

The National Curricular Common Base as *revoicing of voices* from the National Curriculum Parameters: The Science, Technology and Society curriculum in science education for Middle School⁺*

Estevão Antunes Júnior¹

Doctoral Student – Universidade Federal do Rio Grande do Sul

Cláudio José de Holanda Cavalcanti¹

Fernanda Ostermann¹

Universidade Federal do Rio Grande do Sul

Porto Alegre – RS

Abstract

In face of the National Curricular Common Base (NCCB) approval scenario for the middle school, we consider relevant to understand the relationship between the scientific discourse brought as new and utterances that were already published since the last century by the National Curriculum Parameters (NCP). Articulating the Bakhtin's philosophy of language to Text Mining procedures, we look to identify and compare perspectives on the STS conveyed in the NCP and NCCB, since they are voices aligned with a critical curriculum perspective for Science Teaching and/or Education, committed to the emancipation of the subjects. We observed that utterances vehiculated in the new NCCB can be considered as revoiced utterances from the NCP, since both documents, even though they convey voices from the STS curriculum, end up not surpassing perspectives aligned to the neutrality of scientific and technological knowledge.

Keywords: *Science Education; NCCB; NCP; Text Mining.*

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¹ E-mails: eantunesjr@gmail.com; claudio.cavalcanti@ufrgs.br; fernanda.ostermann@ufrgs.br

I. Introduction

The final years of Middle School are, in practice, the first formal contact between students and Natural Sciences in school. Since the earlier moments of Brazilian schooling, this stage of education has privileged contents related to hygiene and agriculture (BRASIL, 1890), which according to Antunes Jr., Cavalcanti and Ostermann (2019), might have influenced the dominance of Biological Sciences over the other fields in Natural Sciences.

While the first elements related to Natural Sciences were introduced to Brazilian school policies in the nineteenth century, the twentieth century intensified issues regarding Science subjects. Between 1890 and 1930, there was a push towards training Arts and Sciences graduates, which strengthens Science teaching in the context of Middle School, then called gymnasium.

The 1930s were driven by the notion of standardization of national education through the Francisco Campos reform, which emphasized Natural Sciences in the first ten years of the Vargas Era. However, in the following decade, marked by the Estado Novo (New State), the Capanema Reform was set forth, and it was responsible for establishing two fixed stages for basic schooling, called gymnasial and collegial, as well as increasing nationalism by giving emphasis to the humanities that were connected to the Brazilian context, such as Brazilian History and Geography (DALLABRIDA, 2014).

Several events led to a stronger standing of science subjects in the following decades, based on reforms in the United States and in England, especially in the gymnasium (FERREIRA, 2007). After the launching of the Sputnik satellite by the soviets in 1957, several projects connected to the development of teaching resources for Science Teaching were implemented in the west with the purpose of improving scientific education, which was apparently less effective when compared to the Russian context (LORENZ; BARRA, 1986). For Physics, we may cite the Physical Science Curriculum Study (PSSC), the Project Harvard Physics and the Nuffield Foundation.

The Law of Lines of Direction and Bases of the Education (LLDBE) from 1971 highlights scientific and technological development as one of the three main segments for Brazilian education and states that Natural Sciences are mandatory in all eight years of the then collegial course, ten years after being made mandatory to all years of the gymnasium. The curricular directories, however, did not escape sanitarian notions nor the focus on subjects related to agriculture, which were present in the curriculum from the end of the nineteenth century.

As stated in the National Constitution of 1988 (BRASIL, 1988), a new curricular organization for basic schooling is created, with the LLDBE from 1996. The previous LLDBE, from 1961, recommended propaedeutic education for the social elites and professional training to the rest of the population that had started to have access to schools.

As a consequence of the LLDBE from 1996, documents that intended to regulate and give direction to the curricular structure of schools were created. As the main example, we

have the National Curricular Parameters (NCPs) (BRASIL, 1997), which were no more than orientations that could or not be followed in a school's educational planning or a teacher's lesson plans. The final version of the document was only published after consultations with the academic community, which criticized the document. This led the Ministry of Education and the National Council of Education to keep the document as a "non-obligatory curricular alternative" (MACEDO, 2014, p. 1533)

Even though the NCPs were considered non-obligatory, they impacted the National Textbook Program (NTP) in the late 1990s of the last century by orienting the evaluation of textbooks to be used in Brazilian schools and demanding that all works followed its parameters. Considering that many teachers use textbooks as the main guides to what must be studied in the classroom, it can be said the orientations in this document were effectively used in schools, albeit indirectly.

When analyzing the history of curricular development in Brazil, Macedo (2014) highlights that the political context in which the NCPs were created, in the presidency of Fernando Henrique Cardoso (FHC) (1994-2002), prioritized market logic. Despite facing harsh criticism from the academic community, some of its members who were aligned to the idea of curricular unity in the 1990s collaborated to the document's creation. In the presidency of Luiz Inácio Lula da Silva (2003-2010), the National Curricular Lines of Direction (NCLD) (BRASIL, 2013) were published, and, after nearly four years of social debate, the National Education Plan was approved (BRASIL, 2014). Recently, the National Curricular Common Base (NCCB) was also approved, in for elementary and Middle School in 2017 and for high school in 2018. It is important to note that the context in which the NCCB was written was not different in relation prioritizing market logic, especially since the political group that oversaw the Ministry of Education in 2016, tasked with writing the final versions of the NCCB, had clear connections to the group that wrote the NCPs in the 1990s. On that subject, Aguiar and Tuttman (2020) draw attention to the fact that both the presidencies of Luiz Inácio Lula da Silva (2003-2010) and of Dilma Rousseff (2011-2016) were criticized for keeping in the Ministry of Education certain worldviews that were quite similar to the voices that led the FHC presidency in the turn of the century.

