RBECT
Revista Brasileira de Ensino de Ciência e Tecnologia

Revista Brasileira de Ensino de Ciência e Tecnologia
ISSN: 1982-873X

https://periodicos.utfpr.edu.br/rbect

Characterization of Scientific Dissemination Texts inserted in Nature Science Textbooks and Their Technologies

Claudia Almeida Fioresi
clau_fioresi@hotmail.com
0000-0002-1044-3863
Universidade Federal da Fronteira Sul, Realeza, Paraná, Brasil.

Laura Darif Turra
lauraturra123@gmail.com
0009-0004-6459-4984
Universidade Federal da Fronteira Sul, Realeza, Paraná, Brasil.

Luana Jacomini
luanajacomini1@gmail.com
0009-0009-2527-8301
Instituto Federal do Paraná, Cascavel, Paraná, Brasil.

Alessandra Zeferino
alessandrazeferino5@gmail.com
0009-0004-8399-6575
Universidade Federal da Fronteira Sul, Realeza, Paraná, Brasil.

ABSTRACT

Scientific Dissemination is a form of knowledge circulation present in various spaces, highlighted in this work by its inclusion in Science and Technology textbooks approved in the National Textbook Plan (2021). This analysis[1] comprised the seven approved collections, aiming to identify the ways Scientific Dissemination is incorporated into these works, observing, for example, the chosen themes, cited sources, and the relationship between the text format and its original version. A wide variety of themes were found, such as environmental issues, health, sports, technology, etc. Additionally, different forms of incorporating these texts were identified, with exercises and text charts standing out. It was observed that such texts can contribute to the contextualization of themes and broaden the discussion of concepts that have been reduced with the new configuration of textbooks.

KEYWORDS: Scientific dissemination. BNCC. Science education.

INTRODUCTION

Scientific knowledge circulates in different ways in society, and in each space, due to distinct production conditions, this knowledge can take on various forms. In the realm of society in general, Scientific Dissemination (SD) is a widely used practice to convey knowledge of Science and Technology. Another way scientific knowledge circulates, addressed in this work, is through Textbooks (TB), in which SD can also be found integrated into their structure.

The incorporation of SD into schools via textbooks is a complex movement that interacts with various entities from different sectors of society, such as public policies, TB producers, and the teachers' own mediation. Thus, investigating the movement of SD into TB is relevant, as they are textual forms with different functions in our society.

This incorporation has already been investigated by Souza (2017), who analyzed biology textbook collections from the National Textbook Program (PNLD) in 2015. The heterogeneity of external sources within TB was analyzed by Fioresi (2020). This author investigated chemistry TB from the PNLD of 2018, examining the inclusion of texts originating from other sources, including SD sources, their forms, production conditions, and their relationship with radioactivity as a scientific fact. However, these investigations took place before the new formulation of TB according to the Common National Curriculum Base (BNCC), which began to be implemented in Brazil in 2022 and significantly altered the form and structure of TB.

Moreover, the BNCC document itself, regarding the teaching of natural sciences in high school, and the 2021 PNLD notice, indicate ways to work with SD and the skills expected in this interaction. Here is an example:

> (EM13CNT303) Interpret scientific dissemination texts that deal with natural sciences themes, available in different media, considering the presentation of data in text form, as well as in equations, graphs, and/or tables, the consistency of arguments, and the coherence of conclusions, aiming to build strategies for selecting reliable information sources (BRASIL, 2018a, p. 559).

Thus, the purpose of this work was to investigate the seven textbook collections approved in the 2021 PNLD after the implementation of the new BNCC for high school, in order to verify and analyze how SD is incorporated into each of these collections. A specific content was not prioritized; rather, the entirety of the books was examined to gain a more general understanding of the aspects related to SD in this new material that was introduced into classrooms starting in early 2022.

Therefore, the following question can be raised: how do SD texts circulate in science and technology textbooks in high school? Consequently, the main objective was to characterize the incorporation of SD texts in these approved collections.

ASPECTS OF SCIENTIFIC DISSEMINATION

Scientific dissemination has been established as a fertile field for science education. "In dark times of denialism like the one affecting everyone in the midst of the Covid-19 pandemic, dissemination not only becomes fertile but also a necessary and increasingly relevant path" (LORENZETTI; RAICIK; DAMASIO, 2021, p. 3).

Moreover, with the advent of information and communication technologies and the ease of internet access in much of the country, encountering scientific dissemination through a simple online search has also facilitated its integration into schools. In addition to magazine articles, there are now numerous channels on YouTube, Facebook pages, blogs, Instagram accounts, and podcasts where journalists and even scientists engage in disseminating Science and Technology topics in diverse perspectives and formats.

> The practices of Scientific Dissemination (SD) have altered how society accesses information about science, technology, and innovation (STI). New communication tools have contributed to enhancing the dynamism of the circulation of such information, while technological development has promoted new forms of interaction in communication, extending to SD (LIMA; GIORDAN, 2017, p. 83).

