DOI: http://dx.doi.org/10.5007/2175-7941.2024.e98066

The use of Actor-Network Theory in Science Teaching: an analysis of articles published over two decades in Brazilian journals*

Amanda Carolina Mikos Dangui[1]
Teacher in Londrina – PR
Sergio de Mello Arruda
Senior professor at the State University of Londrina
Londrina – Paraná
Visiting professor at the State University of Northern Paraná
Cornélio Procópio – PR
Marinez Meneghello Passos
Senior professor at the State University of Londrina
Londrina – PR
Collaborating professor at the State University of Northern Paraná
Cornélio Procópio – PR

Abstract

In this article we present the results of research that sought to understand how the Actor-Network Theory (ANT) has been used by Brazilian researchers in the field of Science Teaching. To this end, we carried out a Systematic Literature Review in national periodicals spanning two decades of publications. The corpus consisted of 38 articles, which were separated into three generations of ANT: period of formation, consolidation and expansion. In order to guide the interpretative process, we elaborated three questions: What are the objectives explained in the articles based on the research they disseminate? From which generation of ANT are the references used in the articles? Which are the groups of researchers that adopted ANT as a reference? To organize the information that answered such questions, we adopted the procedures indicated by Content Analysis, first searching for the objectives exposed in the articles and grouping the researchers by a relationship of authorship and co-authorship. We found that the second generation ANT texts were the most referenced in the articles studied and

* *Received: January 2, 2024.*
Accepted: May 29, 2024.

[1] Emails: amanda_mikos@hotmail.com; sergioarruda@uel.br; marinezpassos@uel.br.

that, in general, they are research that reflects on how Science Education articulates with what we understand as modernity. The articles that used first and third generation ANT texts as references were found in less numbers and developed, respectively, ethnographic research in the classroom and school laboratory and contemporary discussions about post-truth. The interpreted corpus indicates that the research was concentrated among researchers belonging to the following Higher Education institutions: UFRGS, UFMG, UEL e CEFET/RJ.

Keywords: *Actor-Network Theory; Science teaching; Systematic review.*

I. Introduction

The Actor-Network Theory (assumed by the acronym ANT) dates back to the mid-1970s, and since the 2000s, as confirmed by the survey we carried out, has been used in research linked to the following fields of knowledge: Businness, Anthropology, Architecture, Arts, Information Science, Social Science, Communication, Psychology, Public Health and in interdisciplinary research situations (Dangui, 2022).

ANT considers the notion of networks and actors to be a set of research tools that make it possible to map different actors in an action, without disregarding or trying to "dismantle" the complexity involved in the situation studied, which it establishes as potentially interdisciplinary, multidisciplinary, transdisciplinary.

Latour (2012), when reconceptualizing what was considered "social" for classical sociologists, included in the scope of analysis not only humans involved in the course of an action, but also non-humans of which he considered to also act. Therefore, "[...] anything that does modify a state of affairs by making a difference is an actor" (Latour, 2005, p. 71).

To exemplify how objects can make a difference in the course of an action, try to imagine yourself hammering a nail without a hammer, boiling water without a pan, walking down the street without clothes, running a company without accounting (Latour, 2012).

This "new view" of the objects and action that ANT can provide was seen as a theoretical possibility to investigate the action of teachers and students in Science and Mathematics classrooms, as described in the research program *PROAÇÃO* (PROACTION in English) (Arruda; Passos; Broietti, 2021), developed by the research group EDUCIM (Research Group in Science Education and Mathematics Education) from the State University of Londrina. It is in this context that the present research is inserted.

Seeking to analyze how ANT was being used by Brazilian researchers, at first we came across dissertations, theses and articles positioned by their authors in the area of Science Teaching. Among the research carried out, we did not find any that was dedicated to preparing a review or bibliometric mapping relating both topics of interest to this research –

ANT and Science Teaching – in journal articles. Due to this gap, we carried out a Systematic Literature Review in national periodicals, considering what Okoli presents to us (2015).

In order to assist in the analysis of articles, the ANT was systematized into three generations: period of formation, consolidation and expansion, from the perspective of Marcos Mattedi (Webinário, 2021), to later carry out the analytical movement. In order to guide the interpretative process, we elaborated three questions: What are the objectives explained in the articles based on the research they disseminate? From which generation of ANT are the references used in the articles? Which are the groups of researchers that adopted ANT as a reference?

In the next sections we briefly describe the three generations of ANT, the methodological procedures and the delimitation of the *corpus*[2], in addition to presenting the data and conclusions we reached.

II. Theoretical foundation: the Actor-Network Theory and its generations

In this section, initially, we present the general concepts of Actor-Network Theory (ANT) and, subsequently, we approach said theory from a chronological perspective, inspired by Mattedi's analyses (Webinário, 2021).

ANT starts from the Social Studies of Science and Technology (Rezzadori; Oliveira, 2018; Mocelin, 2009), in which authors such as Bruno Latour and Steve Woolgar, Michael Lynch and Knorr-Cetina marked a change in perspective from macroanalysis to microanalysis of Science (Mota; Gontijo; Oliveira, 2017). While authors such as Thomas Kuhn and Pierre Bourdieu analyzed the practice of Science in broader terms, from structural and functional perspectives, Bruno Latour and some other authors reoriented the analysis to the relationships that occur in the laboratory, based on the development of ethnographic trajectories in the laboratory (Mocelin, 2009). It is from this reorientation of the view towards Sciences that ANT began to be developed by Bruno Latour, Michel Callon, John Law, Madeleine Akrich, Wiebe Bijker in the mid 70s.

The ANT, in general, can be understood "[...] as a sociological perspective that aims to show how the social is constructed in the very act of development of Science, the market and innovation" (Rezzadori; Oliveira, 2018, p. 230, our translation), by creating theoretical and discursive resources to describe how the social is constructed while investigating itself, using resources from the field of Anthropology, especially.

According to Mattedi (Webinário, 2021), ANT went through three phases of development, considering three generations: the period of formation, consolidation and expansion. Before understanding how the generations differ, it was necessary to highlight what remained in ANT in these three generations. And, subsequently, the processes it went through and, consequently, its development.

[2] The set of documents taken into account to be subjected to analytical procedures (Bardin, 2016).

The generations of ANT vary in scale, context, and questions, but maintain the logical structure of investigation: mapping and describing networks of actors, be they the scientist, the chemical compound, the virus, the scale, the university, the state, the company, plastic, the carbon cycle, the speech, the articles, the book, the conference, the government, among others. ANT seeks to understand things as effects of a network interaction and defining actors based on their actions (Coutinho; Silva, 2014).

To explain what constitutes a network, Latour (2013) uses an example cited by science historian Simon Schaffer: initially it was believed that Isaac Newton's *Principia Mathematica* was written in complete isolation and what was discovered is that "Newton was more like a spider at the center of a huge web that encompasses all kinds of evidence transporting and sending information from one side to the other" (Latour, 2013, p. 25, our translation).

As for the actors, Latour (2013) calls them mediators who act, modify, leave traces of their actions and displacements. As for those who do not modify/modulate the action, these are not actors, but intermediaries (LATOUR, 2012). To define an entity (an agent, an actor, an actant) one must then develop its attributes, that is, its network. This actor-network relationship is symmetric: "[...] an actor is a network and vice versa" (Fenwick; Edwards, 2010, p. 9).

The first generation of the ANT, which is delimited in a period that goes from 1979 to 1992, occurred from the redefinition of the way to conceive scientific activity, being considered the period of its formation. Two works from this period are widely used in national research: *Laboratory Life: The Construction of Scientific Facts* originally published in 1979 (translated into Portuguese in 1997) and *Science in Action: How to Follow Scientists and Engineers Through Society* from the year 1987 (with translation into Portuguese in 2000).