By loosely reading the NCPs and the NCCB directed towards the final years of Middle School, it is possible to notice that, even if preliminarily, the interaction between science, technology, and society (STS) is an important element of the proposals, however, this does not mean that the prerogatives of the STS movement acts as the foundation to these documents. Without an adequate basis and critical perspective, the articulation between science, technology, and society may result in outdated worldviews that fall, among other aspects, within the supposed neutrality of the scientific-technological knowledge. On that subject, Antunes Jr., Cavalcanti and Ostermann (2020) analyzed the NCCB for Science Teaching in the final years of Middle School and found that the voices that were amplified in that document are closely related to a simplistic perspective on the STS interaction which, for

instance, sides with voices that amplify the idea of scientific neutrality and the myth scientific development always brings with it technological development and social welfare, as well as with the utilitarian perspective on science, which advocates for the study of scientific concepts conditioned strictly to its application in daily life.

Rezende and Ostermann (2019) state that the voices that advocate for a curriculum that is based on worldviews connected to the STS movement bring forth critical curricular positions, meaning that their objective is to overcome traditional curricular and teaching models, by seeking to reinvent them in a way that makes it possible for political, economic, social, and cultural issues to be brought to the center of the discussion. The authors also show that the voices that advocate for such a perspective are still a minority in Science Education research in Brazil.

Since the Bakhtinian curriculum understands the ideological reality built from the social relations that live in dialectic synthesis dynamized by enunciation processes, we may thus see the NCPs and the NCCB as instruments that carry voices which have ideological roles and may be interpreted as signs. We may also infer that these voices in the documents express exterior signs that convey information, mostly from interior signs, from the consciousness of the individual speakers.

II. Critical voices in science education: the STS movement in Brazil

The STS movement began towards the half of the last century, with the intention of with the aim of placing Science and Technology (ST) on a more democratic level, mainly due to the cold war period, associated with the space race. However, this movement was connected to European and North American demands, which led to the need in engineers and scientists to think critically about ST in a Latin American context.

Antidemocratic scientific and technological policies were challenged by Brazilian authors, such as Auler (2011), who defends an STS movement that is devoted to a greater participation of the population in scientific and technological decisions (STRIEDER, 2012). Conversely, in the disputes over the meaning of this movement in Brazil, projects that were influenced by North American and European STS became a reality, even if they took aspects of our political, social, and educational culture into consideration.

In this section, we reflect on some of the stances aligned to the curriculum we defend, while still recognizing that, in the Brazilian context, the STS approach was and still is a field of disputes (RIBEIRO; SANTOS; GENOVESE, 2017). It is possible to find STS proposals that do not break away from ideas of knowledge based on scientism, aligned to the perspective of scientific neutrality; however, there are proposals that are critical towards the status quo, such as STS education under the Freirean perspective (REZENDE; OSTERMANN, 2019).

Thus, by countering scientism and the salvationist understanding of science, the critical STS movement aspires to lead the decisions related to STS to a wider dimension. It

also intends to ensure that more social agents may be capable of participating in such decision-making processes that involve scientific and technological subjects (AULER; BAZZO, 2001), not to show the possibilities of science, but to make representations available, which allow the citizen to act, make such decisions and understand what is at stake in the specialized discourse (FOUREZ apud SANTOS; MORTIMER, 2002). Thus, the STS movement is in favor of the democratization of knowledge that involves STs and of the promotion of critical thinking.

Such critical thinking should be extended to science itself as a human activity, mostly by criticizing the so-called scientific neutrality, the notion that Science is impartial and immune to prejudices and skewed decisions – these notions are still present in the conception of the scientist as someone who is capable of behaving in ways that are not influenced by their own history and worldviews. Scientific neutrality manifests itself in the following three "myths": the superiority of technocratic decisions, the salvationist perspective of ST and technological determinism.

The first myth points towards the neutrality of scientific thinking, that is, the scientific conception would be more valuable in relation to other voices, with no space for contesting or criticizing it. This perspective, associated to the non-critical teaching of individuals in relation to socioscientific issues, increases the belief on the word of the scientist as infallible, turning the specialists the only individuals who may speak for issues involving science and technology.

The second myth discussed by the authors (AULER; DELIZOICOV, 2001) relates to the salvationist stance, which considers ST the path to improving people's lives by leading them to social welfare. Therefore, scientific and technological development would be the answers to social issues, in a perspective that ignores the fact that the solution to such problems is not always of scientific or technological nature. The linear development model considers that scientific and technological development would lead to economic development, which would then lead to social development.

The last myth portrays society as ruled by technology, meaning that it improves with greater scientific and technological development (technological determinism). The influence of social relations in the process of technological development is neglected and the latter is seen as the main factor for social improvement. Such viewpoint allows us to state that if there is development of technology, the world certainly will progress, changing the social standing of people for the better. If there is no technological development, humanity is doomed to failure.

This type of discourse can become dangerous if we consider that it has the potential to be well-received in schools. It may also become a reality, even if subtly, in some official documents. Such notion, which aims towards the projection of the scientific discourse as neutral and intrinsically superior to others, aligns itself with scientism, which seeks to become the privileged discourse in schools. On the other hand, the critical voices for Science

Education are aligned to a stance that defends that education should be committed to a critical reading of the world and to the critical development of citizens in relation to issues involving STs (AULER; DELIZOICOV, 2001). In this perspective, the STS interaction questions these three myths by making it possible for students to understand the influence that society holds over the development of STs and vice-versa. Thus, knowledge can be considered emancipating, by granting people conscience and autonomy.

The conception of science in the STS curriculum is not restricted to a perspective of neutrality and infallibility, free from social and economic influences. In this perspective, the STS curriculum assumes that teaching critical citizens is not associated only to the technical, material and/or utilitarian aspects of technology, but to a tripod that also considers social and organizational aspects. Science Teaching thus becomes socially engaged by supporting subjects with social relevance, such as problems related to the environment, health, economy, transportation, communication, energy, and military issues, among many other problems of modern society. On the other hand, opposing these principles leads to the voices that are aligned to a traditional cultural perspective, which, according to Silva (2015) and Lopes and Macedo (2011), maintains the *status quo*.