Furthermore, there is no consensus on a single definition for the term SD, as it "far from designating a specific type of text, is related to how scientific knowledge is produced, formulated, and circulates in a society like ours" (SILVA, 2006, p. 53).

Regarding this, Campos and Freitas (2021) mention that SD does not have a single definition and presents a polysemic character, meaning it is confronted with different established views of the term. In this sense, the meaning of SD varies according to the researcher's understanding who uses it, which also depends on the means of dissemination analyzed and the audience they intend to reach.

In this work, we understand SD not merely as a simplification of specialized science for the general public, but rather as a form of *textualization* of science with its own characteristics, encompassing not only textual but also epistemological aspects related to the production of scientific knowledge (FIORESI; SILVA, 2022).

The notion of textualization and circulation of scientific knowledge employed in this work understands that whether verbal, written, oral, text-visual, visual, or audiovisual, texts are "the product of an act of interpretation, beyond the subject's intentionality, in a specific socio-historical context. There is no production/circulation of knowledge without it taking certain textual forms" (SILVA, 2013, p. 253).

> This perspective has allowed me to consider not only the meanings of texts and their "contents," nor only the methods and values associated with their production as the focus of scientific education, but the texts themselves as objects of study, in a perspective that takes into account their contexts of production, formulation, and circulation, the content-form relationships, the interlocution relationships, and the institutions involved in their production and circulation - in other words, textualization (SILVA, 2010, p. 29).

Thus, "scientific dissemination texts can be considered an important tool to be used in the classroom to bring new information and possibilities for science education" (BATISTELE; DINIZ; OLIVEIRA, 2018, p. 183). Moreover,

> [...] didactic strategies that value students' contact with different types of scientific texts and express a variety of forms of argumentation and viewpoints can bring certain benefits, including: access to a greater diversity of information; development of reading skills and mastery of concepts, forms of argumentation, and elements of scientific terminology [...] (FERREIRA; QUEIROZ, 2012, p. 1-2).

Considering the area of Natural Sciences and Their Technologies covered in the Common National Curriculum Base (BNCC), which includes Biology, Physics, and Chemistry, working with themes from these areas through scientific dissemination can be a strategy to promote the construction of scientific concepts as well as develop students' critical thinking skills.

BRIEF HISTORY OF TEXTBOOKS

It is essential to discuss the importance of Textbooks (TB) in various contexts, according to Martins (2006, p. 118):

> "The unquestionable importance of the textbook in the education scenario can be understood in historical terms, through the relationship between this educational material and the constitutive practices of school and school teaching. This importance is evidenced, among other factors, by the debate surrounding its function in the democratization of socially legitimized knowledge related to different fields of knowledge, by the controversy about its role as a structurer of teaching activity, by the economic interests around its production and commercialization, and by the investments of governments in evaluation programs."

Textbooks (TB) have existed and been part of education for a long time. Mortimer (1988), in one of his works, analyzes Chemistry TB since 1930. According to this author, "until 1930, textbooks were characterized as compendiums of general chemistry, which is consistent with the then structure of secondary chemistry education" (MORTIMER, 1988, p. 25).

From 1930 onward, TB underwent changes resulting from the Francisco Campos Reform (1931). They became serialized, started presenting historical aspects of chemistry, more illustrations and diagrams were added, and some of these books even began to include exercises. In the 1940s and 1950s, Mortimer's analysis (1988) revealed that there were not as many significant changes in TB as in the earlier analyzed period. Moreover, between 1961 and 1970, there was the greatest heterogeneity in TB, meaning it was the period with the greatest diversity of approaches.

The National Textbook Program (PNLD) was an important public policy for the maintenance and oversight of knowledge in TB. PNLD began in 1937, under a different name, and is considered the oldest program aimed at distributing educational works initially for public children's education in Brazil.

On December 21, 1937, Law No. 93 was sanctioned, creating the National Book Institute, and shortly thereafter, in 1938, Decree Law No. 1,006 established

the National Commission of Textbooks (CNLD), responsible for the first legislation and control policy on the production and circulation of textbooks in the country. This Commission aimed to encourage both the distribution and commercialization of TB. It was only in 1985, through Decree No. 91,542, that teachers were guaranteed the right to participate in the selection of TB (BRASIL, 2018b).

In 2004, the National Textbook Program for High School (PNLEM) was progressively implemented. At the beginning of its implementation, PNLEM distributed textbooks for the 1st year of high school, covering the subjects of Mathematics and Portuguese. It was only in 2008 and 2009 that the subjects of Chemistry, Physics, and Biology were included in PNLEM (BRASIL, 2018b).

Another public policy that strongly impacted the formulation of TB was the BNCC, approved in 2018 in a politically turbulent context in Brazil (SILVA, 2018), and had three versions in total since its appearance in 2014. It was implemented throughout the education network, both public and private, in 2022.