By describing the scientific practices of the laboratory and bringing to light the inaccuracies, informalities, subjectivities of scientists, intellectual and economic disputes, by conceiving the idea of constructing facts, Latour drew the attention of some researchers who believed that this was an attack to the Sciences, an attack on the idea of achieving universal truths. Latour discussed and questioned "[...] the position of positivists that Science is an acquired fact and that scientists discover the truth using natural and logical processes" (Rezzadori; Oliveira, 2018, p. 229, our translation).

In fact, Latour (1998) admits that there is a war between Sciences, but not a war between reason and irrationalism (as had been accused), however he suggests that there is an opposition between

> *[...] those who believe that the essential political problem, capable of defining the common world, has been resolved once and for all, since there is a unified and universal nature, which says nothing relevant about the diversity of cultures; and, on the other hand, those who think that no one, especially a scientist, has the right to*

> *simplify so grossly, to short-circuit the historical process by which the common world comes together little by little* (Latour, 1998, p. nf, our translation).

This "Science War" that was established in the 90s, marked by external and internal "attacks" on ANT, established the transition from the first to the second generation (Webinário, 2021).

The second generation of ANT can be positioned in the period from 1992 to 2006, when the consolidation of the Theory occurred. According to Mattedi (Webinário, 2021), considerations in this time interval do not fall on "[...] scientific activity and the social context, but [on] subject and object, that is, the modes of enunciation that characterize law, religion, economics, ecology, biology and so on" (verbal information).

The modern notion regarding relations/interactions between subject and object tells us that it is the subject who acts on the object, the object does not act on the subject. What ANT proposes is that the subject acts on the object as well as the object acts on the subject. In other words, it would be saying in terms of ANT that humans act on non-humans in the same way that non-humans act on humans.

It is then recognized that "[...] humans create objects by directly interfering with them, but these objects also interfere with the ways of living, of being in the world of humans" (MELO, 2010, p. 2, our translation). And it is in the work *We Have Never Been Modern*, from 1991, that Latour develops what he called Symmetrical Anthropology. Latour says that modern people choose to study everything that is considered not belonging to the modern world, called "the others", such as remote tribes, exotic customs, complex cults and family relationships, and even when they dedicate themselves to studying modern society they analyze popular customs, symbolic representations, marginalized people (Lima; Ostermann; Cavalcanti, 2018). Latour argues that "we", those considered modern, must also study our relationships, cults and representations.

We are on a journey that began with anthropological research in a scientific laboratory and is moving towards theorizing about what modernity would be in a context of environmental discourse. Therefore, the second generation of the ANT does not cease discussions about scientific practices, but when discussing the logics that govern modernity, politics in the scientific environment, redefining what is understood by social, and proposing that this formation of the social occurs based on the description of a network of actors, the ANT leaves the laboratory to be part of several other fields of study, such as the legal and religious ones.

The year 2006 can be considered as the first year of the third generation of ANT, when Latour entered *Sciences Po* (Paris Institute of Political Studies). This is a period of expansion of theory focusing on the cognitive and moral implications of climate change. According to Mattedi (Webinário, 2021), the ANT becomes part of the great discourse of understanding society, in the "Former Climatic Regime" – founded on modern ideals – "[...]

society is considered active and nature passive, that is, the social has no objects and the natural has no politics" (verbal information).

In the "New Climate Regime" theorized by Latour, there is an end to the nature/society duality (becoming nature-society) in which a redistribution of agencies occurs and nature begins to act politically. Latour (2020) in *Facing Gaia: eight lectures on the new climatic regime* developed important considerations regarding the Anthropocene, a central concept for the third-generation ANT.

Anthropocene is the name given to a new geological era in Earth's history, it means the end of the Holocene and the beginning of an era in which the power of humans in shaping the planet's environmental conditions is recognized by interfering in biogeochemical cycles such as carbon, nitrogen, phosphorus, sulfur and water. There is still no consensus regarding the beginning of the Anthropocene, this is a controversy currently under discussion, mainly by the international Geology community (Latour, 2020; Coutinho *et al.*, 2016).

In addition to a geohistorical concept, Latour (2020) sees the Anthropocene as a philosophical, political, religious, anthropological concept with the power to move away from the notions of what is "modern" and what is "modernity" marked by their dichotomies: nature/society, culture/nature, subject/object, good/evil, man/woman, Human Sciences/Exact Sciences.

According to Mattedi (Webinário, 2021), the ANT change process is not sequential, but parallel and cumulative. Each generation of ANT has an application layer: the first generation ANT provides vocabulary for describing scientific facts, the second decentralizes the human in the analysis and the third discusses the change in our relationship with the world.

III. Methodological procedures and the constitution of the *corpus*

To construct the research *corpus*, which has a qualitative character, methodological procedures indicated by Okoli's Systematic Literature Review (SLR) (2015) and various organizational and interpretative guidelines from Bardin's Content Analysis (CA) (2016) were used.

Okoli (2015), states that SLR needs to be systematic in following a methodological approach, be explicit in explaining the procedures by which it was conducted and comprehensive in its scope by attempting to include all relevant material, in addition to having the possibility of being reproducible. The author also warns that "[...] the review cannot simply regurgitate the subject matter: it should contribute to the work in its dual approach of synthesizing the available material" (Okoli, 2015, p. 43), by offering an academic critique of the theory and developing a coherent theoretical history, indications that we seek to carry out in this article.

To create the *corpus*, we were guided by the eight steps proposed by Okoli (2015) and for the pre-analysis process we considered Bardin (2016). Such guidelines and

considerations generated seven steps, systematized in Figure 1, which demonstrates that both methodological references helped in the investigative process experienced.

The first step is “choosing the topic”. To choose the topic to be reviewed, it was necessary to define its purpose by answering the question: Why do a literature review? At this stage, articles, dissertations and theses were found that used ANT as a theoretical or methodological reference (Dangui, 2022). However, no literature review that focused only on articles and that related both topics of interest to this research (Actor-Network Theory and Science Teaching) was found, as specified below:

> *It is hoped that this research will contribute by synthesizing how Bruno Latour's ideas, linked to the ANT, have been used in science teaching research in Brazil, identifying some of the Brazilian research clusters and the main theoretical lines that study this framework (Dangui, 2022, p. 38, our translation).*

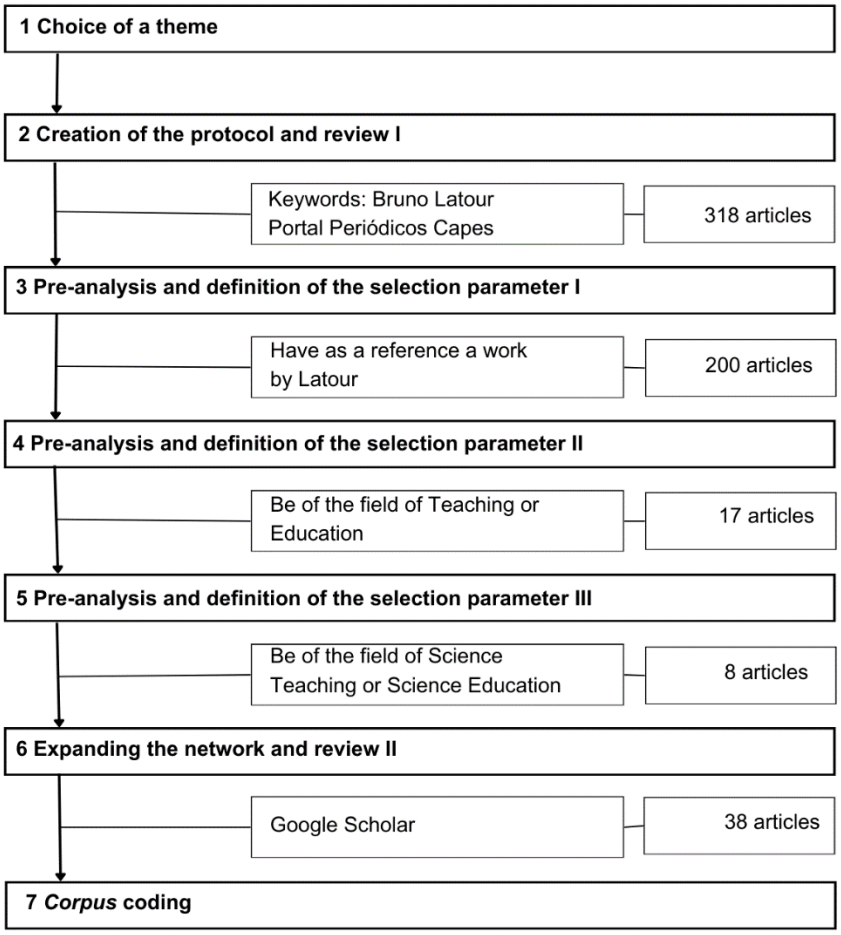


Figure 1 – Steps taken to build the analytical corpus. Source: the authors.

