015, p. 332). In other words, an EE is necessary to provoke reflection on the need to prevent not only what implies already known risks, but also acts, enterprising or scientific work whose consequences are unknown.

The contamination of the river water is presented in this scenario of tensions. In the set of interviews, there is a greater demand for the theme “contaminated water”, and it is out of this concern about the health of the population that students make explicit their feelings for learning about water and the river.

All the subjects interviewed have as common themes the presence of “*metals in the water*”, the “*water unfit for human consumption*”, “*there is iron, this thing from the*

53 In the original: “propiciar aos alunos condições de análise crítica das situações e fatos do dia a dia, para que possam fazer escolhas mais assertivas para si e para o grupo social ao qual pertencem, tornando-se cidadãos conscientes e solidários, que atuem e modifiquem, positivamente, sua realidade”.

54 In the original: “de práticas educativas que fortaleçam a participação dos sujeitos e grupos em espaços públicos, o controle social das políticas públicas e a reversão das assimetrias no uso e apropriação de recursos naturais”.

55 In the original: “deve ser visto como um princípio que antecede a prevenção: sua preocupação não é evitar o dano ambiental, mas antes disso, pretende evitar qualquer risco de dano ao meio ambiente”.

mining company” (Jair, school B), “*the dead fish and very dirty water*” (Sara, school C); “*a lot of ore that went into the water*” (Iana, school B), as these excerpts illustrate.

Davi, who sought information about the river after the dam broke, “*on television*”, reaffirms the presence of metals in the water, “*mercury, iron ore, copper, metals of this kind, but I don’t know their name exactly*”, and also states that “*the Rio Doce was already affected by metals, but it was the mud that increased the amount of metal in the water*”.

The students evoke the presence of metals in the river, present a list of these metals, and can even locate them in a periodic table, as Alan (school C) claims during the interview: “*if you show me the periodic table, I’ll show it to you*” – knowledge learned on television, Internet, newspapers, from parents, a teacher, grandparents and fishermen, but do not know the probable effects of these metals on human health.

Due to their lack of knowledge on the subject, the students suspect that metals “harm health” and cause diseases such as cancer, visual impairment, stomach problems, flu, yellow fever. Their concerns about the river are therefore linked to survival and health, and in the “contamination of the water”, they find an explanation for the illness of their fathers, mothers, uncles, grandmothers and younger siblings.

The students’ concerns about the presence of metals in water are justified. The Instituto Mineiro de Gestão das Águas (Igam) published, in 2018, a document on the quality of the waters of the Rio Doce after three years of the Fundão Dam rupture, and confirms the presence of arsenic and metals, such as iron, aluminum, lead, manganese, chromium, mercury, and nickel, above the accepted limit (IGAM, 2018).

Therefore, part of these metals are still present in the river, however, the SAAE reports refer only to the basic quality parameters of the treated and served water, and do not indicate anomalous results⁵⁶. The technical language of the reports makes it difficult to effectively understand the situation. Thus, insecurity is established, generating stress, so “the disaster becomes only a ‘risk factor’, in technical and clinical/biomedical language. However, for the population, the risks do not mean risks, but damages, diseases, physical pain”⁵⁷ (PENIDO, 2018, p. 45, quotes of the author), as studies confirm it by problematizing the effects of this socio-technical disaster on human health, including concerns about the concentration of heavy metals in the river (RODRIGUES *et al.*, 2016).

Although the students’ evocations, both in the inventories of knowledge and in the interviews, show that school appears discreetly as a source of learning about the water and the Rio Doce, the subjects interviewed wish to learn more from school and teachers.

The need for a link between school knowledge and life permeates various debates in the field of education, and listening to students shows that the link

⁵⁶ Information available at: <http://www.saaegv.com.br/downloads/categoria/control-de-agua/19>. Access on: August, 2019.

⁵⁷ In the original: “o desastre se torna tão somente um ‘fator de risco’, na linguagem técnica e clínica/biomédica. Entretanto, para a população atingida, os riscos não são riscos, e sim danos, doenças, dores físicas”.

between this knowledge is made by subjects in a movement of inter signification. School acquires centrality when moving towards this direction. As students direct the needs and desires of learning to school, demonstrating confidence in its knowledge, in a context of insecurity and environmental risk.

One learns and it is also taught at school that water in its natural state is colorless and odorless, but for Breno (school B) the water made available for drinking right after the dam broke “had a strange taste”. On the day of the interview, he said he did not know if it was “*good to drink*”, but he suspected that maybe he was already getting used to “*its taste [so] it is good*”. This is the context of insecurity experienced by students and their families that outlines the demands of school-oriented learning.