> The Base Nacional Comum Curricular (BNCC) is a normative document that defines the organic and progressive set of essential learning that all students must develop throughout the stages and modalities of basic education, ensuring their rights to learning and development, in accordance with the National Education Plan (PNE) (BRASIL, 2018c, p. 7).

In addition to its stated objectives, the BNCC aims to reduce educational inequalities across Brazil, ensuring that, for example, a student in the south of Brazil can study the same content as a student in another region. This is somewhat questionable, given that Brazil is a continental country with unique cultures.

The BNCC includes competencies and skills intended for all learning stages. Introducing the term "competence," BNCC proposes 10 general competencies that students are expected to acquire throughout their school trajectory. However, the term "competence" in education carries significant weight, as according to Silva (2018, p. 12), competence "is limited by its pragmatic and ahistorical nature, reiterating the idea that 'competence' is related to young people's integration into the job market after leaving high school."

On the other hand, the term "skill" refers to "cognitive and socio-emotional practices" (Brazil, 2018c, p. 8), and in the document, they appear with verbs that students will develop in their daily lives during high school and even after graduation. For example: compare, understand, locate, discuss, identify, select, investigate, plan, associate, justify, analyze, etc.

As mentioned earlier, the organization of the curricular structure across different levels of Basic Education was altered with the BNCC. Early childhood education is divided into fields of experiences, such as: self, others, and us; traits, sounds, colors, and shapes, etc. Elementary school is divided into five areas of knowledge: Languages; Mathematics; Human Sciences; and Natural Sciences. In high school, the knowledge areas are: Languages and their Technologies; Mathematics and their Technologies; Natural Sciences and their Technologies; Mathematics and their Technologies; Human and Social Sciences applied and technical vocational training.

METHODOLOGY

In this study, all textbooks (TB) for Natural Sciences and their Technologies approved by PNLD (2021) were selected. The research involved a meticulous reading of the collections, aiming to identify DC texts inserted in their chapters and units. This reading encompassed every page of each collection, seeking references to sources from print or digital media, such as magazines, newspapers, electronic websites (including institutional pages of universities, institutes, and research centers), and other media that disseminate information on science and technology, as identified by the textbook authors.

It is important to note that, following the proposal of BNCC for High School, textbooks are no longer divided into disciplines of Biology, Physics, and Chemistry but are integrated into the axis of Natural Sciences and their Technologies. Each collection consists of a set of six textbooks, which are used throughout the three years of high school.

Table 1 presents information regarding the seven collections analyzed and their respective identification codes used throughout the text, aimed at enhancing the systematization and discussion of data, noting that each collection comprises six volumes of textbooks.

Table 1 - List of Textbook Collections and their Identification in the Text

Collection Name	Identification in the Text
To Be the Protagonist	CL1
Natural Sciences and their Technologies	CL2
Multiverses	CL3
Connections	CL4
Modern Plus	CL5
Matter, Energy, and Life	CL6
Dialogue	CL7

Source: Own elaboration (2022).

The aspects analyzed were based on the analytical framework proposed by Fioresi (2020), which are as follows:

a) **Themes of DC texts:** Themes present in the circulation of DC texts were analyzed.

b) **Source of original DC texts cited in the work:** The cited sources were identified, including DC magazines, newspapers, websites, blogs, institutional websites, and books.

c) **Form in which texts appear in textbooks (TB):** This refers to the space given to this material in the structure of TB, such as the relationship between the form of the text and its cited original version, which can be in the form of a quotation, reading suggestion, excerpt from the original, adaptation, or fully cited text.

d) **Strategy for integrating DC text into TB:** This aspect identified the strategies for integrating these texts, such as exercises, charts, figures, boxes, insertion within chapters, opening or closing chapters.

RESULTS AND DISCUSSIONS

Through the analytical framework used to characterize the overall entry of SC in the LD for Natural Sciences and their Technologies, a total of 575 insertions of SC were found across the seven collections. It is important to note that the content of these texts was not deeply analyzed, given the large quantity, and in line with the initially outlined objective of characterizing these insertions in a more general manner, paving the way for further research. Additionally, the texts were grouped according to their main subject matter, mostly related to the themes of the units in which they were inserted. Figure 1 below exemplifies the topics addressed in the SC texts:

Figure 1: Themes covered in DC texts

CL1 – TO BE THE PROTAGONIST	
Themes	Quantity
Matter and energy	10
Environmental themes	22
Science and health	17
Biochemistry	1
Science and technology	7
Transformations of matter	5
Work and energy	5
Time and space	5
Modern science	3
Genetics	1
Ecology and biodiversity	8
	Total: 90

CL2 – NATURAL SCIENCES AND THEIR TECHNOLOGIES	
Themes	Quantity
Life and Universe	10
Goals and Minerals	3
Science and Technology	8
Environmental themes	27
Energy and Life	2
Science and Sports	4
Science and Health	13
Science and Animals	2
Forensic Analysis	4
	Total:73