In the second stage "Creation of the protocol and review I" the following keyword was defined: "Bruno Latour". Although the focus of this research is Actor-Network Theory, the choice of the author's name is justified because he was one of the precursors of the ANT and one of the most used authors in Brazil indicated by *The Actor Network Resource: Thematic List* (2000) and corroborated by Vianna and Carvalho (2001) and Wortmann (2002). The database used was the *Portal Periódico Capes* with access as the *Comunidade Acadêmica Federada* (CAFe). No specific time range was defined and filters were used to search only articles in Portuguese, resulting in 318 articles, organized in chronological order[3].

In general, in steps 3, 4 and 5 of "Pre-analysis and definition of the selection parameter I, II and III" a pre-analysis was carried out as well as the organization and phase of choosing the documents that constituted the *corpus* that were submitted to analysis (Bardin, 2016). Document selection parameters must be explicit and justified, as long as the SLR is reproducible (Okoli, 2015). In step 3, the first selection parameter was defined: having a work by Latour as a reference. In step 4, the second selection parameter was defined: being in the Teaching or Education field. And in step 5 the last selection parameter was: being from the field of Science Teaching or Science Education.

This sequence of parameters filtered the articles into "layers". In stage 3, 200 articles, among the 318 collected in stage 2, had at least some work by Latour as a reference. In stage 4, of the 200 articles from different fields of knowledge, 17 articles specifically addressed Education or Teaching. And in stage 5, in which the inclusion parameter was that it had to be from Science Teaching or Scientific Education, 8 articles were found. As shown in Figure 1.

In step 6, the "backward search" and "forward search" strategies were used. In the "backward search" we focused on the references of the 8 articles found in step 5, which allowed us to select 22 new articles that met all the selection parameters of steps 3, 4 and 5 and were in Portuguese. In the "forward search" new documents were searched that cited the articles resulting from step 5. 14 articles were found, which met all the previously decided parameters. From the amount 8, plus 22 and 14, we have 44 articles, which when removing the repeated articles, resulted in 38 articles. Okoli (2015) states that these strategies serve to complement the research, seeking as many sources as possible. In this SLR, using these strategies was crucial for composing the *corpus*. We clarify to the reader that to carry out what was explained in this paragraph, the Google Scholar search tool was used.

In step 7 "*Corpus* coding", the 38 articles resulting from the previous steps were coded as shown before the Bibliographic References in ***Corpus* Codes and References**, in chronological order of publication and which has the authors listed in the code and the complete references of each article.

[3] Although a specific period was not determined, the articles selected in the second stage covered the period from 1993 to the beginning of 2021. This explains why articles published later in 2021 and 2022 did not appear in the filtering or in the *corpus*.

III. Results and discussions

As explained in the Introduction, to seek to understand how the ANT, as a theoretical-methodological foundation, participated in research in the area of Science Teaching in Brazil, during the period of analysis considered, we elaborated three questions, which we return to below. The first question is: What are the objectives explained in the articles based on the research they disseminate? This question sought to understand in which themes parts of this theory is used. The second question: From which generation of ANT are the references used in the articles? Understanding that the ANT is diverse in its proponents and uses, we analyzed which parts of the theory Brazilian researchers use. In the third question: Which are the groups of researchers that adopted ANT as a reference? Here we sought to map where the Brazilian researchers who use ANT are located geographically and who they are.

We analyzed the objectives of the articles that make up the *corpus* because we believe that they delimit the subject's actions in the research, that is, the goals that are intended to be achieved to solve a problem or answer an investigative question (PASSOS, 2009). Such objectives were codified, named and assumed by us as emerging categories. In Table 1 we organize information related to this methodological and interpretative process.

Table 1 – The objectives under analysis.

Categories (O1 to O8) and their descriptions	**Codes of the articles belonging to them**
O1 – Theoretical articulation of Bruno Latour's ideas with Science Teaching.	2001 – Vianna.Carvalho (a) 2006 – Oliveira 2017 – Massoni.Moreira 2018 – Rezzadori.Oliveira 2018 – Lima.Ostermann.Cavalcanti
O2 – Investigation of opinions on topics related to the Nature of Science.	2001 – Vianna.Carvalho (b) 2004 – Queiroz.Almeida 2007 – Zanon.Almeida.Queiroz 2020 – Fanfa.Martello.Teixeira 2020 – Vittorazzi.Silva
O3 – Mapping of sociotechnical controversies and networks.	2010 – Melo 2011 – Rezzadori.Oliveira 2015 – Cappelle.Coutinho 2015 – Faria.Coutinho 2020 – Silva.Pretto.Lima
O4 – Description of the classroom from the ANT.	2008 – Oliveira 2010 – Oliveira 2014 – Coutinho.Goulart.Munford.Ribeiro 2016 – Coutinho.Santos.Amaral.Santos.Silva

	2021 – Peron.Moraes
O5 – Development of teaching material, characterization map and teaching tools.	2012 – Oliveira.Queiroz 2014 – Coutinho.Silva 2016 – Oliveira.Queiroz
O6 – Analysis of discursive characteristics.	2015 – Roxael.Diniz.Oliveira 2017 – Mota.Gontijo.Oliveira 2018 – Gomes.Oliveira 2018 – Lima.Souza.Cavalcanti.Ostermann 2020 – Batistele.Oliveira 2020 – Vazata.Lima.Ortermann.Cavalcanti
O7 – Reflections and discussions involving the post-truth phenomenon.	2019 – Lima.Vazata.Ostermann.Cavalcanti.Moraes 2020 – Barcellos 2020 – Ranniery.Telha.Terra 2020 – Souza.Martins 2020 – Zanatta.Saavedra
O8 – Other authors in focus (other than Bruno Latour).	2017 – Lima.Antunes.Ostermann.Cavalcanti 2018 – Meglhioratti.Batista 2019 – Lima.Nascimento.Ostermann.Cavalcanti 2019 – Pigozzo.Lima.Nascimento

Source: the authors.

Two considerations need to be made regarding Table 1. Regarding Category O5, the common characteristic of the three articles in this category is that all materials were created as tools for analyzing scientific texts (i.e., they were not intended to teach scientific content). Two of the articles in this category, Oliveira and Queiroz (2012, 2016), developed tools focused on analyzing scientific texts, in which Latour's ideas make up a group of base references regarding language and scientific communication. While in the article by Coutinho and Silva (2014), the authors present a strategy for analyzing textbook texts based on principles of the Actor-Network Theory.

In relation to the articles in Category O7, influenced by the most recent generation of the ANT, they focus on discussions about how the post-truth phenomenon has been impacting Science Teaching. This theme, despite not having been highlighted as the main characteristic of the third generation ANT, is also raised by Latour. Endorsing the statement that the third generation ANT, in Science Education, in Brazil, in addition to supporting environmental discussions, also supports discussions regarding scientific truths and post-truths.

Next, we insert examples of excerpts taken from the articles that justify and elucidate the inclusion of that article in the related category (Table 2). We only bring examples, as the completeness of the data would be inappropriate for presentation at this time, as it would require an excessive number of pages, which is why we indicate that all information relating to this investigation can be accessed in Dangui (2022).

