

Thematic investigation as curricular dynamics: developing the proposal in the classroom

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Abstract

This is a qualitative study, based on the theoretical perspective by Paulo Freire and the assumptions of the Science-Technology-Society (STS) approach and the Latin American Thought in Science, Technology and Society (LAT-STTS), considering the perspective of the social context of students as a starting point for their learning. From this perspective, we investigate how a curricular configuration based on Freirean assumptions and CTS/PLACTS productions may contribute to the knowledge building by students in the school environment from an effective work in the classroom. The objective of this investigation is to get a better contextualize the knowledge, involving students in order to promote their critical positioning and the creation of a more democratic society, in which students can express themselves in view of the advances in Science-Technology (ST), regarding issues that imply changes in their world. Thus, we addressed the theme of the implementation and operation of a Hydroelectric Power Plant. Therefore, we investigated an effective classroom practice, which involved teachers of Science and Geography and 9th-grade students from a municipal public school in the same location as the power plant. The corpus for analysis consists of journals kept by the students and the researcher used during practice. Methodologically, we adopt the Discursive Textual Analysis. The results are presented in three categories: Resignifying knowledge through 'demystification'; The critical social-environmental development of students in relation to the theme: from limit situations to untested feasibility; Learning assessment: the understanding and lines of thought from the perspective of students. Hence, connecting the critical-reflective classroom practice to curricular development.

Keywords: Science Teaching; Educational Practice; Science-Technology-Society; Curriculum.

Investigação temática como dinâmica curricular: o desenvolvimento da proposta em sala de aula

Resumo

Esta pesquisa é de cunho qualitativo, fundamentada na perspectiva teórica de Paulo Freire e pressupostos do enfoque Ciência-Tecnologia-Sociedade (CTS) e do Pensamento Latino-Americano em Ciência-Tecnologia-Sociedade (PLACTS), considerando a problematização do contexto social do educando como ponto de partida de sua aprendizagem na qual investigamos como uma configuração curricular de perspectiva dos pressupostos freireanos e produções CTS/PLACTS pode contribuir para a construção do conhecimento pelo estudante em espaços escolares, a partir de trabalhos efetivos em sala de aula. O objetivo desta investigação é para obter uma melhor contextualização dos conhecimentos, provocando o envolvimento dos estudantes a fim de favorecer o posicionamento crítico, na construção de uma sociedade mais democrática, em que os estudantes possam se posicionar frente aos avanços da Ciência-Tecnologia (CT), em questões que impliquem mudanças no seu mundo vivido. Para tanto usando a temática que aborda a problemática de implementação e o funcionamento de uma Usina Hidrelétrica. Portanto, investigamos uma prática efetiva em sala de aula, a qual envolveu professores (as) das disciplinas de Ciência e Geografia e estudantes do 9º ano do Ensino Fundamental de uma escola pública municipal de mesmo local do empreendimento. O corpus de análise é composto pelos diários dos estudantes e pesquisador, utilizados durante a prática. Metodologicamente, seguimos a Análise Textual Discursiva. Os resultados são apresentados em três categorias: Ressignificando conhecimentos a partir da 'desmistificação'; O florescer socioambiental crítico de estudantes diante da temática: de situações limites ao inédito e viável; Avaliação da aprendizagem: um retorno às compreensões e reflexões na

perspectiva dos estudantes. Assim, proporcionando vinculação de uma prática crítico-reflexiva em sala de aula ao desenvolvimento curricular.

Palavras-chave: Ensino de Ciências; Prática Educativa; Ciência-Tecnologia-Sociedade; Currículo.

Investigación temática como dinámica curricular: el desarrollo de la propuesta en salón de clase

Resumen

Esta investigación es de carácter cualitativo, basada en la perspectiva teórica de Paulo Freire y presupuestos del enfoque Ciência-Tecnologia-Sociedade (CTS) y del Pensamento Latino-Americano em Ciência-Tecnologia-Sociedade (PLACTS), considerando la problematización del contexto social del educando como punto de partida de su aprendizaje en la cual investigamos. Cómo una configuración curricular de perspectiva de los presupuestos freireanos y producciones CTS/PLACTS puede contribuir para la construcción del conocimiento por el estudiante en espacios escolares, a partir de trabajos efectivos en salón de clase. El propósito de esta investigación es para obtener una mayor contextualización de los conocimientos, provocando la participación de los estudiantes a fin de favorecer el posicionamiento crítico, en la construcción de una sociedad más democrática en que los alumnos puedan posicionarse ante de los avances de la Ciência-Tecnologia (CT), en cuestiones que supongan cambios en su mundo vivido. Para estos fines empleamos la temática que aborda la problemática de implementación y el funcionamiento de una Usina Hidroeléctrica. Por lo tanto, investigamos una práctica efectiva en salón de clase, la cual ha involucrado profesores (as) de las asignaturas de Ciencia y Geografía y estudiantes del 9º grado de la Educación Básica de una escuela pública municipal del mismo local del emprendimiento. El corpus de análisis es compuesto por los diarios de los estudiantes e investigador, utilizados durante la práctica. Metodológicamente, seguimos el Análisis Textual Discursiva. Los resultados son presentados en tres categorías: Reconsiderando conocimientos a partir de la “revelación”; El florecer socioambiental crítico de estudiantes delante de la temática: de situaciones límites al inédito y viable; Evaluación del aprendizaje: un retorno a las comprensiones y reflexiones en la perspectiva de los estudiantes. Así, se proporciona la vinculación de una práctica crítico-reflexiva en salón de clase al desarrollo curricular.

Palabras clave: Enseñanza de Ciencias; Prática Educativa; Ciência-Tecnologia-Sociedade; Currículo.