CL3 – MULTIVERSES	
Life and Universe	12
Environmental themes	23
Science and Sports	2
Cellular metabolism	2
Science and Health	14
Energy and Work	2
Electricity generation	6
Electromagnetism	3
Science and Evolution	8
Scientific Method	3
Biochemistry	3
Modern Physics	4

CL4 - CONNECTIONS	
Environmental themes	16
Matter and Energy	5
Radioactivity	3
Science in everyday life	5
Life and Energy	4
Transformations of matter	3
Science and Health	13
Energy generation	7
Electromagnetism	1
Energy and Work	1
Food Science	10
Biotechnology	5
Time and Space	4
	Total:77

	Total:82	**CL6 – MATTER, ENERGY, AND LIFE**	
CL5 – MODERNA PLUS		Earth and Universe	5
Health and Sports	15	Science and Technology	17
Energy	3	Environmental Themes	6
Social Issues	1	Life and Evolution	14
Science and Technology	8	Health and Sports	29
Environmental Themes	9	Energy	1
Life and Evolution	4	Social Issues	7
	Total:40		Total:79
CL7 – DIALOGUE			
Earth and Universe	27	Health and Sports	19
Life and Evolution	20	Environmental Themes	32
Science and Technology	8	Energy	14
Social Issues	12	Metals and Minerals	2
			Total: 134

Source: Research Data (2023).

Based on the data presented in Figure 1 above, a wide variety of themes is observed. Since there is no longer a division into specific areas of Chemistry, Physics, and Biology, the availability of concepts varies considerably from collection to collection. In general, environmental themes have prominently appeared in collections with different focuses, including environmental impacts and sustainability, environmental disasters such as those in Brumadinho and Mariana/MG, improper disposal of batteries, mining, plastics, ocean acidification, among other topics.

Health-related subjects also circulated significantly, with topics such as self-medication, disease treatment, vaccine production, individual and collective health, etc.

However, it was also noted that the more specific the unit's theme, the fewer DC texts were included. Specific themes such as "Cellular Metabolism," "Genetics," "Biochemistry," and "Electromagnetism" were highlighted. In these cases, authors included excerpts from scientific texts related to Biology, Physics, or Chemistry disciplines, such as Revista Química Nova, Química Nova na Escola, Revista Eletrônica do Departamento de Química da UFSC, Estudos Avançados (included in the *Scielo* platform), among others. These texts typically exhibit language and characteristics distinct from DC textuality and were not part of this analysis.

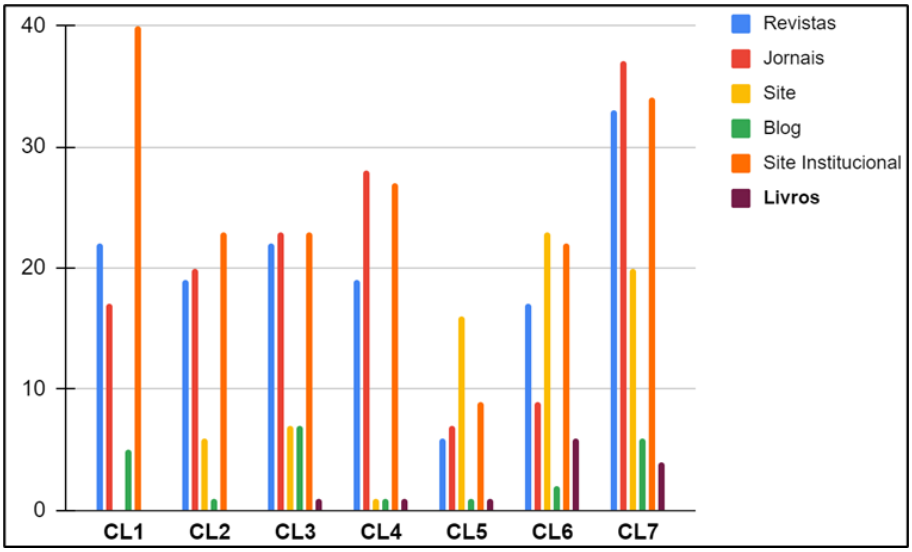
It is believed that these texts aim to bring controversial topics closer to students and to bridge scientific concepts with everyday life. According to Souza and Rocha (2015, p. 134), "DC texts can constitute an important strategy in Science Education by contextualizing the content developed in the classroom, making the lesson attractive, participatory, and dynamic."

Furthermore, it can be inferred that since the creation of PNLD, textbook authors have adhered to certain standards to meet its requirements, with recurring elements such as experimentation, history of science, contextualization of knowledge, interdisciplinarity, and addressing Science, Technology, and Society (STS), among others (FIORESI; SILVA,2019).

The PNLD call for proposals mandates the inclusion of DC texts in these books. Among the PNLD criteria, there is a requirement for "circulation and reception of scientific dissemination texts and social media" (BRASIL, 2021, p. 81). The inclusion of DC has become an indispensable criterion, being a decisive factor in the selection of works.