By randomly selecting 120 articles in one of the main journals on Science Teaching in Brazil, Rezende and Ostermann (2019) demonstrated that in 94 percent of the selected articles, the title refers to traditional curricular perspectives, which displayed the predominance of such discourse in Science Teaching, or rather the privileged worldview (voice) in this context. If the voices that are aligned to traditional curricular perspectives, which are evidently not aligned to the principles of the STS curriculum, are privileged in this specific context, it is possible to believe that they will also be privileged in other contexts associated with Science Teaching and/or Education.

Therefore, we believe that Science Teaching in the final years of Middle School should privilege those voices that are aligned to the general notions of STS Education, committed to transforming society. In the defense of a critical STS perspective, this paper aims to widen the analysis conducted by Antunes Jr., Cavalcanti and Ostermann (2020) on the amplification of voices that are aligned to the STS curriculum in Science Teaching and/or Education in the final years of Middle School by identifying and comparing STS perspectives in the NCPs and the NCCB.

III. Theoretical and methodological standpoint: proposing the interaction between text mining and bakhtinian analysis

By understanding the importance of investigate the perspectives on the STS relation that exist within curricular documents but may be nearly imperceptible when reading said documents, we agree that the mixed method is an adequate choice.

It is important to note that we do not see the mixed method as inherently better than qualitative and quantitative methods when analyzed separately, but rather as a consistent

alternative within the proposal of this work. Thus, we use the philosophy of language of the Bakhtinian Circle (BAKHTIN, 2016; VOLOSHINOV, 2018) in articulation with Text Mining to analyze the consecutive co-occurrence of nouns and adjectives.

Bakhtin and his circle, by opposing two linguistic perspectives of the nineteenth century (idealist objectivism and abstract subjectivism), proposes a new philosophy of language. This philosophy understands utterances as real, concrete, and unique, in the sense that they are composed by verbal and extraverbal parts that are interconnected and interact mutually. Utterances are dialogical and produced in social, material, and historical contexts, yet they interact dialogically with these contexts (reality), causing changes in them. The unity of the utterance is established by the always unique context in which it is produced. For Voloshinov (2018), the utterance is "a link in the uninterrupted chain of verbal discourse" and "even when written and finalized, it answers something and orients itself towards an answer" (VOLOSHINOV, 2018, p. 184).

For Voloshinov (1930), the verbal part of the utterance is materialized, in oral or written form, while the extraverbal part carries the context around the speech act that produced the utterance. According to Bakhtin (2016), an utterance is filled with voices that can be connected to it. A concrete utterance carries with it at least two voices: the voice of the speaker and of the listener. Related to those are the responsive and the directive voices (real or assumed).

From the perspective of the Bakhtin Circle, the voices can be understood as the worldview or perspective adopted by the speaker when producing the utterance, or the perspective through which the listener understands and takes a stance regarding this utterance (internalization of voices). Therefore, official documents or curricular policies can be understood as concrete utterances, which are constituted by verbal production in extraverbal contexts. These utterances convey voices from theoretical and ideological perspectives to which the speaker is affiliated. Thus, we can consider the possibility that two or more utterances share voices, or that a second utterance revoices voices from other utterances, conveying with it the same ideological bias.

Bakhtin (2002) classified the voices of others incorporated into ours based on what he refers to as authoritarian word and internally persuasive word, in which the first manifests itself as a fixed and rigid authoritative speech, and that "it is necessary to accept it as a whole or refuse it in full" (p. 144), while the second is "half ours, half someone else's" (p. 145), in addition to being a reanimated word, based on the adaptation to a new enunciative context, linked to the ideological awareness of the new speakers. The internally persuasive word, or what we call revoiced word (MAYBIN, 2008), is a process of incorporating the original voice into the voice of the new speaker, which connects itself with or opposes, implicitly or explicitly, the original voice, thus creating what is called the interanimation of voices. In this conception, the new speaker adds their own intonation as well as perspective to the original

utterance, along with adding emphasis on certain aspects instead of others. On that, Bakhtin (2002) remarks that

[...] unlike the outer authoritarian word, the inner persuasive word, in the process of its positive assimilation, is closely intertwined with "our word", since "our word" is gradually and slowly elaborated from the recognized and assimilated words of others, and at first its borders are almost imperceptible (BAKHTIN, 2002, p. 145).

It is important to note that this revoicing process, of incorporating the words of another, is in the philosophy of language of the Bakhtin circle configured as a conscious entanglement, that is, an interanimation of voices, different from what is called in the French discourse analysis the ideological subjection or ideological questioning (BRANDÃO, 2007).

It is relevant to highlight that, for the philosophy of language in the circle, "everything that is ideological has a signification: it represents and substitutes something found outside of it, which means it is a sign" (VOLOSHINOV, 2018, p. 91). Therefore, signs are fundamental elements of ideology. Voloshinov (2018) understands human consciousness as a group of signs that only manifest themselves in interindividual or social instances. Thus, it is pertinent to highlight that "individual consciousness is an ideological and social fact" (VOLOSHINOV, 2018, p. 97) and that "the word follows and comments on every ideological act" (VOLOSHINOV, 2018, p. 100).

Therefore, if we understand public policies and/or curricular documents as instruments that hold an ideological position and can be interpreted as utterances, it is possible to say that the voices conveyed in these documents provide elements that contain information about the ideological position of the speakers. From this perspective, the voice as an ideological sign which carries cultural, social, economic, and political aspects can manifest itself in a somewhat privileged way, depending on the context in which it is inserted.

In that sense, our analysis starts with the analytical device developed by Veneu, Ferraz and Rezende (2015) and moves towards Text Mining, thus, it is an interpretative quantitative method. Nascimento *et al.* (2019) highlights the importance of using interpretative quantitative methods (a type of mixed method) in research in Science Education, noting that these types of strategies "exist as potential alternatives for researchers seeking to broaden their understanding of the variables involved in the investigation by being able to "see" beyond the raw data" (NASCIMENTO *et al.* 2019, p. 778).