La recherche thématique comme dynamique programme: l'élaboration de la proposition en classe

Résumé

Cette recherche est de nature qualitative et est basée sur la perspective théorique de Paulo Freire à partir des hypothèses de l'approche Science-Technology-Society (STS) et Pensée latino-américaine dans la science-technologie-société (PLACTS). Ces hypothèses considèrent la problématisation du contexte social des élèves comme un point de départ pour l'apprentissage. Notre intention est comment examiner une configuration curriculaire dans cette perspective et à partir des hypothèses basées sur la théorie de Freire et les productions ST/PLACTS peuvent contribuer à la construction des connaissances par les élèves dans les espaces scolaires, à partir d'un travail efficace en classe. Le but de cette recherche était d'obtenir une meilleure contextualisation, provoquant l'implication des étudiants afin de promouvoir une position critique, dans la construction d'une société plus démocratique, dans laquelle les étudiants peuvent se positionner face aux avancées de la Science-Technologie (ST), dans les questions qui impliquent le changement dans leur monde vécu. En utilisant le thème qui aborde la question de l'implantation et de l'exploitation d'une centrale hydroélectrique. L'objectif est d'obtenir une plus, nous avons étudié une pratique de classe efficace, qui impliquait des enseignants qui enseignaient des cours de sciences et de géographie avec des élèves de la 9e année du primaire dans une école publique municipale située au même endroit que l'entreprise. Le corpus d'analyse est constitué des agendas des étudiants et des chercheurs, qui ont été utilisés lors de la pratique. Méthodologiquement, nous avons suivi l'analyse textuelle discursive. Les résultats sont présentés en trois catégories: la réallocation des connaissances résultant de la démythification; Le développement socio-environnemental critique des étudiants en relation avec le thème: des situations limites nouvelles et viables; Évaluation des apprentissages: retour à la compréhension et à la réflexion du point de vue des élèves. Ainsi, fournir un lien entre la pratique de la pensée critique en classe et l'élaboration du curriculum.

Mots clés: Enseignement des Sciences; Pratiques éducatives; Science-Technologie-Société; Curriculum.

1. INTRODUCTION

Currently, many researchers – (Auler, 2002, 2007), (Auler, Dalmolin, Fenalti, 2009), (Santos, 2016), (Santos and Auler, 2019), (Strieder, 2012) – analyze the articulation, within the educational sphere, of the Science-Technology-Society (STS) approach and the ideas of Paulo Freire. Such articulation is based on the thematic approach, being a "curricular perspective whose logic of organization is structured on themes, through which the teaching contents of the disciplines are selected. In this approach, the scientific conceptualization of the curriculum is subordinated to the theme" (Delizoicov, Angotti, Pernambuco, 2009, p. 189). However, regarding the attainment of this theme, there are divergences to both approaches.

In the Freirean thematic approach, the themes are obtained through a "Thematic Investigation" in a search for "generating themes", which involve problematic and contradictory situations, highlighting the importance of dialogue and problematization as a way of obtaining the themes and providing them back with a dialogical-problematizing approach to education (Freire, 1987), in which the curricular relationship between the "school world" and the "life world" are two dimensions that interact, one influencing the other, establishing a communication between curriculum and reality (Auler, 2007).

The thematic approach in the STS perspective disregards the effective interaction between the "school world" and "life world" dimensions, with more general themes (Auler, Dalmolin, Fenalti, 2009), differing from Freire's perspective, whose central point is that the themes must have meaning to the students, that is, themes related to their experience. Another divergence occurs in defining the theme to be worked on, Freire proposes the Thematic Investigation, and the "participation of the school community in defining the themes, while for the STS approach, this is not necessarily the case, since generally, the themes would come from the teacher" (Strieder, 2012, p. 151). As for the theme/content relationship, in the Freirean approach, "after defining the theme, the question arises: what contents, what knowledge is needed for understanding, for decoding the theme. There is no a priori defined curriculum" (Auler, Dalmolin, Fenalti, 2009, p. 78). That is, the contents are subordinated to the theme. From the perspective of the STS approach, "the curriculum is established before defining the theme. The theme then arises to energize, contextualize, motivate the development of curricula, often structured in a linear and fragmented manner" (Auler, Dalmolin, Fenalti, 2009, p. 78), the theme is subordinated to the content.

Thus, the convergence point between both approaches is characterized by greater participation in decision-making processes on social themes involving Science-Technology (ST), common elements to Freire's references. In overcoming the culture of silence, they promote a greater perception of the world. The human being ceases to be a historical object and becomes an active and critical subject, problematizing the current directions given to scientific-technological development and indicating new aspects.

Para Paulo Freire la cultura del silencio es producida por la imposibilidad de que los hombres y mujeres digan su palabra, de que se manifiesten como sujetos de praxis y ciudadanos políticos, sin condiciones de interferir en la realidad que los cerca. Realidad generalmente opresora y/o desvinculada de su propia cultura (Streck, Redin, Zitkoski, 2015, p. 129).

As a consequence of this movement, part of society ceases to be a mere passive agent and moves on to a participating condition in the construction of knowledge and decision making. This perspective is corroborated by one of the educational objectives of this pedagogical work, which seeks to involve students in a context that contemplates the interactions between Science, Technology and Society and, above all, that is not detached from their reality. Through STS activities, it seeks to incorporate a consideration of the possibilities of sustainable development and the social and environmental consequences of human action.

For Sachs (2004), the concept of sustainable development is governed by five main factors, called "pillars of sustainable development." Sachs has not dismissed the concept of environmental sustainability, as described by Kruel (2010); in fact, the author associated the environment and other issues, specifically and simultaneously to these five factors: Social sustainability, aimed at building a civilization for the "being," with greater equity in the distribution of possessions and income, working to improve the rights and living conditions of the population. Economic sustainability, made possible by efficient resource management and regular flow of public and private investment, as well as an evaluation in macrosocial terms rather than by profitability criteria alone. Ecological sustainability refers to the intensification of the use of potential resources of various ecosystems with minimal damage to life-sustaining systems; by limiting consumption of fossil fuels and depletable resources, replacing them with renewable and clean resources. Spatial sustainability, with a more balanced rural-urban configuration and for a better territorial distribution with respect to urban settlements and economic activities. Cultural sustainability, privileging change processes within cultural continuity and translating the concept of ecodevelopment into particular solutions that respect the specificities of each ecosystem, each culture (Krue, 2010, p. 07).