Regarding the second aspect of the analysis, Figure 2 illustrates the relationship between the total number of entries and the sources cited in these insertions (magazines, newspapers, website, blog, institutional website, books).

Figure 2 - Quantity of DC Texts (vertical axis) in relation to the cited sources



Source: Research Data (2022).

Examining Figure 2, it is notable that the majority of DC texts originate from institutional websites such as FAPESP, Fiocruz, Instituto Nacional de Pesquisas Espaciais (INPE), newspapers (Jornal da USP, G1-globo, BBC Brasil), and popular science magazines (Pesquisa FAPESP, Galileu, Superinteressante, and Ciência Hoje). All cited sources are available online. The preference for citing online sources is believed to stem from the increasing trend of using digital platforms for research, as subscriptions to physical newspapers or magazines have become less frequent.

Considering the classroom context, providing links can guide teachers and students, allowing them to access the full versions of these materials. Additionally, Rocha (2012, p. 55) presents findings from a study in schools where teachers “highlighted the benefits of using DC in classrooms, including the ability to contextualize curriculum content, enhance interaction between students and scientific information, and address current and socially relevant topics”. This observation aligns with the findings of Souza and Rocha (2015) and Fioresi and Silva

(2019), who emphasize that such inclusions facilitate integrating science with students' everyday lives.

It is noteworthy that CL5 collection had the fewest DC texts, totaling only 40 entries. Upon analysis, this collection appears more content-driven, with fewer contextualized themes. In most cases, DC texts were included as suggested readings at the end of chapters under a section called "expanding your knowledge."

In contrast, CL7 collection stood out with the highest number of DC texts (134 in total)[2]. Moreover, this collection encompassed all forms of cited sources as depicted in Figure 2. However, it's important to note that out of these 134 entries, 50 were presented in a featured box format within the LD, displaying the headline prominently followed by a brief description (lead) and a reference/link for external access. Figure 3 illustrates this format of entry.

Figure 3 - Representation of a featured box with headline followed by a link.

Source: CL7, LD v. 1, p. 38 (2020).

This practice was also quite common in CL2 through the "Stay Informed" box. This form of entry is considered less engaging compared to inserting excerpts from the text or even presenting it in its entirety. This is because in such cases, only the title or a brief introduction does not provide the full scope or context of the entire text, which can affect its comprehension and its relationship with the studied content.

Regarding adaptations of DC texts, authors Passeri, Aires, and Rocha (2017, p. 159) concluded that "already in the process of re-elaboration, it is possible to notice that a large part of the information is dispensed with, which may interfere with the purpose of presenting current information on the subject." The authors also indicate that in the adapted text, the elimination of relevant sections becomes evident, hindering a more reflective debate on the topic (PASSERI; AIRES; ROCHA, 2017). Figure 3 explicitly shows that without necessary information, it is challenging to critically argue about the subject, thus making it a less appealing format for the classroom context.

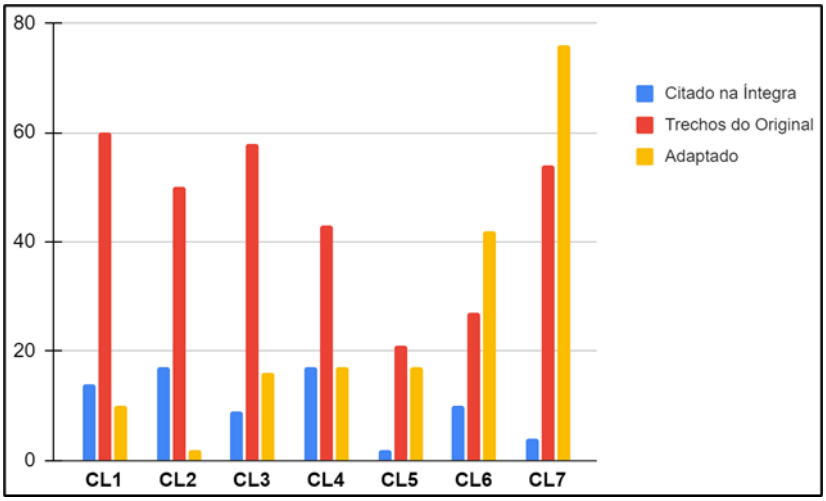
The use of books, although infrequent, also occurred. We can highlight CLD 6 and mention DC books referenced in its LD, such as "From X-rays to Quarks: Modern Physicists and Their Discoveries" and "The Disappearing Spoon - And Other True Tales of Madness, Love, and the History of the World from the Periodic Table's Elements," which were included as excerpts from the original.