Considering the philosophy of language of the Bakhtin circle, Veneu, Ferraz and Rezende (2015) propose four steps for the analysis under this paradigm. The first stage is the identification and delimitation of the utterances. Even if all characteristics of a discourse genre (BAKHTIN, 2016) are necessary for this delimitation, the authors note that Bakhtin's theory treats the alternance between speakers as sufficient for such goals. That is, the utterance starts when one speaker starts speaking and ends when there is room for an answer (VENEU; FERRAZ; REZENDE, 2015). The second stage is constituted by the previous (and fluid) reading of the utterances, which seeks to find a relation with the concepts connected to

the theory relevant to the research. The third stage is the delimitation of the extraverbal context, where lies the concrete character for the utterance. This stage consists of the investigation of this context, seeking to restrict the extraverbal factors that are important to the analysis. Stage 4 consists of the analysis of the utterance, which covers the interrelation between the Bakhtinian concepts, the research questions, and the linguistic elements (verbal and extraverbal).

Considering that the objective of our analysis is to elucidate relatively hidden characteristics in the reading of the document, we will use quantitative support through Text Mining along the analysis of the utterance, so that this quantitative basis can support the discursive discussion of the utterances.

The quantitative support from Text Mining becomes relevant, considering that from the analysis of the co-occurrence of nouns and adjectives, we can extract textual patterns that are not as visible in the reading of the text itself. According to Feinerer, Hornik and Meyer (2008), there are several trends within Text Mining, with the common element among them being that the input is the text. In general terms, it is possible to say that the method concerns an interdisciplinary approach, in the sense that it contemplates aspects of data mining, linguistics, computational statistics and Computer Science.

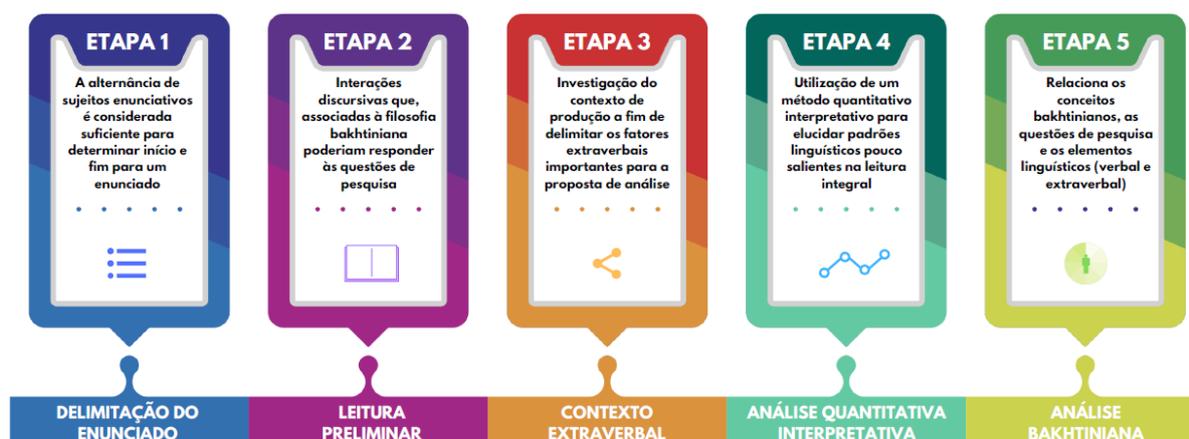


Image 1 – Methodological proposal: quantitative method based on Bakhtinian analysis.

Developed by the authors based on Veneu, Ferraz and Rezende (2015).

The classic use of this technique in essence transforms text into a structured format based on the frequency of terms and subsequently applies standard data mining techniques. Thus, we can, as an example, develop bigrams (noun followed by adjective) that have more latent meanings in the text than in the individual words. The most frequent nouns carry information on the most relevant themes in the text, its thematic inclination. The most frequent adjective adjacent to each noun allows us to infer the axiological character, the

valuation of each theme. Such aspects are important in Bakhtinian analysis and with them we formulate an analysis of qualitative character.

Text Mining is a set of procedures, usually based on natural language processing, which investigates the relationships between concepts and/or central topics in a text (or set of texts). This can result in viewings that allow us to investigate these relationships and interpret their meanings (for example, through a Bakhtinian prism). In other words, such group of methods allows the gathering of information (structured data) from non-structured data (such as texts). One of the possibilities would be to investigate in this text the frequency in which a given word (noun, for example) is followed by a second word (an adjective, for example). The articulation of this method with Bakhtinian analysis is part of a perspective focused on mixed methods in an articulated regime (SYMONDS; GORARD, 2010).

Thus, when conducting the Text Mining of each of the documents, we were able to observe interesting patterns regarding the conveyed and revoiced voices. The Text Mining that we present in the analysis will be represented in two formats, word networks and bigram clouds.

IV. Analysis

IV.1 Identification and delimitation of sources

Considering our concern with curricular policies involving Science Teaching and/or Education in the final years of Middle School, we will use as our object of analysis, or as our utterances, the sections referring to the Natural Sciences for this stage of schooling in both the old and the new document, which are respectively the NCPs and the NCCB. The version of the NCCB that we used for the analysis was the third version of the document for Early Childhood Education and Elementary Education, published before the final version of the NCCB for High School. The justification for this is that at the time, the complete document that contemplated all basic schooling had not yet been published.

The identification and delimitation of utterances are associated with six elements, which are: style, compositional structure, theme, relationship with the speaker, conclusion, and alternation of subjects. The first three elements are what characterize the discursive genre (BAKHTIN, 2016), that is, they present a relative stability to the analyzed utterances. Therefore, the identification of utterances happens specifically through the relationship with the speaker, the conclusibility and the alternation of subjects. According to Bakhtin (2016), the utterance is defined “precisely by the alternation of subjects, and it ends with the transmission of the word to the other” (p. 29).

IV.2 Preliminary reading of the utterances

The preliminary reading of the analyzed utterances sought to identify views regarding mainly the STS relations that are conveyed both in the NCPs and in the NCCB for Science Teaching and/or Education for the last years of Middle School.