Involving educational aspects, Paulo Freire gains prominence in the confrontation of themes and experiential problems with non-formal education, through which he proposed the approach by themes, using the thematic investigation as methodology, which we transpose to formal education in the classroom.

As curricular approaches based on Freirean assumptions and on the references of the so-called STS movement become pertinent, and as the influence of ST in human activities has emerged in a way that collaborates with the teacher and enhances the participation of students in the classroom, when the experienced reality is problematized, a critical analysis of this reality can be achieved, which is established as the structuring axis of this approach.

The curricular approach of this research is based on Freire's perspective. The premises focus on the objectives of STS and the Latin American Thought in Science, Technology and Society (LAT-STTS), considering the problematization of the social context of students as the starting point for their learning. The Freirean thematic investigation was used as the curricular dynamics (Freire, 1987; Delizoicov, Angotti, Pernambuco, 2009), organized in 5 stages, as will be discussed below, and reaching the classroom, which was the focus of this research. Therefore, in this paper, we analyze a curricular development proposal that intends to contribute with different perspectives to the curricular construction, through an activity that discusses the environmental impacts caused by the insertion of a Hydroelectric Power Plant, with 9th grade students in a municipal public school located in the same municipality where the power plant¹ is located. The intention was to create concrete experiences and works that would allow an approach to the STS movement with a focus on environmental education, which would be effective in the classroom, from the fifth stage of thematic investigation proposed by Delizoicov, Angotti, Pernambuco (2009) for the development of the program in the classroom.

In summary, we investigated how a curricular configuration based on the Freirean premises and the STS/LAT-STTS productions can contribute to the students' knowledge building in school environments from effective classroom work. By dimensioning these principles according to the school curriculum, we investigated how to foster social participation in the decision-making processes of ST, preparing critical and responsible beings capable of making changes/transformations to their world. The objective was to achieve a greater contextualization of knowledge, involving students in order to favor critical thinking and belonging, in building a more democratic society, in which they can express themselves in face of the advances of ST, regarding issues that imply changes to their reality and collaborate with the school environment, introducing different socio-scientific issues, in which they can relate issues from their world to the experiences acquired in the classroom and thus develop social responsibility.

These objectives are intrinsically related to the teachers, who work in this sense in structuring a curriculum that meets the contextualization of the school practice, from the articulation between the Freirean thematic approach and STS, in an interdisciplinary manner, in the search for a democratic and participative curriculum, forming critical subjects and transforming their reality.

¹ Located about 550km from the state's capital, Porto Alegre (RS), UHE Passo São João began to operate in 2012, being built in the Ijuí River in Roque Gonzales. The area of its reservoir also affects São Luiz Gonzaga, São Pedro do Butiá and Rolador. UHE Passo São João is a power plant that operates in the run-of-river type, meaning, its reservoir only function is to maintain the necessary unevenness to generate energy. The power plant is made up of a dam, that uses an adduction channel to lead the water to the powerhouse, in order to take advantage of the natural fall of the Ijuí River.

2. THEORETICAL REFERENCE

In 1961, in Brazil, the first Law of Guidelines and Bases of National Education (LDB) was promulgated, initiating changes in education at all levels. The most recent update of a guideline document was the National Common Curriculum Base (BNCC), from 2017, defined as "[...] a normative document that defines the organic and progressive set of essential learning that all students must develop throughout the stages and modalities of Basic Education" (Brazil, 2017, p. 07). This model guides the work of teachers and students of educational institutions.

The curriculum becomes an instrument, a guide for teaching activities, as well as a training tool for teachers. Thus, when teachers plan a curriculum, they are planning their pedagogical practice. Thus, the curriculum cannot be a set of subjects with specific knowledge to be transmitted disconnected from the experience of both teachers and students. Or else, a curriculum that does not include decisions on: what to teach? What contents to approach? These questions are answered by different specialists, and Basic Education teachers are often not part of that group. Sacristán and Pérez Gómez (1998) warn that we need a more careful analysis of the processes that guide the teachers' activities, separating the internal from the external context.

A more careful analysis will allow us to understand that the value of what is decided outside the school is not independent of how this is then transformed in the school. Also, anything that is produced inside the school is not completely foreign to what happens outside it. (p. 122)

The perception of a curriculum that free of interests, conflicts and contradictions, both external and internal to the environment in which it was conceived.

The curriculum is not an innocent and neutral element of disinterested transmission of social knowledge. The curriculum is implicated in power relations, the curriculum transmits particular social visions and interests, the curriculum produces particular individual and social identities. (Moreira and Silva, 2002, pp. 7-8)

Therefore, with the concern of how they affect the curriculum and, consequently, the teacher's activities, more specifically in Science teaching, and considering the fact that the curriculum can be presented to the teacher with previously defined determinations, decontextualized to their context and without their participation in its elaboration, showing itself a closed and normative curriculum, as properly declares itself and recently explicit the new BNCC version. (Brazil, 2019) The normative process can cause the simple reproduction of the knowledge provided on BNCC, including values and interests of who has financed its construction, increasing the relation of power for those who conceive and not for those who reproduce the curriculum that has been imposed.

Creating a general perception of teachers and students, since they treat them equally, denying their individualities, their differences, imposing contents that they think are necessary for the students' development and determining

the teaching activities, without knowing their practice. Therefore, the following question can be made: what is the possibility that a document such as BNCC can encompass and contextualize teachers and students' different experiences from distinct schools in a country like Brazil? Not to strongly criticize it (BNCC), but to think through a different angle, that is, discussing if there is really the possibility of a curricular document that can embrace all the distinctions and experiences of teachers and students.