It can be assumed that the low utilization of references from DC books is due to the fact that most books are not available online, unlike other sources (journals, newspapers, websites, and blogs), which are all easily accessible with an internet

search. Another factor, as reported by Strack, Loguércio, and Del Pino (2009, p. 440) in their study on the use of DC books in the classroom, is that teachers justified that they "already use books in classes when 'time' allows." According to the authors' research, DC books are underutilized by teachers in their classes.

Next, in Figure 4, data is presented grouped according to the form of the text and its relationship with the original reference version.

Figure 4 - Relationship between the text form and its original reference version



Source: Research Data (2022).

Regarding Figure 4 above, it is also noted that collection CL7 has the highest number of citations of DC texts in adapted form. As mentioned earlier, this is justified by its entry format containing only the title and/or lead. Martins and Damasceno (2002), analyzing the insertion of DC in Science LDs, argued that adaptation,

> [...] may reveal an attempt to make the didactic text more homogeneous from the standpoint of the variety of forms of presentation of ideas, since, in general, the dissemination text tends to be more argumentative and the didactic text more descriptive (MARTINS; DAMASCENO, 2002, p. 4).

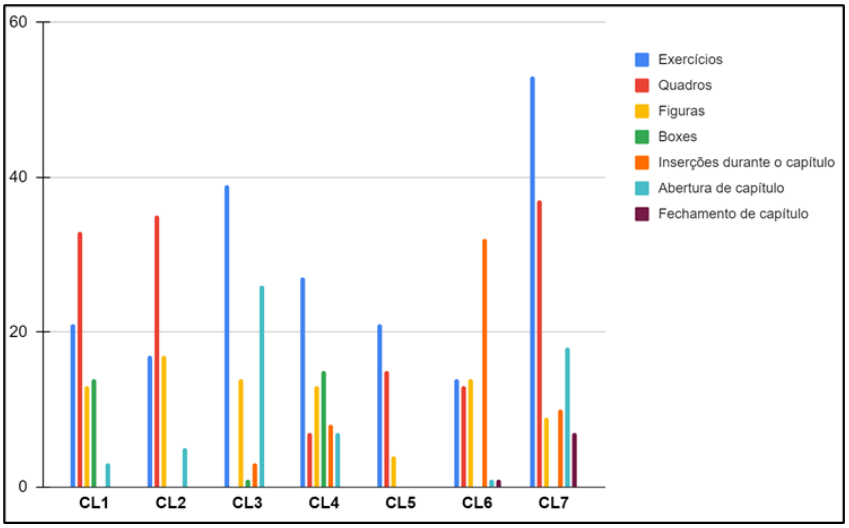
Full citations, that is, the original version cited in its entirety, appeared less frequently in CL3 and CL4. From the analysis of the collections, it was observed that these appeared mostly in the form of images and infographics, which fall under the category of figures (Figure 5 graph). Collections CL3 and CL4 show significant quantities of texts cited in full. This is because, in the vast majority of cases, it is not a text that has been fully excerpted from its source but rather in the form of an image, diagram, representation, infographic, graph, etc., and has been simply transposed into the LD.

It is also possible to analyze that it is a preference of the collections to use excerpts from the original DC text. In their work, Martins and Damasceno (2002) present arguments that authors choose to reduce DC texts in order to extract the main information and adjust the formatting to fit the LD size, considering that some of them can occupy several pages and LDs have space limitations. Furthermore, in line with these data, Jacomini, Zeferino, and Fioresi (2021) also

report in their work that authors' preference for using excerpts from the original is due to LD layout and space considerations.

Moving on to the fourth aspect of the analysis regarding how the text appears in the LD, Figure 5 presents the data grouped according to the form of insertion of each text.

Figure 5 - Forms of entries of DC texts in different collections



Source: Research Data (2022).

Regarding the graph in Figure 5, it is notable that the majority of texts are presented in the form of exercises (192) and boxes (140). Collections CL7 and CL3 had the highest number of DC texts inserted in the form of exercises. CL3 also featured many texts inserted in charts, along with collections CL1 and CL2. For instance, in CL3, out of 83 DC insertions, 39 texts were inserted as exercises, with most of these exercises containing excerpts from the cited original version. Figure 6 below illustrates this form of insertion.

Figure 6 - Representation of insertion as exercises

1. Leia o texto e a seguir faça o que se pede.

[...]

E o Sal Rosa do Himalaia é mesmo o melhor para consumo?

Recentemente muita polêmica foi criada sobre o consumo do sal rosa do Himalaia, e de acordo com alguns pesquisadores ele poderia não ser benéfico para a saúde. O sal rosa é o "sal do momento", e aclamado na mídia por trazer benefícios a saúde. Ele é um sal das rochas existentes em minas na cordilheira do Himalaia. A **composição clássica do sal rosa é de 98% de cloreto de sódio**, incluindo até outros 80 elementos, entre eles fósforo, magnésio, potássio, cálcio, zinco, cobre e ferro. A coloração do sal, que pode ir do vermelho ao rosa claro, é derivada da concentração de alguns minerais. Quanto mais claro, maior é o seu grau de pureza."