From the reading of the NCPs, it is not difficult to identify that the STS movement is one of the guidelines that lead the perspective of the document elaborated in the 1990s. The document directly cites the assumptions of the STS movement as a guideline for curricular development, an influential perspective in Science Education that gained strength between the 1980s and 1990s, in Europe and North America. It should be noted that the idea of implementing the STS perspective in official documents in an undemocratic way relates to the initial assumptions of the Latin American STS, which are opposed to those adopted by the main Brazilian authors in the early 2000s (STRIEDER, 2012). The founders of the Latin American school of thought on STS “had as a perspective the ability to influence the course of ST, however, not through public participation in science, but directly, through scientific-technological policies” (STRIEDER, 2012, p. 26) which may influence the creation of curricular policies for the Teaching of Science and Technology.

On the other hand, The NCCB, as a set of voices, stands against a single perspective for didactic practice, even if it proposes a directional diagram to guide teachers (BRASIL, 2017, p. 321). This perspective sometimes expresses a certain flexibility of the proposal regarding its application to specific regional situations, and sometimes aligns itself with the understanding of curriculum as the planning of school activities according to “objective” and “scientific” criteria, which, according to Lopes and Macedo (2011), is a characteristic of the traditional curriculum.

On the STS relations, the document highlights competences such as

debating scientific, technological, socio-environmental and labor issues [...] explaining characteristics, phenomena and processes related to the natural, social and technological world (including the digital world), as well as the relationships established between them [. ..] understanding political, socio-environmental and cultural applications and implications of science and its technologies to propose alternatives to the challenges of the contemporary world [...] knowledge of the Natural Sciences in order to make decisions regarding scientific-technological and socio-environmental issues, as well as individual and collective health, based on ethical, democratic, sustainable and solidary principles (BRASIL, 2017, p. 322).

This suggests that the document is based on research results in Science Teaching and/or Education, which, among other equally relevant issues, has for years been dedicated to highlighting the importance of the assumptions of the STS movement for Science Education, even with the limitation to the widespread implementation of such perspective in schools.

By analyzing the approach of the subjects, we noticed a large difference between what is present in the NCPs and in the NCCB. In the older document, Natural Sciences are

mostly focused on Biological Sciences and it is more responsive to the history of the Natural Science curriculum in Brazil.

Regarding the epistemological aspect, the perspective on science conveyed in the NCCB is initially aligned with the idea that scientific knowledge is changeable, since it understands "Natural Sciences as a human enterprise, and scientific knowledge as provisional, cultural and historical" (BRASIL, 2017, p. 322). On that aspect, the NCPs are more rigorous regarding the myth of scientific neutrality and are against the dogmatic role of the scientific method, however, they strongly steer towards the Popperian evolutionary paradigm, remarkably similar to what is present in the 2017 NCCB.

The preliminary reading of the document indicates that, even though the documents were written during different periods of time, they apparently convey voices that are often similar, if not the same. To further investigate the topics covered in this subsection, we will analyze the contexts in which each document was prepared (extraverbal context) and the verbal parts (written), articulating them to this context.

IV.3 Extraverbal context

Voloshinov (1930) defends the notion that a given speech only carries meaning if analyzed considering the context in which it was produced, what he calls extraverbal context. By understanding each document as an utterance that carries worldviews (voices), has supposed recipients and is responsive to context (institutional, political, social, economic, cultural), this context of elaboration must be clear for the analysis to be consistent. Considering that this extraverbal context can be quite broad, as each utterance responds to previous utterances and is directed to later ones, we will limit the extraverbal context to the historical and political context of the elaboration of each of the utterances (the NCPs and the NCCB), which were explored in the introduction of this article, as well as the professional histories of the academics responsible for writing these documents.

The elaboration of both the NCCB and the NCPs involves government projects that convey voices that are either more or less privileged and that are related to the ideological bias. On the elaboration of the NCCB, for example, Aguiar and Tuttmann (2020) claim that the projects "refer to the visions of society, personhood, curriculum, assessment, management and teacher training that permeate the propositions and government practices" (AGUIAR; TUTTMAN, 2020, p. 71).

As for the authors of the NCPs, in the part referring to Natural Sciences for the final years of Middle School, by carrying out the investigation based on the Lattes platform and on platforms such as LinkedIn, Research Gate and Escavador, we observed that all people had basic degrees and specialization in Biology, while among the names with information available online, no author had degrees in Chemistry or Physics. We also observed the centrality of universities in São Paulo, since all authors obtained their degrees and/or work/worked in universities in the state of São Paulo.

Table 1 – Education and professional positions of the NCP authors.

Author	Initial Education	University	Specialization	Education level
A1	Biology	USP	Textbooks	Graduate degree only
A2	Biology	USP	Biosciences	Graduate degree only
A3	Biology	USP/UNITAU	Public Health	Doctor's degree
A4	Biology	USP	Environmental Education	Resumé not available
A5	Biology	USP	Environmental Science	Master's degree
A6	Biology/Geography	USP	Physical Geography	Doctor's degree

Source: developed by the authors.

Regarding the NCCB, on the other hand, "three of the four enunciative agents of the part referring to Natural Sciences in the final years of Middle School are researchers in Science Teaching and/or Education" (ANTUNES JR.; CAVALCANTI; OSTERMANN, 2020). In addition, none of the writers has a degree in Chemistry and the centrality of specialists educated at universities in São Paulo is maintained.

Table 2 – Education and work field of the writers.

Author	Initial Education	University	Specialization	Education level
A1	Biology	UNESP	Farmacology	Master's degree, but only graduate degree at the time
A2	Physics	USP	Science teaching	Doctor's degree
A3	Biology	USP	Public Health	Doctor's degree
A4	Biology	USP	Genetic Biology	Doctor's degree

Source: adapted from Antunes Jr., Cavalcanti e Ostermann, 2020.

An important difference between the documents regarding the enunciative agents is that the NCPs were concerned with selecting people who were engaged in themes related to environmental and sexual education. The NCCB, in turn, based the selection of enunciators on technical and content-related aspects.

This context, although restricted, expresses important information about the writing of each of the documents. The next section presents the intertwining between the verbal part, represented by the documents themselves, and the extraverbal part (context of elaboration of the documents), mediated by an interpretive quantitative method, which in our case consists of Text Mining through bigram clouds and word networks.