Table 2 – Excerpts from the article objectives.

Categories	**Articles** **Excerpts (objective)**
O1	2017 – Massoni.Moreira The objective of this text is *to present Bruno Latour's ideas about the nature of science* [4] from his immersion in a cutting-edge scientific laboratory (p. 61).
O2	2001 – Vianna.Carvalho (b) Our objective was *to seek the opinion of the course participants about the course, whether they noticed or not if there was a change in the way they see the process of building scientific knowledge*, which factors most caught their attention and whether, based on what they experienced, they intend to modify their teaching practice (p. 124).
O3	2011 – Rezzadori.Oliveira The main objective of this work is *to describe the socio-technical network of the High School Chemistry Laboratory* of the school - *Centro Estadual de Educação Profissional Professora Maria do Rosário Castaldi*, in the city of Londrina – PR, taking as motivation the theories of translation proposed by Bruno Latour and John Law (p. 16).
O4	2014 – Coutinho.Goulart.Munford.Ribeiro In this article, we are interested in understanding *how practices occur when five-year-old children explore the natural world based on a certain socio-material arrangement established by their teacher*. More specifically, we sought to examine the effects of introducing an observation instrument, in this case, a magnifying glass, during a science class. Thus, we intend to understand the role of this object in the formation of a sociomaterial network and, then, we ask ourselves: what learning emerges in this network of associations? (p. 383).
O5	2016 – Oliveira.Queiroz The objective of this work is to *present the theoretical concepts that supported the elaboration of a Scientific Text Characterization Map*, as well as describe its application in the analysis of original research articles published in the journal *Química Nova* (p. 142).
O6	2018 – Lima.Souza.Cavalcanti.Ostermann We carry out *a metalinguistic analysis of the texts on Quantum Physics present in Physics books approved in the PNLDEM 2015* in dialogue with the philosophical interpretations of the photon in scientific articles, based on a theoretical framework that articulates the philosophies of Bruno Latour and Mikhail Bakhtin (p. 331).
O7	2020 – Barcellos This article *discusses the role of scientific education in the crisis of truth* (p. 1496).
O8	2018 – Meglhioratti.Batista [...] This article *aims to outline a brief history of the main perspectives of the Sociology of Science and the Sociology of Scientific Knowledge*, as well as identify

[4] The parts in italics are the elements that led us to develop the categories and justify the criteria for inserting each article in that category. More information about these procedures can be found in Dangui (2022).

	how elements and authors that emerged from these perspectives are present in journals in the Teaching area, focusing on Science Teaching [...] (p. 2-3).

Source: the authors.

In our view, the eight categories listed in Table 1 (elucidated by the excerpts presented in Table 2) answer the first research question stated above.

Next, we dedicate ourselves to presenting the results relating to the second investigative question, which seeks to identify which generation of the ANT the references cited in the 38 articles that make up the *corpus* of this research.

To illustrate what was done, we brought information about the first [1] and the last article [38]. In Table 3, we insert the article code in the first column, in the second the Latourian references (copied literally from the articles analyzed, hence the normative divergence between the two examples) and, in the last column, the generation to which the Latourian reference is inserted. We explain that the results included in this table considered the years of publication of the original works.

Table 3 – Identification of the ANT generation (examples).

Articles	**Latourian references**	**Generation**
[1] 2001 – Vianna.Carvalho (a)	LATOUR, B.; WOOLGAR, S. La Vie de Laboratoire, Editions La Découverte,Paris, 1988 / A Vida de Laboratório. Rio de Janeiro: Relume Dumará, 1997.	1st
	LATOUR, B. La Science en Action. Paris: Editions La Découverte, 1989 / Ciência em Ação. São Paulo: Editora UNESP, 2000.	1st
	LATOUR, B. O Reino do Texto Científico. *In*: WITKOWSKI, N. (coord.). Ciência e Tecnologia Hoje. São Paulo: Editora Ensaio, 1995, p. 399-401.	2nd
	LATOUR, B. Pasteuret Pouchet: Hétérogenèse de l'Histoire des Sciences. *In*: SERRES, M. (org.) Eléments d'Histoire des Sciences. Bordas, Paris, 1994, p. 423-445.	2nd
	LATOUR, B.; FABBRI, P. La Rhétorique de la Science – Pouvoiret Devoirdans un Articlede Science Exacte, Actes de la Rechercheen Sciences Sociales, ne13, février, 1977, p. 81-95.	1st
[38] 2021 – Peron.Moraes	Latour, B. (2001). A esperança de Pandora. EDUSC.	2nd
	Latour, B. (2011). Ciência em ação: como	1st

	seguir cientistas e engenheiros sociedade afora. (2.ed.). Unesp.	
	Latour, B. (2012). Reagregando o Social. Uma introdução à teoria do Ator-rede. EDUSC.	2nd
	Latour, B. (2013). Jamais fomos modernos. (3. ed.). Editora 34.	2nd
	Latour, B., & Woolgar. (1997). A vida de laboratório: a produção dos fatos científicos. Relume Dumará.	1st

Source: the authors.

From the quantification of all references listed in the 38 articles, it was possible to create Graph 1, which represents the arrangement of the three generations. On the vertical axis we brought the numbering of the 38 articles. Horizontally, the percentages referring to each generation present in the articles can be consulted.

As described in the Summary, Graph 1 indicates that the 2nd generation of ANT was the most used and cited by Brazilian researchers during the period of publications considered in this review. Why did this occur? We do not have a clear answer to this question, however, it seems to us that, as many of these articles referred to ethnographic research in classrooms, laboratories and reflections on science education, their objectives would be more related to the Science Teaching field.

We now dedicate ourselves to the third research question: Which are the groups of researchers that adopted ANT as a reference?

In this investigation, research clusters are understood as a network, that is, as a set of associations between heterogeneous elements that are always in movements of reassociation and reaggregation (LATOUR, 2012). Therefore, the groupings of articles, researchers and ideas studied do not refer to a fixed organization, or a "consolidated" research group, but rather to authors who, when publishing articles together, formed thematic research networks.

In Table 4 we have information regarding the analysis carried out, which allowed us to create 15 groups, 10 of which had just one article and 5 of which had more than one article published by the same set of authors in common. They are organized in descending order of participation in articles from top to bottom, and those with the same participation are arranged in alphabetical order. The objectives from O1 to O8 helped with this arrangement and the number in brackets refers to the numbering of each of the 38 articles that form the *corpus* in chronological order, as already explained.

Graph 1 – Percentages related to the ANT generations explained in the references. Source: the authors.

Table 4 – Groupings and objectives.

Groups	Authors	Objectives
1	Anna Maria Pessoa de Carvalho	Theoretical articulation of Bruno Latour's ideas with Science Teaching. [1]
	Deise Miranda Vianna	Investigation of opinions on topics related to the Nature of Science. [2]
2	Jane Raquel Silva de Oliveira	Investigation of opinions on topics related to the Nature of Science. [3, 5] Development of teaching material, characterization maps and teaching tools. [10, 17] Analysis of discursive characteristics. [15, 20, 30]
	Salete Linhares Queiroz	
	Dulcimere Ap. V. Zanon	
	Fernanda Resende Roxael	
	Gabriela Belini Gontijo	
	Geovânia Pereira dos Reis Mota	
	Marcio César Braga Batistele	
	Maria José P. M. de Almeida	
	Natália De Paiva Diniz	
3	Moises Alves de Oliveira	Description of the classroom from the ANT. [6, 7] Mapping sociotechnical controversies and networks. [9] Theoretical articulation of Bruno Latour's ideas with Science Teaching. [4, 21] Analysis of discursive characteristics. [22]
	Cristiane Beatriz Dal Bosco Rezzadori	
	Fabiana Gomes	
4	Maria de Fátima Aranha e Queiroz e Melo	Mapping sociotechnical controversies and networks. [8]
5	Francisco Angelo Coutinho	Development of teaching material, characterization maps and teaching tools. [11] Description of the classroom from ANT. [12, 16] Mapping sociotechnical controversies and networks. [13, 14]
	Fabio Augusto Rodrigues e Silva	
	Ana Cláudia Reis Amaral	
	Analise de Jesus da Silva	
	Danusa Munford	
	Elisa Sampaio de Faria	
	Magno Inácio dos Santos	
	Maria Inês Goulart	
	Natália Almeida Ribeiro	
	Vanessa Cappelle	
	Victor Marcondes de Freitas Santo	
6	Nathan Willig Lima	Other authors in focus (other than Bruno Latour). [18, 26, 28] Analysis of discursive characteristics. [23, 35] Theoretical articulation of Bruno Latour's ideas with Science Teaching. [24] Reflections and discussions involving the post-truth phenomenon. [27] Description of the classroom from the ANT. [38]
	Claudio José de Holanda Cavalcanti	
	Fernanda Ostermann	
	Andreia Guerra de Moraes	
	Matheus Monteiro Nascimento	
	Pedro Antônio Viana Vazata	
	Bruno Birkheur de Souza	