Following this line of thought, curricular configurations guided by the reference of educator Paulo Freire, together with the STS approach, penetrate into the school environment as an alternative to the so-called traditional curriculum proposal which, often, can associate curricular subjects to market issues, being limited to a reproduction/transmission of specific knowledge from teachers to students, aggravating inequalities regarding the interests of social classes that have an advantage in the social organization, rooted in the capitalist ideology. In contrast to the traditional curriculum, the so-called critical curriculum opposes the power relations transmitted to students in a traditional conception (Moreira and Silva, 2002). A complete inversion of the fundamentals of critical theories in relation to traditional curriculum theories, as Silva (2005) points out:

[...] Traditional theories therefore focus on how to organize and develop the curriculum. Traditional curriculum models were restricted to the technical work of preparing the curriculum. Critical theories regarding the curriculum, in contrast, began by questioning precisely the assumptions of the current social and educational arrangements. (p. 30)

Although Paulo Freire did not develop a specific curriculum theory, he focused his work mainly on popular education, aiming at adult literacy, in non-formal educational contexts, as already mentioned. In this case, literacy was based on what Freire (1987) called a "generating word," that is, "it was based on a word belonging to the reality of these students, not only teaching the writing of that word but problematizing it in its social dimension" (Santos, 2016, p. 63). However, Freire, mainly in his work called "Pedagogy of the Oppressed," offered great insights to curriculum theories, linked to the thematic investigation, which, in the search for generating themes involve problematic, contradictory situations, emphasizing the importance of using dialogue and problematization as a way to obtain the themes and returning them as a dialogical-problematizing concept of education, a clear opposition to "banking" education, which only makes "deposits that the students, as mere incidents, patiently receive, memorize and repeat" (Freire, 1987, p. 37).

The concept of education defended by Freire is dialogical, an education carried out with the students, not over them, "the authentic education does not happen from 'A' to B,' or from 'A over B,' but from 'A' with 'B,' mediated by the world" (Freire, 1987, p. 54), aiming at the critical development of students. A dialogue that does not involve talking about something, but a dialogue mediated by the world, a dialogue between student and educator on themes and issues existing in the world (Santos, 2016). Problematization considers the social context of the

students as a starting point for their learning, originating from questioning, which will make them confront the problems, realizing that they need a new knowledge for their solution, that is, problematizing the life experience of the students, based on dialogue. It is based on both of these categories: dialogue and problematization.

The thematic investigation, described with more emphasis in the third chapter of the "Pedagogy of the Oppressed" (Freire, 1987), was initially developed in four stages and achieved its fifth stage by Delizoicov, Angotti, Pernambuco (2009), and is systematized as follows: a) First stage: - preliminary survey - consisting of recognizing the social-historical-economic-cultural context in which the student is inserted; b) Second stage: - analysis of situations and choice of codifications - choosing contradictions experienced by the students that summarize their way of thinking and seeing/interacting with the world, as well as the choice of codifications; c) Third stage: - decoding dialogues - obtaining the Generating Themes from decoding dialogues; d) Fourth stage: - Thematic Reduction - interdisciplinary team work, aiming at elaborating the curricular program and identifying which knowledge is necessary to understand the themes; e) Fifth stage: - program development in the classroom. This method is presented as a way of investigating the reality of students in their search for the theme. The latter generally presents scientific-technological problems that are part of the "life world" of students. They are then worked on in the classroom from the perspective of the STS approach.

As for the STS approach with educational characteristics, it derived from the STS movement, initially originated in the middle of the 20th century, in the Northern Hemisphere, mainly in the so-called capitalist countries, with the purpose of developing social welfare, opposing the mythical idea that more science and more technology would necessarily solve environmental, social and economic problems. Thus, the central objective of this movement is the search for democratizing decision-making processes involving themes/problems conditioned by the development of ST "in a society of scientific-technological products, the search is for a participation that reduces their negative, undesirable effects" (Santos, Rosa, Auler, 2013, p. 18).

At the same time, in Latin America, the Latin American Thought in Science, Technology and Society (LAT-STs) emerges, seeking the production of national ST that would meet local demands, bearing in mind that that ST imported from so-called developed countries "[...] would not necessarily be adequate to the interests and needs of the Latin American population, requiring a reorientation of the ST research agenda in such a way that it would incorporate local demands and values" (Roso and Auler, 2016, p. 372). A criticism to the linearity in which ST was transmitted by the so-called first world countries of the Northern Hemisphere.

Unlike the STS movement, LAT-STs did not have an initial impact in the educational field. However, some Brazilian educators - Auler (2002) and Auler and Delizoicov (2006) - are currently developing studies related to Education in this area, relating references concerning LAT-STs with those by the educator Paulo Freire, aiming at a greater social participation in the

decision making process of themes that involve common elements to Freirean principles, to overcome the culture of silence, breaking with the submission caused by "historical constructions" (Auler and Delizoicov, 2015) on the development of Science-Technology, in which part of society is led to sustain a posture of "fatalism", which, for Freire (2020), seeks to "[...] persuade us that we can do nothing to change the social situation which, once seen as historical and cultural, is now becoming 'almost the natural state'" (Freire, 2020, p. 21).

Such ideology creates "myths" or absolute truths, resulting from the historical construction of the scientific-technological activity, a logic that emphasizes oppressive hegemonic processes, in face of an oppressed and silenced society, limiting its action, caused by a reading of the world, believed to be free of values or intentionality, that is, neutral, strengthening myths created by the lack of problematizations, essential and intrinsic to a critical understanding of the world. Auler (2002) highlights the need to problematize myths: "the superiority of technocratic decision models, the libertarian/redemptory perspective attributed to Science-Technology (ST) and the technological determinism", which are supported by the supposed neutrality of ST, derived from naive conceptions about STS, considered as "limit situations", being presented as "historical determinants, overwhelming in the face of which there is no other choice, but to adapt" (Freire, 1987, p. 53). When problematizing these myths, solutions to the problems are visualized, reaching the "untested feasibility," so that the "liberating" action is imposed on people (Freire, 1987).

Paulo Freire uses this word/category (untested feasibility) for the first time in his work "Pedagogy of the Oppressed".

In this case, the themes are concealed by 'limit situations' that are presented as if they were historical determinants, overwhelming in the face of which there is no other choice, but to adapt. In this situation, humans are unable to transcend the limit — situations to discover that beyond these situations — and in contradiction to them — lies an untested feasibility (Freire, 1987, p. 60).