IV.4 Text mining analysis based on Bakhtinian analysis

This subsection intends to connect the written verbal context and the extraverbal context. Our theoretical-methodological framework, supported by the quantitative interpretive method presented in section III, shows the need to articulate the Bakhtinian theoretical framework, the Bakhtinian analytical device of Veneu, Ferraz and Rezende (2015) and the statistical technique of Text Mining.

The Bakhtinian analytical device of Veneu, Ferraz and Rezende (2015) refers mostly to qualitative research that uses as a theoretical framework the philosophy of language of the Bakhtin circle. The quantitative interpretive method, being a mixed method, considers quantitative aspects analyzed under the light of the statistical method. Thus, the Text Mining in this work is present to add to the Bakhtinian analysis, an interpretative quantitative method. As a result, word networks and bigram clouds were built.

Bigram clouds, unlike word clouds obtained with software like NVivo, for example, are bigrams of nouns followed by the most likely adjective. Traditional maps often generate clouds of individual words without relating them to each other. Thus, these clouds that we present here express greater richness of meaning. In the bigram clouds shown in the images that follow, both the size and color of the bigrams are proportional to how often they appear, however, less frequent bigrams are not distinguished by color, only by size.

Both in the clouds and in the networks, the terms were lemmatized, that is, where “observation direct” appears, for example, “direct observation” is understood (noun "observation" followed by the adjective "direct"). Lemmatization is important, since it eliminates gendered words, plurals, verb tenses and other inflections. Thus, the terms "observation direct" and "direct observation" are both converted to "direct observation". Had lemmatization not been performed, identical terms would certainly be considered different and would disrupt the clarity of the networks and word clouds by allowing redundancies.

For the lemmatization process, only nouns and adjectives were used (we excluded verbs, prepositions, pronouns, etc.), in which the package itself holds the grammar function of the word. For our analysis, we used the R program associated with the Udpipes package (WIJFFELS, 2020), since it allowed us to build our own programming code for the analysis, while the IRAMUTEQ package is more restrictive in this respect. The code provides a matrix of two columns and many rows, one for each bigram, different from the adjacency matrix, which is a square matrix. Thus, the verb/noun appears in one of the columns and the adjective in the other. To assemble the networks, we selected the most frequent bigrams.

Regarding the word networks, we must stress that the size of the vertices shows how central a word is, meaning that the more lines leave a specific vertex, the more important it is considered (however, it leads to other terms). Additionally, the direction of the arrows shows the order in which the words appear.

Initially, we must compare the word networks based on nouns followed by their most likely adjectives in the context of each document. These co-occurrences can be converted into an image, which allows the visualization of the terms. The arrows show the most frequent adjective after a certain noun. We opted to use a code to isolate the larger components (at least 3 components), with more terms which were not linked to other networks, as they express more richness of meanings, instead of using clusters. All links that were removed from the image networks had a maximum of 3 links, unlike those shown, which are the “backbone” of the analysis.

By observing the word network formed from the NCPs of the final years of Middle School for the area of Natural Sciences (Image 2), it is possible to notice that even with direct references to the STS movement and with all the argumentative articulation of the document around this axis, the adjectives “scientific” (*científico*) and “technological” (*tecnológico*) appear next to the noun “development” (*desenvolvimento*). Although subtle and implicit, this voice is aligned to the idea of the linear development model (AULER and DELIZOICOV, 2001), at least in part. Both terms appear distant from the term “society” (*sociedade*), which is more related to the concepts of “human being” (*ser humano*), “living being” (*ser vivo*) or “organism” (*organismo*), more in line with specificities in Biological Sciences. This allows us to infer that the STS perspective conveyed in the document is aligned to a concept that was discussed by Auler and Delizoicov (2001) more than twenty years ago.

Another relevant factor relates to the subjects being centered around Biological Sciences. This aspect is not surprising, since all writers of the document for Natural Sciences are connected to the field of Biology. As stated, the term “society” (*sociedade*) appears in the network in connection to that area.

The second map (Image 3) is the largest component of the word network, where more terms are linked together (and are, therefore, related) and where there are more possibilities of inferring a greater number of concepts. It is possible to consider this major component as the “backbone” of the network. Only components with at least 4 terms were considered, all obtained from the NCCB for Natural Sciences from 2017 that refers to the final years of Middle School. The sequence of words that begins with “development” (*desenvolvimento*), followed by “scientific” (*científico*) and “technological” (*tecnológico*) is noteworthy, suggesting that the NCCB conveys the idea of a direct association between science and technology (scientific development leads to technological development).