I would like to know the name of all the metals, I would like to know the amount of them in the water and the problems that happen if you have the water with one of these metals.
(Daniel, A school)

If the water's good... if we can drink it. (Eder, C school)

If you can get a disease, how they clean the water, what products they use. (Gui, D school)

Yeah, I was wondering if it's clean now if you can drink it for sure. (Flávio, school B)⁵⁸ (own translation)

Therefore, the school means the safe place for accurate knowledge about the quality of water, but the demands for learning are limited to human health, although this view is legitimate, it enables us to reflect on the predominance of an anthropocentric view on nature – at the service of the humanity and the disregard of the river as part of a dynamic system, where water, land and living beings, including human beings, are interconnected and interdependent.

This strengthens “the need to build an ecological consciousness based on scientific knowledge”⁵⁹ (CHARLOT; SILVA, 2005, p. 73, own translation). This awareness and the role of school are present in the speech of one of the students in recognizing the “*environmental imbalance*”, relating it to yellow fever as he learned from the science teacher: “*Cause [before] there were fish, toads, these animals that ate the mosquitoes. Then the fever came because they weren't there to eat the mosquitoes*”⁶⁰ (Carlos, school C).

Following the arguments and defenses of the authors of this field, already cited in this article, a range of possibilities is opened up for EE, which is even demanded by the students themselves. Aldo (school B) recognizes the river as “*alive*” and would like to know “*more about its recovery. But it'll be difficult to recover it, for sure*”.

58 In the original: “Eu queria saber o nome de todos os metais, eu gostaria de saber a quantidade deles que tem nas águas e os problemas que acontecem se ingerir a água com um desses metais”; “Se a água está boa, se a gente pode beber”; “Se dá doença mesmo, como é que eles limpam a água, que produto que eles usam”; “É, eu queria saber se já tá limpo, se já pode beber mesmo, ter a certeza”.

59 In the original: “a necessidade de construção de uma consciência ecológica apoiada em um saber científico”.

60 In the original: “Porque tinha peixe, sapo, esses bichos que comem os mosquitos. Aí deu doença, porque eles não estavam lá para comer os mosquitos”.

Aldo's statement is corroborated by authors who have dedicated themselves to analyzing the effects of this disaster on the river and the complexity of the recovery process, which may be impossible or take decades in the case of endangered species, depending on the aspect in question (FREITAS; SILVA; MENEZES, 2016).

In addition to the recognition of the river as alive, another student indicates the desire to learn about history, and her speech states that it is a river already affected by human action. For this reason, she calls on the population to position themselves as citizens.

Oh! I think people don't talk much because they don't know. I had to explain the story better, talk about why it's like this. That all this, I think the population is to blame a little. That even before all this tragedy, it was the way it was. Dirty, drying up, that's the population's fault, they don't care. So, I think, first of all, people had to be aware of it.⁶¹ (Bia, C school) (own translation)

If school knowledge about rivers such as historical and geographical aspects, socioeconomic importance, river basin, main river and tributaries, springs and mouths, biodiversity and others can be limited to certain subjects such as history, geography, and sciences, in the historical ways of the curriculum organization in Brazil, it is worth reflecting on the perspective of EE as a cross-curricular theme, especially in the context of environmental risk experienced by these students. In this context, there is an urgent need for an interdisciplinary movement in environmental education that provokes reflexivity, in a constant process of “recreation and reinterpretation of information, concepts and meanings, which originate from classroom learning or the students’ personal experience”⁶² (JACOBI, 2005, p. 245, own translation). Therefore, it is important to recognize the complexity of the interrelationships between people and the environment that imply the strengthening of bonds; relationships that imply a feeling of belonging, identities and cultural relations; environmental protection; citizenly positionings; environmental solidarity towards the challenging formation of an “ecological subject” (SAUVÉ, 2005a).

As we reflect on the presence of the theme “heavy metals” in the inventories of knowledge, a theme also expanded to the interviews as concerns with human health, we see that this theme in school is linked to the knowledge about heavy metals and their effects on various living beings in food chains (bioaccumulation and biomagnification) and physical-chemical parameters of water and are treated as specificities of science teaching.

61 In the original: “Oh! Acho que as pessoas não falam muito, porque não conhecem. Tinha que explicar melhor a história, falar por que tá assim. Que isso tudo, acho que tem uma pequena culpa da população. Que, mesmo antes de toda essa tragédia, já tava do jeito que tava. Sujo, secando, isso é falta de cuidado da população. Então, acho que, antes de tudo, tinha que conscientizar as pessoas, né?”