This investigation contribute to the process of emancipation of people as subjects, capable of discussing and acting, a process that requires knowledge building through dialogue, problematization and the idea of transforming reality (Strieder, 2012), in which the central point of the aforementioned Freire-STS approach in the educational field is established, the promotion in students of a greater perception of the world, in which the human being ceases to be a historical object and becomes an active and critical subject, problematizing the current directions given to scientific-technological development and establishing new indications to it. That is,

[...] aiming at the development of critical citizens, who understand scientific-technological activity and its relations with society, who know how to take a stand on issues involving them, who take responsibility and, furthermore, who are capable of intervening in the world in which they live. (Strieder, 2012, p. 161)

With the previously discussed premises, this research aims to analyze the implications of a curricular configuration based on the Freire-STS-LAT-STS approach, whose dynamics was based on thematic investigation, with a greater focus on the fifth stage, in the classroom, with the purpose of fostering social participation in the ST decision-making processes, developing critical and responsible beings capable of changes/transformations in the world they live in.

3. METHODOLOGY

As this work is part of a more comprehensive research, to our understanding, it is necessary a brief explanation of the whole study to contribute to the understanding of this paper. This is a master's thesis research that investigates the perspective of curricular configuration that articulates the Freirean thematic approach and STS in Basic Education, using the thematic investigation (Freire, 1987) to obtain the generating themes, emphasizing the importance of dialogue and problematization to obtain the generating themes and, in turn, providing as a dialogical-problematizing concept of education. In order to develop the thematic investigation, we also used the Delizoicov, Angotti, Pernambuco (2009) referential, which reached the fifth stage of classroom development, that is, the first three stages of thematic investigation for this research were investigated and defined by the author of this research, since he was inserted in the school context, developing at the time the work of education monitor, where, from observations and participation in the active school life of these students, he was able to know the context in which the students live and establish its contradictions.

This way, denoted the contradictions to the choice of the theme – about the implementation of a power plant that utilizes the river's hydroelectric potential for energy generation, involves several scientific-technological and socioenvironmental controversies, mainly about its impact – it is shown pertinent. Basically, the written of the research were divided in two moments, however, intrinsically connected, which correspond respectively to the fourth and fifth stages of the thematic investigation. The fourth stage of "thematic reduction" has assigned in its analysis class planning, that involved Science and Geography teachers in the elaboration of the curriculum that guides their work in the fifth stage of the effective work in classroom, performed together with students of the 9^o grade of Elementary School, with an average age of 14 years old.

The methodological organization of classes, correspond to the fourth stage, in which the participating teachers elaborated their planning together, has follow the Delizoicov, Angotti, Pernambuco (2009) referential, structured in the "Three Pedagogical Moments" and thus characterized: **Initial problematization:** stage of planning that consists in defiance the students to expose situations that they are thinking about, problematizing their knowledge while they are exposing. **Knowledge organization:** selected knowledge in the previous stage are systematically studied. **Knowledge application:** it is intended to address all the knowledge incorporated by the student.

It is important to highlight that, the fourth stage denominated "thematic reduction", in this work was described succinctly, in order to just contextualize the total set of the research, in other words, the fourth stage is presented in its totality in an approved article and awaits to be published in the journal "Caminhos da Educação Matemática em Revista", with the title "Currículo textures and educational practices: Freire-CTS approach in Science teaching". Therefore, the present work analyses just the fifth stage of thematic investigation, the classroom practice.

The practice was developed in a municipal public school sited in the same city of the project implementation (power plant). As the development of the proposal has occurred in the annual school year, the classes were organized accordingly to the schedule provided by the school administration, having no influence on other non-participating teachers and subjects. Each participant teacher has weekly class hours for your subject and it has been followed. Science has weekly workload of three hours/classes and Geography has two hours/classes per week. At the end of the practice, it was used and counted: ten hours/classes of Science and four hours/classes of Geography, being that, there were four hours/classes together, totalizing eighteen hours/class used to carry out the fifth stage.

All participating students used journals, used along all the work in classroom. There they described their reflection about the knowledge taught and everything that was significant on the topic addressed. One of the researchers followed all the process and to perform this observation it was also used a journal, describing his reflections about the practice, as well as the dialogues between students, teachers and other subjects signaled ahead. For Porlán and Martín (1997), the use of the "diary" as a methodological resource allows reflecting on the most significant processes in which the author is immersed.

Es una guía para la reflexión sobre la práctica, favoreciendo la toma de conciencia del profesor sobre su proceso de evolución y sobre sus modelos de referencia. Favorece, también, el establecimiento de conexiones significativas entre conocimiento práctico y conocimiento disciplinar, lo que permite una toma de decisiones más fundamentada. A través del diario se pueden realizar focalizaciones sucesivas en la problemática, que se aborda, sin perder las referencias al contexto (p. 23).

It the end, all the journals (students and researcher) were used to analyze the practice development in classroom, respectively the fifth stage of the Thematic Investigation, making up then the corpus of analysis.

As this is a qualitative analysis, we used the Discursive Textual Analysis (DTA) (Moraes and Galiazzi, 2016) to implement the analysis about the corpus (journals). The DTA is structured in the following stages: Unitarization: corpus fragmentation elaborated through the comprehension of the works, where texts are separated in meaning units. These that from the process of text fragmentation or deconstruction, contributed to understand the meanings of the texts in different limits and their

details, being the researchers themselves who decide to what extent they will fragment their texts. "Each unit composes an element of meaning pertinent to the phenomenon of analysis" (Moraes and Galiazzi, 2016, p. 41).

The second stage of DTA, the categorization: the meaning units are grouped according to their semantic similarities, in this work in three emerging categories, presented from the third stage called Communication: descriptive and interpretative texts were elaborated (meta texts) about the thematic categories (Moraes e Galiazzi, 2016), presenting ahead.

To contribute to the identification of research subjects, we use alphanumeric codes, both for student memories identifying them as "S1, S2... S13", as well as in the speeches of the Geography "T1" and Science "T2" teachers, identified in the memories of the researcher.