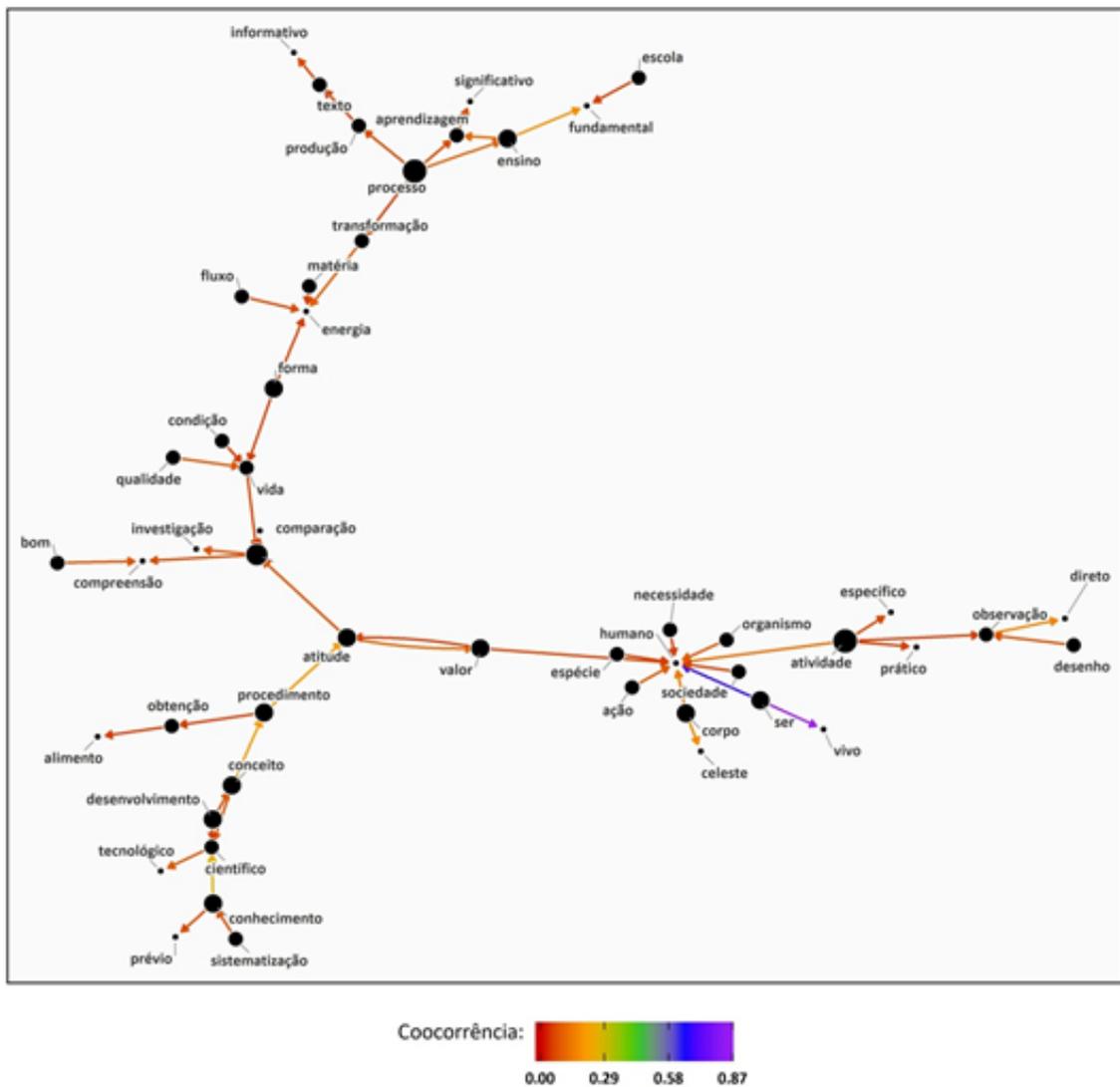


Image 2 – Word network made from the NCPs. The numeric values in the subtitle (colorful bar) show the number of cooccurrences divided by the number of pages in the document.

Source: developed by the authors, 2020.

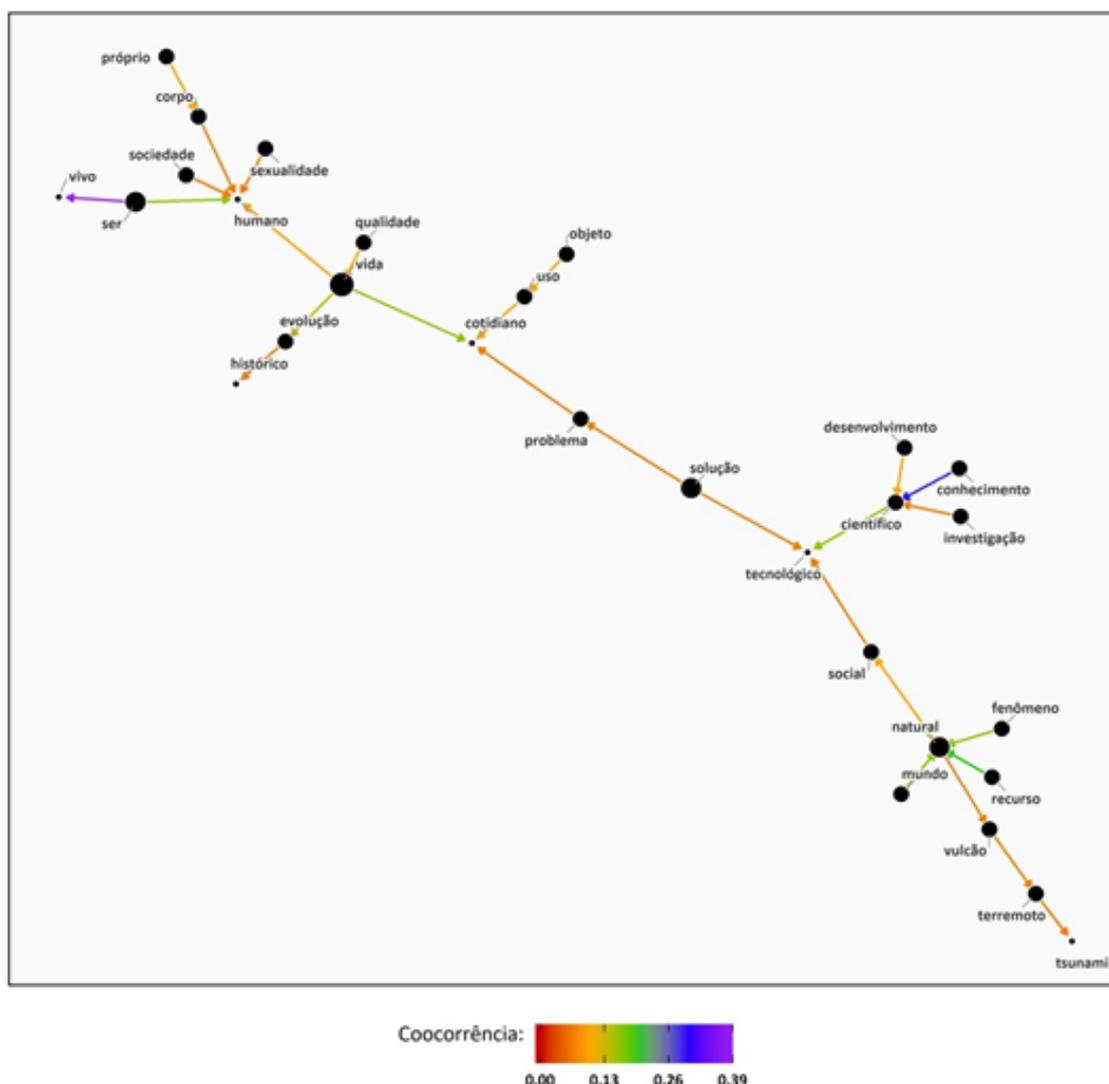


Image 3 – Word network made from the NCCB. The numeric values in the subtitles were found through the same logic used in the previous network.