	Daniel Pigozzo	
	Estevão Antunes Junior	
	Thiago Silva Peron	
7	Neusa Teresinha Massoni	Theoretical articulation of Bruno Latour's ideas with Science Teaching. [19]
	Marco Antonio Moreira	
8	Fernanda Aparecida Meglhioratti	Other authors in focus (other than Bruno Latour). [25]
	Irinéa De Lourdes Batista	
9	Marcilia Barcellos	Reflections and discussions involving the post-truth phenomenon. [29]
10	Caroline Martello	Investigation of opinions on topics related to the Nature of Science. [31]
	Maria do Rocio Fontoura Teixeira	
	Michele de Souza Fanfa	
11	Nathalia Terra	Reflections and discussions involving the post-truth phenomenon. [32]
	Renata Telha	
	Thiago Ranniery	
12	Danilo Mota Lima	Mapping sociotechnical controversies and networks. [33]
	Nelson de Luca Pretto	
	Patrícia Silva	
13	Alana Tamires de Souza	Reflections and discussions involving the post-truth phenomenon. [34]
	André Ferrer Pinto Martins	
14	Alcina Maria Testa Braz da Silva	Investigation of opinions on topics related to the Nature of Science. [36]
	Dayvisson Luís Vittorazzi	
15	Nestor Cortez Saavedra Filho	Reflections and discussions involving the post-truth phenomenon. [37]
	Ronnie Petter Pereira Zanatta	

Source: the authors.

To exemplify these analytical procedures carried out, we brought Group 6, which is the 'largest', composed of 10 authors and 8 articles, in which high school and higher education textbooks were analyzed and reflections were raised regarding the importance of rethinking the Education and Teaching in Science today.

In Figures 2 and 3 there is evidence that there are at least three main authors: Nathan Willig Lima, PhD in Physics Teaching from the Federal University of Rio Grande do Sul (UFRGS), Fernanda Ostermann, PhD in Physics from UFRGS, and Claudio José de Holanda Cavalcanti, PhD in Physics from UFRGS. They are all professors at UFRGS and participate in the Research and Didactic Innovation Group in Physics Teaching from a sociocultural perspective, formed in 2010.

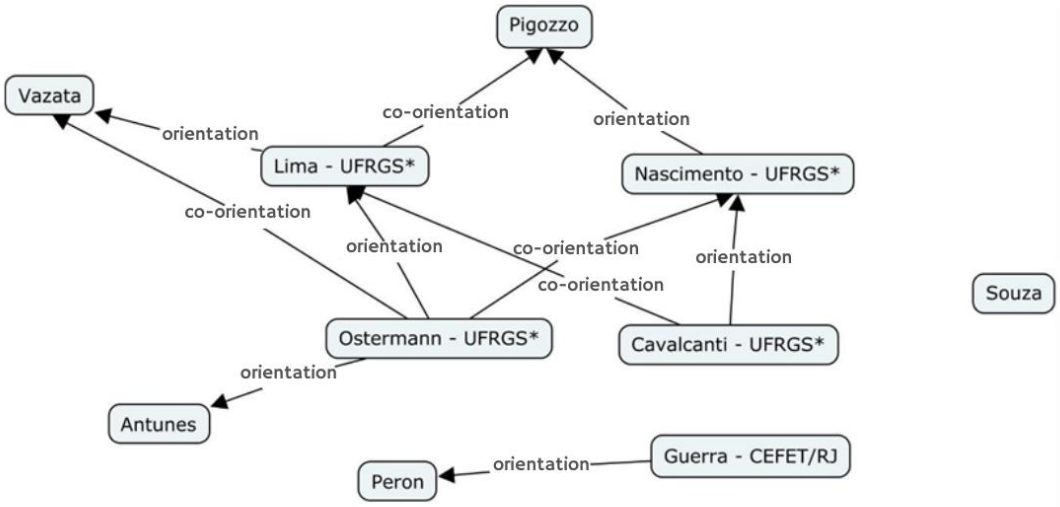


Figure 2 – Orientation relationships Group 6. Source: the authors.

In Figure 3, we sought to create a diagram that represented the main authors and the dates on which the articles were published.

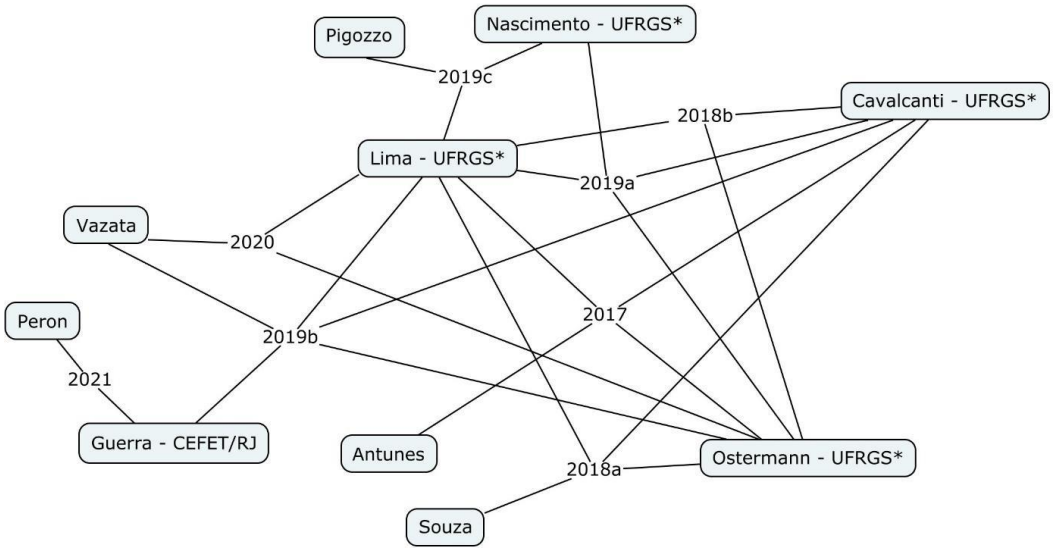
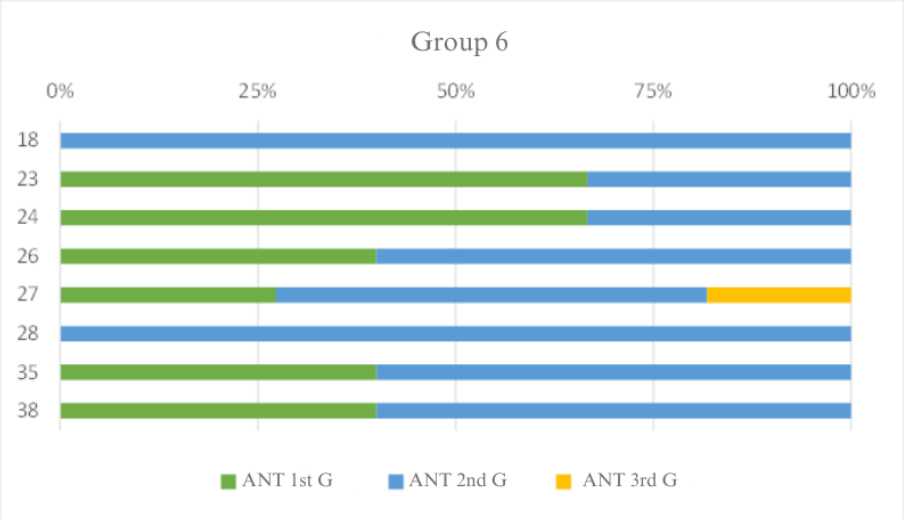


Figure 3 – Network of articles from Group 6. Source: the authors.