4. RESULTS

Based on ATD, we identified 96 "units of meaning" extracted from the corpus of analysis, revealing three categories in the categorization process: "Resignifying knowledge through "demystification"; "The critical social-environmental development of students in relation to the theme: from limit situations to untested feasibility" and "Learning assessment: the understanding and lines of thought from the perspective of students".

Categories we present, use several "context units" (fragments of the corpus). "These are relatively large fragments of texts that delimit the context of the units of analysis" (Moraes and Galiazzi, 2016, p. 78), that is, with the purpose of better contextualizing the "units of meaning" found in the unitarization stage.

4.1 Resignifying knowledge through "demystification"

The first category arises from the analysis of both the students' and the researcher's logbooks, based on an appropriation of knowledge, proposed by the participating teachers to the students, which provoked in them their resignification. The latter is possible due to the unveiling of "myths" which, for Freire (1987), are "created and developed in the oppressive structure [...]" (p. 27). The myths are caused by a world view that is believed to be free of values, aseptic, that is, neutral. Thus, creating a fatalistic posture to the oppressed and their unquestionable immobilizing will, in relation to which, from the point of view of this ideology, we can do nothing about and there is only one way out, "to adapt the student to this reality that cannot be changed" (Freire, 2020, p. 21).

A fatalist posture, which in school education means to reproduce content, to reproduce an "elaborated culture", which, for Auler (2018), is the type of knowledge that, in general terms, "[...] passes through the filters of the capital or of the dominant elites at each historical moment", that is, "knowledge marked by history, by the interests and values of those who demand this culture" (p. 123).

To "escape", so to speak, from this structure of reproduction of an elaborated culture, decontextualized

from the experience of students, the dynamics of the Thematic Investigation was used, entering the school environment, in opposition to banking education, whose main result is the silence of students, because, besides patiently receiving the elaborated culture, they are contaminated by alienation and passivity, which does not match Freire's problematizing and liberating education, which comes from the critical and joint reflection of reality, and is only possible through dialogue.

A problematizing dialogue that is perceptible at different times and that I point out in this category, such as the one concerning the first "demystification" about the promised creation of jobs. For contextualization purposes, the dialogue between teachers and students began by analyzing two articles from public websites, which emphasized the significant creation of jobs that the Passo São João Hydroelectric Power Plant (HPP) facilities would bring to the municipality, a fact that could be viewed as an economically positive milestone, with few impacts, as claimed by S4: "No, this means growth for the city." However, after reading and discussing the articles, this was firmly contested by the same students, who, by investigating the divergences pointed out after a visit to the power plant facilities, noted that there were effectively only 12 employees. The teacher was ready to explain that "the creation of jobs was temporary, and after construction this number would plummet, because there would not be the need, there would not be as many jobs for everyone" (T1). This caused some indignation in S2: "Why didn't the article explain that?"

A brief dialogue that has shown how historical constructions, also presented in the articles, can induce myths, fed by the supposed neutrality, presented as a fact not consistent with reality, or at least concealed. The argument that with the greater development of ST, caused by the installation and operation of the Hydroelectric Power Plant, there would be a greater economic development feeds the traditional/linear model of progress. "In that sense, scientific development (SD) creates technological development (TD), which creates economic development (ED), which in turn determines social development (SD – social welfare). SD → TD → ED → SD" (Auler, 2018, p. 113).

The second "demystification" that we point out in the development of this category, is in accordance with the general objectives of this research, which involves several scientific-technological and socio-environmental controversies. It began with a visit to Casa da memória ("House of memory"), which is a physical space dedicated to the maintenance of the social and cultural memory of the residents of the five municipalities affected by the hydroelectric lake (Roque Gonzales, Dezesseis de Novembro, São Luiz Gonzaga, Rolador and São Pedro do Butiá).

The dialogue that most caught the students' attention during the visit was the removal of the residents from the flooded areas, their great social impact, reported by the person in charge of guiding visits to Casa da Memória, who was a former resident (R) of one of the areas. "It hurts a lot" (R). "We had plans for the future!" (R). "We were left with little assistance!" (R), said the employee/resident. Again, bringing to the debate the supposed redemptive

salvation of ST, which credits it with all the possibilities of solutions to social problems that are created and that may be created in the future, thus leading society towards social welfare (Auler, 2002). "The more scientific-technological development, necessarily the more social development, ignoring the social relations in which the ST is conceived and used" (Santos, 2016, p. 60).

Certainly, the initial expectation of students was not met, as indicated above, in terms of an impact-free development. Such statements instigated the students, regarding the great social impacts created, who asked "Why didn't the residents say they did not want to sell their areas nor leave their homes?" (S4). Causing the explanation given by (a) T1, since it was "no longer a matter of choice, due to the implications and laws of the state." Emphasizing the model of technocratic decisions in which "the power of the decision is centered only on one subject, considered an 'expert,' [...] capable of solving, efficiently and neutrally, all the problems of society" (Santos, 2016, p. 60).

Other examples of "demystification" that can be considered, using the same reflections as above, is water being pointed out as a renewable natural resource, with an infinite and clean cycle, ignoring the fact that too much exploration exceeds its capacity for renewal. As well as the environmental impacts, mainly in the reproduction of fish, where they are transposed by land by an appropriate company and also by "ecological corridors in water resources", which the fish use during their reproduction season, which seems, at first, to mitigate any impact, but can influence "directly on the reproductive cycle of ichthyofauna" (Cardoso, 2015, p. 12). These examples were also discussed in the classroom.

Therefore, this category was limited to the analysis of how the appropriate knowledge by the students was resignified by the demystification of "myths", involving the installation and operation of the HPP, provided by the teachers in the classroom, having as a basis, in this process, the use of problematization and dialogue. These myths are anchored in technocratic decisions and salvationist perspectives, which constitute the basis of the ST neutrality, and may limit students to make critical and responsible decisions. This is observed in the next category, consisting in the development of students' criticality towards the central research theme.