62 In the original: “recriação e reinterpretação de informações, conceitos e significados, que se originam do aprendizado em sala de aula ou da experiência pessoal do aluno”.

Charlot (2009, p. 26) emphasizes that “learning is to appropriate knowledge”, whether they are objects of everyday life, relational forms, control of activities, etc. (CHARLOT, 2000, 2001, 2009), and also specific knowledges, which in schooled societies concern knowledge that, in a certain way, circulates in school, or, when evoked in different situations, carry the school’s mark; the author cites, in his researches, activities, such as reading, writing, telling, or specific knowledge, such as “the capital of Brazil, what magnetism is or an account report” (CHARLOT, 2009, p. 26). The author gives importance to school as a specific place for epistemic knowledge, which has meaning in the bonds established in identity and social relations (CHARLOT, 2000, 2001, 2009). Therefore, the meaning and demands presented by these students on the theme “heavy metals” and its unfoldings are reaffirmed.

In order to comprehend the complexity of the environmental debate at school, and at the same time welcome and respond to students’ learning demands on this topic – one that reveals insecurity about water and the procedural effects of the ongoing disaster –, as other studies have shown (FREITAS; SILVA; MENEZES 2016; MILANEZ; LOSEKANN, 2016; LOSEKANN, 2018; PENIDO, 2018; ZHOURI *et al.*, 2018), in FTS, the transversality of the theme is presented as a possibility, via the Sustainability and Protagonism axis, which is part of the science area. On the other hand, due to the context, EE is challenged to insert itself “in the heart of school practices given its condition of transversality” (CARVALHO, 2005, p. 59), so that we avoid the curricular fragmentation that impairs the understanding about the complexity of the relations between people and environment.

The challenge for school is to promote environmental education (EE), generating an understanding of how the disruption of the Fundão dam, whose “consequences remain as ‘the damage’ is multiplied, that is, the disaster has become a process”⁶³ (ZHOURI *et al.*, 2018, p. 55, italics of the original, own translation) that is experienced by affected communities, and continues to affect the environment. It is therefore up to EE to contribute to challenge a scenario of environmental, social, political and economic changes, which has enmeshed those affected in the power games of the mining companies, allied to government disengagement, as several studies have shown (FREITAS; SILVA; MENEZES, 2016; MILANEZ; LOSEKANN, 2016; LOSEKANN, 2018; ZHOURI *et al.*, 2018; ZHOURI, 2018).

It is also necessary to deconstruct the anthropocentric vision as “one of the ethical principles of environmental education” (REIGOTA, 2017, p. 16). In the context of the socio-technical disaster that has had a major impact on the environment, it is imperative that the groups and populations affected feel part of the environment, so that they can, in a reflexive and citizenly manner, understand and position themselves in the power games involved in the relations between the mining companies responsible for the disaster and the populations affected, as well as in defense of the river and the biosphere that constitutes it.

63 In the original: “consequências permanecem à medida que se multiplicam ‘os estragos’, ou seja, enquanto o desastre, como processo”.

CONCLUDING

In the study with FTS students, the EE on the Rio Doce was the most evoked, and the media was recognized as the main source of learning. However, younger students want to know more about ISL, so schools and teachers are presented as references for the desired learning. In this sense, students reaffirm the school as a place of specific learning and, therefore, of guiding towards the problematization of the issues that affect them, especially those elaborated in the context of the socio-technical disaster in the Rio Doce.

The considerations carried out in this study on the environmental learning of students and their desire to learn at school about water quality, the presence of heavy metals in the river, the consequences of the disaster, the future of the river, show us gaps in environmental learning, which need to be filled by the school playing its role as the subjects of this study demand. Efforts are also being made to expand the repertoire of environmental learning for students from affected communities, for collective decision making and action in the context of the disaster, in a socially responsible manner.

Thus, from this perspective, we are concerned about the few references made by the participants in this study to the CL, and the gaps identified in these learnings that reflect on political action in relation to the Rio Doce and understand the responsibilities of companies and public authorities, as well as the necessary engagements of those affected to denounce the socio-environmental damage and the ask for effective actions.

As we identify the disaster as socio-technical, we recognize its procedural law framework and many of its consequences that have not come public. The affected populations are at the mercy of the legal violations, and mitigation is not yet a reality as rebuked by the authors cited in this text. Thus, the concept of socio-technical disaster advocates the importance of continuously discussing the subject and promoting learning among FTS students and other affected populations. Therefore, it is a scenario of uncertainty, in which we are all also affected by the devaluation of public policies on education and the environment, so that incentives are given to large economic development projects instead.

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