It can also be observed that when we focus on column 3 of Table 3 (information regarding Group 6), in addition to being the largest group in terms of number of authors and articles, it is also the one with the greatest variety of objectives. We list the following: the analysis of statements from higher education and Basic Education textbooks; the investigation of Bakhtin's Theory of Concrete Statement; the proposition of an analytical trajectory; the suggestion of introducing visions of the Nature of Science in Science classes; the proposition of discussions and explanations relevant to the formation of post-truth; and the validation of issues involving scientific knowledge.

It was also possible to create, based on all the information we organized and interpreted, Chart 2, which highlights the generations of ANT relevant to what these authors used and disseminated.



Graph 2 – References Group 6. Source: the authors.

For readers interested in the understandings we reached in relation to the other Groupings, as we present only Group 6 at this time, access Dangui (2022), where Figures similar to 2 and 3 and representative Graphs such as Graph 2 are available, for each of them, that is, another 28 figures and 14 supplementary graphs were created, in addition to those shown here.

III. Final considerations

After the considerations and analyzes presented in the previous sections, we return to the questions already stated in this article: What are the objectives explained in the articles based on the research they disseminate? From which generation of ANT are the references used in the articles? Which are the groups of researchers that adopted ANT as a reference? These were the questions we sought to answer in this article, which were already presented in the Introduction.

As for objectives O1 to O8, they bring the interpretative results, naming and exemplifying them: O1 – Theoretical articulation of Bruno Latour's ideas with Science Teaching; O2 – Investigation of opinions on topics related to the Nature of Science; O3 – Mapping of sociotechnical controversies and networks; O4 – Description of the classroom from the ANT; O5 – Development of teaching material, characterization map and teaching tools; O6 – Analysis of discursive characteristics; O7 – Reflections and discussions involving the post-truth phenomenon; O8 – Other authors in focus (other than Bruno Latour).

Graph 1 highlights the blue color linked to the 2nd generation exposed by Mattedi (Webinário, 2021), however the 1st and 3rd are also present and can be considered important and necessary for the theoretical advances that have occurred and are ongoing.

As for the Groups, we highlighted 15 of them and brought organizational and analytical results of the most representative – Group 6. However, all the others, systematized in Table 3, help to answer the research questions of this article, including the three generic questions stated in the first paragraph of this final section.

We end the article, indicating that the geographic location of the research clusters is concentrated in universities in the South/Southeast (listed in decreasing order of evidence frequency): UFRGS, UFMG, UEL, CEFET/RJ, UFRJ, USP, UNIFEI, UFMS, UNESP, UNICAMP, UFSCAR, UTFPR, UFABC and UFOP[5], being the first universities listed with the highest number of publications. Only two clusters were found in the Northeast of Brazil, Clusters 12 and 13, from UFBA and UFRN respectively.

Acknowledgements

We thank CAPES and CNPq for the financial support.

***Corpus* Codes and References**

[1] 2001 – Vianna.Carvalho (a)
VIANNA, D. A.; CARVALHO, A. M. P. Do fazer ao ensinar ciência: a importância dos episódios de pesquisa na formação de professores. **Investigações em Ensino de Ciências**, Porto Alegre, v. 6, n. 2, p. 111-132, 2001a.

[2] 2001 – Vianna.Carvalho (b)
VIANNA, D. M.; CARVALHO, A. M. P. Bruno Latour e contribuições da antropologia da ciência: aspectos para o ensino de ciências. **Ciência & Ensino**, Piracicaba, v.10, n. 1, p. 14-19, 2001b.

[3] 2004 – Queiroz.Almeida
QUEIROZ, S. L.; ALMEIDA, M. J. P. M. de. Do fazer ao compreender ciências: reflexões sobre o aprendizado de alunos de iniciação científica em química. **Ciência & Educação**, Bauru, v. 10, n. 1, p. 41-53, 2004.

[5] From Portuguese: UFRGS – Universidade Federal do Rio Grande do Sul; UFMG – Universidade Federal de Minas Gerais; UEL – Universidade Estadual de Londrina; CEFET–RJ – Centro Federal de Educação Tecnológica Celso Suckow da Fonseca; UERJ – Universidade Estadual do Rio de Janeiro; USP – Universidade de São Paulo; UNIFEI – Universidade Federal de Itajubá; UFMS – Universidade Federal do Mato Grosso do Sul; UNESP – Universidade Estadual Paulista Júlio de Mesquita Filho; UNICAMP – Universidade Estadual de Campinas; UFSCAR – Universidade Federal de São Carlos; UTFPR – Universidade Tecnológica Federal do Paraná; UFABC – Universidade Federal do ABC; UFOP – Universidade Federal de Ouro Preto; UFBA – Universidade Federal da Bahia; UFRN – Universidade Federal do Rio Grande do Norte.

[4] 2006 – Oliveira
OLIVEIRA, M. A. de. Estudos de laboratório no ensino médio a partir de Bruno Latour. **Revista Educação & Realidade**, Porto Alegre, v. 31, n. 1, p. 20, 2006.

[5] 2007 – Zanon.Almeida.Queiroz
ZANON, D. A. V.; ALMEIDA, M. J. P. M.; QUEIROZ, L. Contribuições da leitura de um texto de Bruno Latour e Steve Woolgar para a formação de estudantes em um curso superior de Química. **Revista Electrónica de Enseñanza de las Ciencias**, [*s. l.*], v. 6, n. 1, p. 59-69, 2007.

[6] 2008 – Oliveira
OLIVEIRA, M. A. O laboratório didático de química: uma micronarrativa etnográfica pela ótica do conceito de articulação. **Ciência & Educação**, Bauru, v. 14, n. 1, p. 101-114, 2008.

[7] 2010 – Oliveira
OLIVEIRA, M. A. Alfabetização Científica no Clube de Ciências do Ensino Fundamental: uma questão de inscrição. **Ensaio Pesquisa em Educação em Ciências**, Belo Horizonte, v. 12, n. 2, p. 11-26, 2010.

[8] 2010 – Melo
MELO, M. D. F. A. D. Q. A pipa e os quatro significados da mediação sociotécnica: articulações possíveis entre a Educação e a Psicologia para o estudo de um brinquedo. **Investigações em Ensino de Ciências**, Porto Alegre, v. 10, n. 2, p. 18, 2010.

[9] 2011 – Rezzadori.Oliveira
REZZADORI, C. B. D. B.; OLIVEIRA, M. A. A Rede Sociotécnica de um Laboratório de Química do Ensino Médio. **Experiências em Ensino de Ciências**, Cuiabá, v. 6, n. 3, p. 16-37, 2011.

[10] 2012 – Oliveira.Queiroz
OLIVEIRA, J. R. S.; QUEIROZ, S. L. A retórica da linguagem científica: das bases teóricas à elaboração de material didático para o ensino superior de Química. **Química Nova**, Belo Horizonte, v. 35, n. 4, p. 851-857, 2012.

[11] 2014 – Coutinho.Silva
COUTINHO, F. A.; SILVA, F. A. R. Análise do texto de um livro didático de biologia orientada pela Teoria Ator-Rede: um estudo sobre o tema Evolução Biológica. **Investigações em Ensino de Ciências**, Porto Alegre, v. 19, n. 3, p. 9, 2014.