4.2 The critical social-environmental development of students in relation to the theme: from limit situations to untested feasibility

Paulo Freire's critical approach in educational discussions, specifically in the curricular field that involves practice, has a problematizing and essentially dialogical proposal as its main element. However, the critical thinking highlighted by Freire comes from overcoming naive curiosity. It is still curiosity, but transformed into critical thinking. Naive curiosity that is the result of methodically not rigorous knowledge, which is characterized as common sense. "Knowledge made from pure experience" (Freire, 2020, p. 31). In overcoming this, it becomes an

epistemological curiosity, which is methodically rigorous to the object of knowledge/content.

Precisely because transforming ingenuity into criticality does not happen automatically, one of the primary tasks of the educational-progressive practice is precisely the development of critical, unsatisfied, untamable curiosity. The curiosity that we can use to defend ourselves from 'irrationalism' resulting from or produced by a certain excess of 'rationality' of our highly technological time. This includes those who, on the one hand, do not divinize technology, but, on the other, do not demonize it. Those who look at it or even peek at it with critical curiosity. (Freire, 2020, pp. 33-34)

It must be taken into account that, in order to overcome naïve curiosity, in the direction of a critical curiosity, to be part of decisions related to ST. The latter are only possible through the democratic model, which will enable new indications, new directions to the demands of society.

In this sense, Auler (2018), synthesizes the fourth dimension of Feenberg's (2010) critical theory, which conceives technology as not autonomous, but as coming from a social construction, with the possibility of redesigning it. "Critical theory sees degrees of freedom, it considers that society can exercise control over ST and that it can be democratized" (Auler, 2018, p. 49). However, "[...] it defends the possibility of choices, subjecting them to more democratic controls. It allows the mobilization of society in defending what Science-Technology it wants" (Auler, 2018, p. 49). Dagnino (2014) supported by the same critical theory, proposes the so-called Socio-Technical Adequacy (AST), which "[...] seeks to highlight the need for our potential for knowledge generation to be guided by a process presided over by interests and values compatible with the concept of People, and their participation in the production of knowledge" (p. 89), aligning this thinking with LAT-STs.

Contemporarily, Renato Dagnino has been a leading researcher on LAT-STs, and his critique of Science-Technology Policy (PCT) inspired by the so-called first world countries, which disregards local demands. Dagnino (2008) advocates a reorientation of scientific-technological activity, a PCT that is guided by the demands of the needs of Latin American countries. Along the same line, he works on seven modalities of AST. We call attention here to the last modality: "Incorporation of new scientific-technological knowledge: results from the exhaustion of the process of incremental innovation due to the inexistence of knowledge that can be incorporated into processes or means of production to meet the demands for AST" (Dagnino, 2014, p. 109), that is, a reorientation of the research agenda, with untested problems, requiring knowledge that is also untested. Thus, knowledge coming from local demands.

Enabling to overcome extreme situations, which obstruct the freedom of men, walking towards the unprecedented and viable, that, in turn, provides critical reflections, in decision making, that takes us back to the beginning of this category, of epistemological curiosity. Sharpened in this research, by the defiance of participating teachers, when

using the problematization of social and environmental aspects connected to UHE Passo São João, in contributing to the unveiling of myths (aim of the previous category).

Initially, we highlight an excerpt taken from one of the initial memories of a student, which points to a naïve and conformist curiosity (Freire, 1987) about the few environmental impacts caused by the HPP: "The fauna and flora were preserved and a transposition was created for the fish: sometimes it doesn't work, but the idea was meant to help" (S3). There was little problematization regarding the impacts produced by the HPP. This caused a naïve and uncritical reflection, since the teachers had just started working with the students.

The overcoming of naïve curiosity toward criticism was visible in several parts of the work, such as during the analysis of two articles available on publicly accessible websites², regarding the implementation (beginning of the constructions in 2006) and the conclusion/operation (in 2012). However, what caught the attention (of students) was the estimated costs at the beginning of the works and their final costs of operation, which were more than double that predicted costs. "How can they make such a mistake? Who carried out this research?" (S2). These questions proposed the beginning of other issues found at the end of the construction work of the HPP, pointed out by the students, such as the inadequate removal of the flora, which can still be seen, with remaining trunks and branches in the flooded area.

Some facts demand attention, such as the importance of the teacher to instigate the curiosity of the students, the work of the teacher with the students (Freire, 2020), which makes it possible to see the beginning of overcoming the naïve curiosity, that is, simply reading the articles without proper attention to the disparity between the expected initial expenses and the final expenses of the work, toward a critical and questioning curiosity. Curiosity arising from an "inquiring restlessness, as an inclination to unveil something, like a verbalized question or not, as a search for clarification, as a signal of attention that suggests warning [...]" (Freire, 2020, p. 33).

Another similar scene refers to an activity arising from the need the teacher had previously observed, since the students presented difficulties in understanding the calculation contained in the electric energy bill, indicating consumption and costs. A task of the teacher that is part of the practice, indicating the "common sense" which perceives the difficulty of the students, stimulates new methods and tasks for calculation, which is not a sign of authoritarianism, but the authority of a teacher pervaded by "common sense" (Freire, 2020). Due to the "common sense" of the teacher, the curiosity of students takes shape. When the latter realize the huge expenses with the electrical appliances used in the school, the great environmental and social impacts in the production of electrical energy, they continue the process of overcoming

² Articles available at: <https://estado.rs.gov.br/obras-da-usina-passo-sao-joao-comecam-no-ultimo-trimestre-do-ano;> and: <https://wp.clicrbs.com.br/noroestemissoes/2012/03/21/usina-a-hidreletrica-passo-sao-joao-de-roque-gonzales-comeca-a-operar/>

the naive curiosity toward critical thinking. As S7 shows: "Not to mention what remains on all day long!" Referring to the daily use of air conditioning in classrooms.

This led to new questions, new research, in seeking alternative sources of electricity production, with low environmental and social costs, as well as ways to reduce consumption, not only at school, but in their homes. This reflection led to another problem not perceived by them before, the fact that in the electric energy bill there is a tariff for the supply of public lighting. "But how can we pay for this, and we have no power?" (S4). This showed another aspect of teaching, the dialogue, between teacher and student mediated by the problems of the world (Freire, 1987).