[...]

RENKE, G. Mitos e verdades sobre o polêmico sal rosa do Himalaia. **Eu atleta**, Rio de Janeiro, 3 nov. 2017. Disponível em: https://globoesporte.globo.com/eu-atleta/saude/noticia/mitos-e-verdades-sobre-o-polemico-sal-rosa-do-himalaia.ghtml. Acesso em: 25 jun. 2020.

a) O sal rosa é um composto molecular ou um composto iônico? Cite as principais características que podem justificar sua resposta.

b) Consulte a tabela periódica e indique, utilizando os símbolos correspondentes, quais elementos formam os cátions presentes no sal rosa.

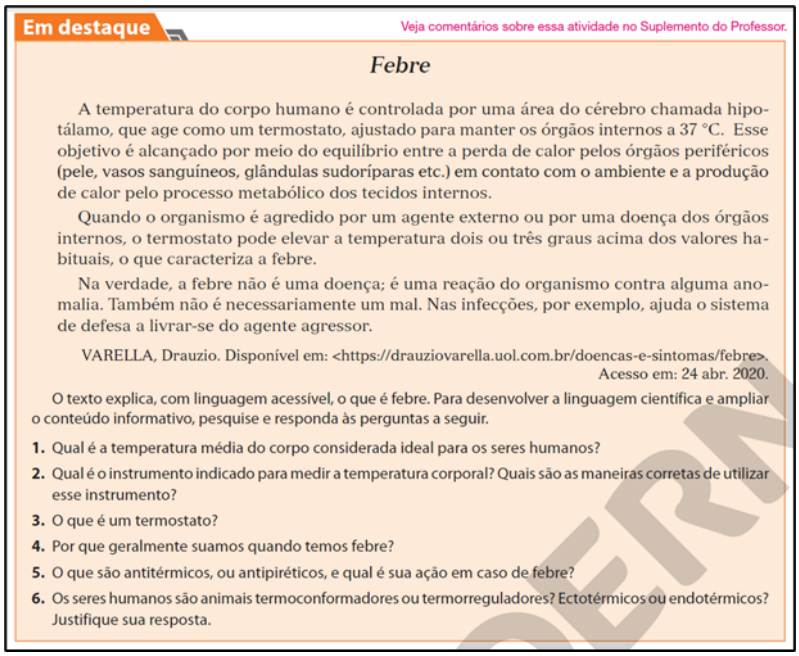
Source: CL3, vol. 1, p. 81 (2020).

The insertion of DC texts in exercises can assist students in understanding the overall context of the topics covered in these exercises, and subsequently in solving them. There is also the possibility that students may become interested in the subject and seek to delve deeper into it through the link provided at the end of the cited excerpt. Jacomini, Zeferino, and Fioresi (2021, p. 08) consider this type of insertion "very beneficial and can be approached in various ways. The teacher can explore the text, encouraging students to seek more information, even before solving the exercise itself."

Additionally, the use of DC texts as exercise prompts is a common educational practice, popularized by college entrance exams such as ENEM. This aspect is relevant given the large number of DC texts that have materialized in LD through exercises and questions (FIORESI, 2020, p. 158).

Regarding the insertion through charts, CL7 presented a chart named "Reviewing what I studied," and CL5 featured the "Highlighted" box, inserted throughout each chapter, containing texts related to technologies, health, advances in science, discoveries, or the history of researchers. Figure 7 below provides an example of DC insertion in the form of a chart.

Figure 7 - Representation of insertion as a chart



Em destaque

Veja comentários sobre essa atividade no Suplemento do Professor.

Febre

A temperatura do corpo humano é controlada por uma área do cérebro chamada hipotálamo, que age como um termostato, ajustado para manter os órgãos internos a 37 °C. Esse objetivo é alcançado por meio do equilíbrio entre a perda de calor pelos órgãos periféricos (pele, vasos sanguíneos, glândulas sudoríparas etc.) em contato com o ambiente e a produção de calor pelo processo metabólico dos tecidos internos.

Quando o organismo é agredido por um agente externo ou por uma doença dos órgãos internos, o termostato pode elevar a temperatura dois ou três graus acima dos valores habituais, o que caracteriza a febre.

Na verdade, a febre não é uma doença; é uma reação do organismo contra alguma anomalia. Também não é necessariamente um mal. Nas infecções, por exemplo, ajuda o sistema de defesa a livrar-se do agente agressor.

VARELLA, Drauzio. Disponível em: <https://drauziovarella.uol.com.br/doencas-e-sintomas/febre>. Acesso em: 24 abr. 2020.

O texto explica, com linguagem acessível, o que é febre. Para desenvolver a linguagem científica e ampliar o conteúdo informativo, pesquise e responda às perguntas a seguir.