[12] 2014 – Coutinho.Goulart.Munford.Ribeiro
COUTINHO, F. A.; GOULART, M. I. M.; MUNFORD, D.; RIBEIRO, N. A. Seguindo uma lupa em uma aula de Ciências para a Educação Infantil. **Investigações em Ensino de Ciências**, Porto Alegre, v. 19, n. 2, p. 22, 2014.

[13] 2015 – Cappelle.Coutinho
CAPPELLE, V.; COUTINHO, F. A. Tornar-se fisiologista vegetal: potencialidades educacionais de uma controvérsia entre cientistas do século XIX sob o ponto de vista de Bruno Latour. **Alexandria**: Revista de Educação em Ciência e Tecnologia, Florianópolis, v. 8, n. 3, p. 181, 2015.

[14] 2015 – Faria.Coutinho
FARIA, E. S.; COUTINHO, F. A. Educação Científica em ação: a cartografia de controvérsias como prática de cidadania técnico-científica. **Caderno de Pesquisa**, São Paulo, v. 22, n. 3, p. 133-147, 2015.

[15] 2015 – Roxael.Diniz.Oliveira
ROXAEL, F. R.; DINIZ, N. de P.; OLIVEIRA, J. R. S. de. O trabalho do cientista nos cartuns de Sidney Harris: um estudo sob a perspectiva da sociologia da ciência. **Química Nova na Escola**, Belo Horizonte, v. 37, p. 68-81, 2015.

[16] 2016 – Coutinho.Santos.Amaral.Santos.Silva
COUTINHO, F. A.; SANTOS, V. M. F. S.; AMARAL, A. C. R.; SANTOS, M. I.; SILVA, F. A. R.; SILVA, A. J. Quando os educandos transformam uma sequência didática em um ator-rede. Movimentos de Translação entre Ciência, Tecnologia, Sociedade e Ambiente na Educação de Jovens e Adultos. **Experiências em Ensino de Ciências**, Cuiabá, v. 11, n. 3, p. 178-193, 2016.

[17] 2016 – Oliveira.Queiroz
OLIVEIRA, J. R. S.; QUEIROZ, S. L. Elaboração de um mapa de caracterização do texto científico: referenciais teóricos e aplicação em destaque. **Investigações em Ensino de Ciências**, Porto Alegre, v. 20, n. 1, p. 142, 2016.

[18] 2017 – Lima.Antunes.Ostermann.Cavalcanti
LIMA, N. W.; ANTUNES, E.; OSTERMANN, F. CAVALCANTI, C. J. H. Uma análise bakhtiniana dos enunciados sobre o efeito fotoelétrico em livros didáticos do Ensino Superior. **Enseñanza de las Ciencias**, [*s. l.*], p. 1947-1951, 2017.

[19] 2017 – Massoni.Moreira

MASSONI, N. T.; MOREIRA, M. A. A visão etnográfica de Bruno Latour da ciência moderna e a antropologia simétrica. **Revista Brasileira de Ensino de Ciência e Tecnologia**, Ponta Grossa, v. 10, n. 3, 2017.

[20] 2017 – Mota.Gontijo.Oliveira
MOTA, G. P. R.; GONTIJO, G. B.; OLIVEIRA, J. R. S. A Revista "Pesquisa FAPESP" como Recurso para Abordagem da Sociologia da Ciência. **Revista Brasileira de Pesquisa em Educação em Ciências**, [*s. l.*], p. 953-983, 2017.

[21] 2018 – Rezzadori.Oliveira
REZZADORI, C. B. D. B.; OLIVEIRA, M. A. Educação química e pensamento latouriano: uma possível articulação. **ACTIO**: Docência em Ciências, Curitiba, v. 3, n. 1, p. 224-247, 2018.

[22] 2018 – Gomes.Oliveira
GOMES, F.; OLIVEIRA, M. A. O Manual do Mundo: as derivas da educação química ciências. **ACTIO**: Docência em Ciências, Curitiba, v. 3, n. 1, p. 248-267, 2018.

[23] 2018 – Lima.Souza.Cavalcanti.Ostermann
LIMA, N. W.; SOUZA, B. B.; CAVALCANTI, C. J. H.; OSTERMANN, F. Um estudo metalinguístico sobre as interpretações do fóton nos livros didáticos de física aprovados no PNLDEM 2015: elementos para uma sociologia simétrica da Educação em Ciências. **Revista Brasileira de Pesquisa em Educação em Ciências**, [*s. l.*], p. 331-364, 2018.

[24] 2018 – Lima.Ostermann.Cavalcanti
LIMA, N. W.; OSTERMANN, F.; CAVALCANTI, C. J. H. A não modernidade de Bruno Latour e suas implicações para a Educação em Ciências. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 35, n. 2, p. 367-388, 2018.

[25] 2018 – Meglhioratti.Batista
MEGLHIORATTI, F. A.; BATISTA, I. D. L. Perspectivas da Sociologia do Conhecimento Científico e o Ensino de Ciências: um estudo em revistas da área de ensino. **Investigações em Ensino de Ciências**, Porto Alegre, v. 23, n. 1, p. 01, 2018.

[26] 2019 – Lima.Nascimento.Ostermann.Cavalcanti
LIMA, N. W.; NASCIMENTO, M. M.; OSTERMANN, F.; CAVALCANTI, C. J. H. A teoria do enunciado concreto e a interpretação metalinguística: bases filosóficas, reflexões metodológicas e aplicações para os estudos das ciências e para a pesquisa em educação em ciências. **Investigações em Ensino de Ciências**, Porto Alegre, v. 24, n. 3, p. 258, 2019.

[27] 2019 – Lima.Vazata.Ostermann.Cavalcanti.Moraes
LIMA, N. W.; VAZATA, P. A. V.; OSTERMANN, F.; CAVALCANTI, C. J. H.; MORAES, A. G. Educação em Ciências nos tempos de pós-verdade: reflexões metafísicas a partir dos estudos das ciências de Bruno Latour. **Revista Brasileira de Pesquisa em Educação em Ciências**, [*s. l.*], v. 19, p. 155-189, 2019.

[28] 2019 – Pigozzo.Lima.Nascimento
PIGOZZO, D.; LIMA, N. W.; NASCIMENTO, M. M. A filosofia sistêmica de Fritjof Capra: um olhar ecológico para a Física e para o Ensino de Física. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 36, n. 3, p. 704-734, 2019.

[29] 2020 – Barcellos
BARCELLOS, M. Ciência não autoritária em tempos de pós-verdade. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 37, n. 3, p. 1496-1525, 2020.

[30] 2020 – Batistele.Oliveira
BATISTELE, M. C. B.; OLIVEIRA, J. R. S. Características discursivas de textos da revista Minas Faz Ciência e suas potencialidades no ensino de química. **Revista de Estudos e Pesquisas sobre Ensino Tecnológico (EDUCITEC)**, Manaus, v. 6, p. e124720, 2020.

[31] 2020 – Fanfa.Martello.Teixeira
FANFA, M.; MARTELLO, C.; TEIXEIRA, M. R. F. Desafios ambientais pós-pandemia. **Revista Brasileira de Educação Ambiental (RevBEA)**, São Paulo, v. 15, n. 4, p. 488-506, 2020.

[32] 2020 – Ranniery.Telha.Terra
RANNIERY, T.; TELHA, R.; TERRA, N. Educação Científica, (Pós)Verdade e (Cosmo)Políticas das Ciências. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 37, n. 3, p. 1120-1146, 2020.

[33] 2020 – Silva.Pretto.Lima
SILVA, P.; PRETTO, N. D. L.; LIMA, D. M. Relações sociotécnicas do movimento escola sem partido a partir de uma análise pós-qualitativa. **Interfaces Científicas – Educação**, [*s. l.*], v. 10, n. 2, p. 80-94, 2020.