Thus, we can understand, through this category, the critical development of students in face of the problems presented by the teachers, identified in the contradictions of experienced situations. Similarly, promoting the overcoming of situations that limit their action, concealed by naive curiosity, allows reaching the untested feasibility, becoming free, capable of discussing, acting, making conscious and critical decisions that demand a response "[...] not only in the intellectual level, but at the level of action" (Freire, 1978, p. 55).

4.3 Learning assessment: the understanding and lines of thought from the perspective of students

This category falls into the analysis of student diaries, an evaluation performed by both participating teachers and perceived by researchers in the "unitarization" stage of ATD. In it, we present scientific concepts or inaccurate reflections, or not sufficiently highlighted in classroom practice, which resulted in a misinformation in some aspects by the students.

An analysis that consists of a second process: that of correcting, both the memories and the activities carried out by the students, at the time of the research, which, for Hoffmann (1993), "[...] correction is a time for thinking about the hypotheses that have been built by the student and not to consider them definitively right or wrong" (p. 65). The same author also describes that the task of correction reflects the paradigm of evaluation, that this act should lead students to overcoming, to enriching their knowledge. Characteristics of a mediating evaluation that "[...] lies in the teachers' involvement with the students and their commitment to their progress in terms of learning" (Hoffmann, 2014, p. 20).

In this sense, working on the mistake, identified from the correction of the activities and conceptions presented in the students' logbook, raises the opportunity:

[...] for the own students to question and reflect on their own production is a propitious way to build the knowledge of what, as the mistake can attest, still needs to be more deeply learned. I emphasize that such opportunities can allow the unveiling of possible cognitive conflicts, and these, when they arise, can serve as cardinal points to guide future

didactic strategies to face these conflicts. (Salsa, 2017, p. 88)

Conflicts in this research necessarily arise from problems, which lead to coherent and ethical decision making. Hence, we remark the importance of "listening" to students, by correcting their mistakes, because "[...] by listening we learn to talk to them" (Freire, 2020, p. 111). Thus, we seek to analyze the misconceptions, such as lack of understanding by students, indicating deficiencies in the structuring that will compose their critical thinking in later problem solving. Thus, we highlight some of these reflections below.

The first highlight is the emancipation of the municipality of Roque Gonzales, which occurred on May 15, 1966, completing 54 years of emancipation this year (2020). However, as highlighted in the students' speeches, the emancipation of the municipality occurred due to the implementation of the Passo São João Hydroelectric Power Plant, whose construction began in 2006. "And a positive aspect about this idea was that I found out that Roque became a city because of the Power Plant. Thanks!" (S4). "I recently learned that after the dam was built, Roque Gonzales became known as a municipality" (S8). Since these were students between 14 and 15 years of age, they were very young when the Hydroelectric Power Plant was built, therefore, they connected the implementation of the Hydroelectric Power Plant as a large undertaking that enabled the emancipation of the municipality.

The second account expressed by the students was a problem identified and analyzed in the previous categories with a different bias. It established the impacts as positive considering the permanent generation of jobs, made possible by the HPP. "The positive impacts were the numerous direct and indirect jobs, the generation of energy for several municipalities, stimulating social and economic growth" (S5). Again, as described above, it was found that currently there were effectively only 12 employees, a number that was lower than the number of employees at the beginning of the work, causing a distorted impression on the social and economic growth brought about by the high number of jobs provided.

The last example that we highlight comes from a misinformation about the precariousness of environmental impact studies, which affect both the fauna and flora of the implementation site. "There is a lot of damage both to the climate and to fauna, fish species and the escape of animals to safe locations" (S9). The student is aware of the impacts caused, but "believes" that the animals go to safe places, unaware of the impacts, which can lead to the disappearance or disproportionate predation of many species, which did not occur so often before.

Thus, this category sought to address some concepts or reflections that present inconsistencies on the part of students highlighted here as "mistakes". We understand that such mistakes are positive factors to teaching, because this is how the teacher can actually observe what is really being learned by the student, which characterizes a mediating evaluation, proving to be an essential process within the fifth stage of thematic research.

5. CLOSING REMARKS

This work is the result of a research that uses Freirean thematic investigation as a curricular dynamics and emphasizes mainly its fifth stage, the work in the classroom. Regarding this aspect, we analyzed the logbooks that make up the corpus of analysis, both from students, who made use of the logbooks during classroom practices developed by teachers of science and geography, as well as the logbook of one of the researchers who attended all the practices.

For the corpus analysis, we use references from the STS and LAT-STs approaches and the premises by Paulo Freire, especially from two of his works: "Pedagogy of the Oppressed" (Freire, 1987) and "Pedagogy of Autonomy: Necessary Knowledge that Leads to Educational Practice" (Freire, 2020). These contributed to the elucidation of how knowledge, used in practice by teachers and students, could be resignified, enabling the unveiling of "myths" created by a model of technocratic decisions from a salvationist perspective attributed to ST, sustained by the neutrality of the social and environmental impacts caused by the Passo São João Hydroelectric Power Plant. Thus, the need to resignify knowledge, previously imposed by a traditional curriculum of a priori definitions, which might not match the experiences of students and teachers. The later becomes possible through a critical curricular configuration.

Similarly, by attributing meaning to knowledge, critical thinking was triggered regarding the problematizations presented by the teachers, which could start from a naive curiosity, to a critical, reflexive and decision-generating curiosity sustained by ethics, which is the objective of this research, leading to problematizations attributed as limit situations, and the untested feasibility, achievable by making critical decisions, given the impacts generated by the HPP. Such practice in the classroom revealed possibilities such as the ones highlighted, as it led to challenges, especially the inconclusive reflections of the students in face of the knowledge addressed, allowing the teachers to rethink their practice.

Therefore, we understand that elaborating a curricular configuration, and all the reflection involved, includes aspects of the teaching-learning process, because the curriculum is elaborated to make this process viable, involving the work of teachers and students. Thus, we understand that it is not possible to dissociate classroom practice from the curriculum. What happens is that different subjects conceive the curricula and others (teachers) execute them. What we intend with this research is not to invert this path, but to provide a different curricular configuration with the involvement among the subjects, a curriculum in action!

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