Source: developed by the authors, 2020.

Furthermore, this branch follows this association: *technological* ← *solution* → *problem* → *daily life* ← *life* (*tecnológico* ← *solução* → *problema* → *cotidiano* ← *vida*). This association is particularly interesting, as it relates relatively well to a naive perspective on STS Education, associated with discourses that are still quite privileged in classrooms. By analyzing this branch as a sequel to the previous association, which links scientific and technological development, the notion of utilitarian science becomes clear and focused on the experiential (everyday) world and, to some extent, on solving problems in this more immediate world. Undoubtedly, this perspective is not aligned with the critical voices for STS Education. Furthermore, this view is discussed in several approaches in the CTS perspective.

When analyzing the context of elaboration of the document in the institutional scope that validated the choices of the work team at the Ministry of Education, we can infer that the dissemination of discourses that are undervalued in the area may have been timid, largely due to the fact that there are researchers in the team who probably did not align themselves with critical and/or post-critical curriculum theories or even with the basic assumptions of the STS movement.

Regarding the bigram clouds, we first present the one developed from the NCPs (Image 4).

Similar to the word networks shown in Images 2 and 3, the bigram cloud developed from the NCPs (Image 4) indicates a direction in the document towards a curriculum centered on Biology. In this case, it is noticeable that among the bigrams that stand out the most and regarding the content presented, we only have terms that refer to Biology, with few exceptions. The following table shows the translation of the main bigrams presented in the cloud.

Table 3 – Translation of the main bigrams in the first cloud.

Bigram	Translation
ser vivo	living being
conhecimento científico	scientific knowledge
tema transversal	cross theme
ensino fundamental	middle school
observação direto	direct observation
cadeia alimentar	food chain
corpo humano	human body
corpo celeste	heavenly body

Source: developed by the authors.



Image 4 – Bigram cloud developed from the NCPs.

Source: developed by the authors.

The second cloud, shown in Image 5, displays the bigrams created from the NCCB, which had a similar composition to the cloud obtained from the NCPs, mainly in terms of the centrality in Biology. Although this cloud has more bigrams that are linked to the areas of Physics and Chemistry, the most frequent bigram ("living being") is still directed to Biological Sciences.



Image 5 – Bigram cloud developed from the NCCB.

Source: developed by the authors.

Table 4 – Translation of the main bigrams in the second cloud.

Bigram	Translation
ser vivo	living being
conhecimento científico	scientific knowledge
unidade temático	thematic unit
energia elétrico	electrical energy
recurso natural	natural resource
fenômeno natural	natural phenomenon
ser humano	human being
ano inicial	early year
ano finais	final years
mundo natural	natural world

vida humano	human life
vida cotidiano	everyday life

Source: developed by the authors.

Although the documents were written in different historical moments and by different enunciating agents, we realized that the voices conveyed are, if not the same, remarkably alike each other. It was possible to infer that the voices conveyed in these documents had similar views on the nature of Science, reinforcing hegemonic views in Science Teaching. Although these views refer to two different historical moments, both the NCCB and the NCPs aligned themselves with traditional perspectives relating to the Science curriculum.

V. Conclusion and final remarks

Our study on the National Common Curricular Base of the final years of Middle School for the area Natural Sciences allowed us to reflect on possible relations to the NCPs that this document presents in terms of the STS perspective. We realized that even though it was conceived 20 years after the NCPs, the new Brazilian curricular base, this time as a law, presents itself as a revoicer of voices from the previous document, sharing worldviews that are aligned with the perspectives defended in the curriculum proposal for STS Education that was written in the end of the 1990s.

Our analysis, through the interpretive quantitative method, led us to two word clouds and two bigram clouds, one for each document. The word clouds show what was not so evident in the reading of the documents, such as the idea of centralizing content and the revoicing of voices regarding the linear development between science, technology, and society. The word clouds had similar results, but they further elucidated the centrality of contents related to Biological Sciences.

The first consideration becomes clear when the adjectives "scientific" and "technological" appear close to the noun "development" in the NCPs. In the NCCB, the sequence *technological* ← *solution* → *problem* → *daily* ← *life* is highlighted. The centrality of Biology in the curriculum, which was evident when analyzing the word maps, became clearer when we noticed the predominance of themes relating to living beings, as shown in the bigram clouds.

Thus, the comparison between the word networks and the bigram clouds shows that, regarding content, the "biologization" of science continues to prevail at the expense of other subjects within the Natural Sciences, while the perspectives for Science Education conveyed in the two documents feed into myths about the interactions of science, technology, and society.

Interestingly enough, this representation of the NCCB as a revoicer of the voices in the NCPs is not surprising, since the similarities go beyond the verbal context and reach the

extraverbal sphere. Many of the contexts in which the utterances are produced are similar, relating both to the centralization in the same research centers and to the government policies adopted by members of the Ministry of Education. Lopes (2004), when reporting the transition from the FHC administration to the Lula administration, alerts to the fact that the curricular policies developed between 1996 and 2004 did not undergo changes, as the “Ministry of Education remains influenced, from a curricular point of view, by the same epistemic community” (LOPES, 2004, p. 115).

While our analysis does not focus on this discussion, it is appropriate to reflect on whether the continued focus on contents from Biological Sciences could be attributed to data from the 2018 school census, which indirectly shows that Physics and Chemistry are more often taught by teachers without training in the area when compared to Biology (BRASIL, 2019). Could this data suggest that this centrality is a strategy used to circumvent the lack of Physics or Chemistry teachers, without a greater commitment to overcoming the lack of attractiveness of the teaching career and to training teachers for these subjects?

Finally, the fact that outdated views about the STS curriculum are propagated from the NCPs to the current NCCB may indicate that not only teachers, but also document writers, lack a more solid training on the relations between ST and society.

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