[34] 2020 – Souza.Martins
SOUZA, A. T. F.; MARTINS, A. F. P. Pós-verdade e a potência dos afetos: um resgate da vida e obra de Rachel Carson para um saber sobre ciências. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 37, n. 3, p. 1147-1172, 2020.

[35] 2020 – Vazata.Lima.Ortermann.Cavalcanti
VAZATA, P. A. V.; LIMA, N. W.; OSTERMANN, F.; CAVALCANTI, C. J. H. Onda ou partícula? Um estudo das trajetórias ontológicas da radiação eletromagnética em livros didáticos de Física da Educação Básica. **Revista Brasileira de Pesquisa em Educação em Ciências**, [*s. l.*], p. 855-885, 2020.

[36] 2020 – Vittorazzi.Silva
VITTORAZZI, D. L.; SILVA, A. M. T. B. D. As representações do ensino de ciências de um grupo de professores do ensino fundamental: implicações na formação científica para a cidadania. **Ensaio Pesquisa em Educação em Ciências**, Belo Horizonte, v. 22, p. e214769, 2020.

[37] 2020 – Zanatta.Saavedra
ZANATTA, R. P. P.; SAAVEDRA FILHO, N. C. O Ensino de Ciências e a leitura da modernidade e da pós-modernidade por Bruno Latour: reflexões acerca do surgimento de pós-verdades e concepções alternativas no Ensino de Física Moderna e Contemporânea no Ensino Fundamental II. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 37, n. 3, p. 1469-1495, 2020.

[38] 2021 – Peron.Moraes
PERON, T. S.; MORAES, A. Construindo a Caixa-Preta da Dualidade Onda-Partícula de Louis de Broglie em sala de aula. **Revista Brasileira de Pesquisa em Educação em Ciências**, [*s. l.*], p. 1-30, 2021.

Bibliographic References

ARRUDA, S. M.; PASSOS, M. M.; BROIETTI, F. C. D. O programa de pesquisa sobre a ação docente, ação discente e suas conexões (PROAÇÃO): fundamentos e abordagens metodológicas. **REPPE: Revista de Produtos Educacionais e Pesquisa em Ensino**, Cornélio Procópio, v. 5, n. 1, p. 215-246, 2021.

BARDIN, L. **Análise de Conteúdo**. Lisboa: Edições 70, 2016.

COUTINHO, F. A.; SANTOS, V. M. F. S.; AMARAL, A. C. R.; SANTOS, M. I.; SILVA, F. A. R.; SILVA, A. J. Quando os educandos transformam uma sequência didática em um ator-rede. Movimentos de Translação entre Ciência, Tecnologia, Sociedade e Ambiente na Educação de Jovens e Adultos. **Experiências em Ensino de Ciências**, Cuiabá, v. 11, n. 3, p. 178-193, 2016.

COUTINHO, F. A.; SILVA, F. A. R. Análise do texto de um livro didático de biologia

orientada pela Teoria Ator-Rede: um estudo sobre o tema Evolução Biológica. **Investigações em Ensino de Ciências**, Porto Alegre, v. 19, n. 3, p. 9, 2014.

DANGUI, A. C. M. **A Teoria Ator-Rede e o ensino de Ciências no Brasil**: uma revisão sistemática dos artigos publicados nos últimos 20 anos. 2022. 144f. Dissertação (Mestrado em Ensino de Ciências e Educação Matemática) – Universidade Estadual de Londrina, Londrina.

FENWICK, T; EDWARDS, R. **Actor-network theory in Education**. New York: Routledge. 2010.

LATOUR, B. A guerra das ciências. **Folha de S. Paulo**, São Paulo, 15 nov. 1998. Caderno Mais, p. 5.

LATOUR, B. **Ciência em ação**: como seguir cientistas e engenheiros sociedade afora. São Paulo: Editora UNESP, 2000.

LATOUR, B. **Diante de Gaia**: oito conferências sobre a natureza no Antropoceno. Tradução Marylua Meyer. Rio de Janeiro: Ubu Editora, 2020.

LATOUR, B. **Reagregando o social**: uma introdução à teoria do Ator-Rede. Tradução: Gilson C. C. de Souza. Salvador: EDUFBA; Bauru: EDUSC, 2012.

LATOUR, B. Redes, sociedades, esferas: reflexões de um teórico Ator-Rede. **Informática na Educação**: Teoria e Prática, Porto Alegre, v. 16, n.1, p. 23-36, 2013.

LATOUR, B. **Science in action**. Cambridge: Harvard University Press, 1987.

LATOUR, B.; WOOLGAR, S. **A vida de laboratório**: a produção dos fatos científicos. Tradução: Angela Ramalho Vianna. Rio de Janeiro: Relume Dumará, 1997.

LATOUR, B.; WOOLGAR, S. **Laboratory life**: the social construction of scientific facts. London: Sage, 1979.

LIMA, N. W.; OSTERMANN, F.; CAVALCANTI, C. J. H. A não modernidade de Bruno Latour e suas implicações para a Educação em Ciências. **Caderno Brasileiro de Ensino de Física**, Florianópolis, v. 35, n. 2, p. 367-388, 2018.

MELO, M. D. F. A. D. Q. A pipa e os quatro significados da mediação sociotécnica: articulações possíveis entre a Educação e a Psicologia para o estudo de um brinquedo.

Investigações em Ensino de Ciências, Porto Alegre, v. 10, n. 2, p. 18, 2010.

MOCELIN, D. G. Concorrência e alianças entre pesquisadores: reflexões acerca da expansão de grupos de pesquisa dos anos 1990 aos 2000 no Brasil. **Revista Brasileira de Pós-Graduação**, Brasília, v. 6, n. 11, p. 35-64, 2009.

MOTA, G. P. R.; GONTIJO, G. B.; OLIVEIRA, J. R. S. A Revista "Pesquisa FAPESP" como Recurso para Abordagem da Sociologia da Ciência. **Revista Brasileira de Pesquisa em Educação em Ciências**, [*s. l.*], p. 953-983, 2017.

OKOLI, C. Guia para realizar uma revisão sistemática da literatura. Tradução: David Wesley Amado Duarte. Revisão técnica e introdução de João Mattar. **EaD em Foco**, Rio de Janeiro, v. 9, n. 1, e748, 2019.

PASSOS, A. M. **Um estudo sobre a formação de professores de ciências e matemática**. 2009. Dissertação (Mestrado em Ensino de Ciências e Educação Matemática) – Universidade Estadual de Londrina, Londrina.

REZZADORI, C. B. D. B.; OLIVEIRA, M. A. Educação química e pensamento latouriano: uma possível articulação. **ACTIO**: Docência em Ciências, Curitiba, v. 3, n. 1, p. 224-247, 2018.

THE ACTOR NETWORK RESOURCE: THEMATIC LIST. **Centre for Science Studies**, [*s. l.*], 2000. Disponível em: http://wp.lancs.ac.uk/sciencestudies/the-actor-network-resource-thematic-list/#pre. Acesso em: 29 out. 2021.

VIANNA, D. A.; CARVALHO, A. M. P. Do fazer ao ensinar ciência: a importância dos episódios de pesquisa na formação de professores. **Investigações em Ensino de Ciências**, Porto Alegre, v. 6, n. 2, p. 111-132, 2001.

WEBINÁRIO – Rastros e Possibilidades da Teoria Ator-Rede no Brasil – 25/02/2021 (Primeiro dia). Núcleo de Antropologias Experimentais – UNILAB, 12 mar. 2021. 1 vídeo (2:31:29). Disponível em: https://www.youtube.com/watch?v=R3fT-AjT2rE&t=2985s. Acesso em: 31 out. 2021.

WORTMANN, M. L. C. A realidade será, por acaso, alguma coisa em que devemos acreditar? Bruno Latour dá notícias das trincheiras das guerras da ciência. **Episteme**, Porto Alegre, n. 14, p. 175-179, 2002.