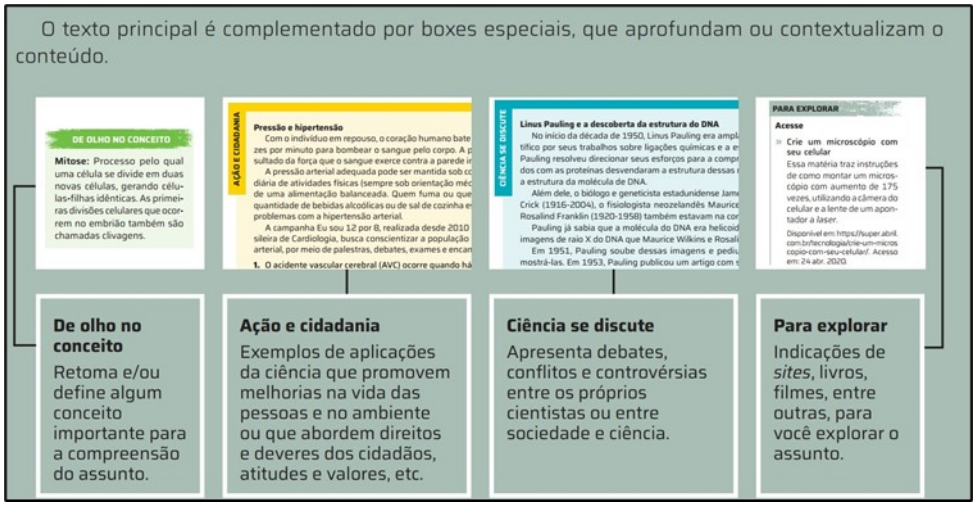
1. Qual é a temperatura média do corpo considerada ideal para os seres humanos?
2. Qual é o instrumento indicado para medir a temperatura corporal? Quais são as maneiras corretas de utilizar esse instrumento?
3. O que é um termostato?
4. Por que geralmente suamos quando temos febre?
5. O que são antitérmicos, ou antipiréticos, e qual é sua ação em caso de febre?
6. Os seres humanos são animais termoconformadores ou termorreguladores? Ectotérmicos ou endotérmicos? Justifique sua resposta.

Source: CL5, v. 3, p. 49 (2020).

It is observed that the boxes, similarly to the exercises, aim to contextualize the main subject treated in the text, subsequently directing through questions the relationship with the content addressed in that chapter.

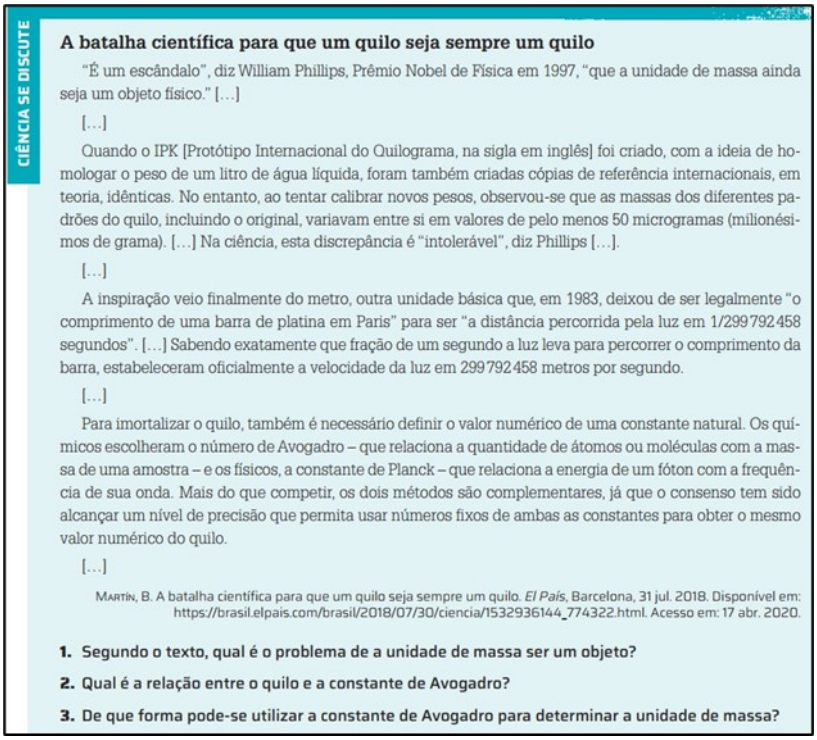
Regarding the form of insertion through boxes, mention is made of "Stay Informed" and "Science Discussion" with various themes related to the chapter. All inserted texts are consistent with the themes addressed in the boxes. In Figure 8 we can observe how the book presents the arrangement of the boxes, and following that, Figure 9 provides an example of this type of insertion.

Figure 8 - Explanation of the arrangement of boxes in LD of CL1



Source: CL1, vol. 1, p. 04, (2020).

Figure 9 - Representation of a form of insertion of DC text as a box



CIÊNCIA SE DISCUTE

A batalha científica para que um quilo seja sempre um quilo

"É um escândalo", diz William Phillips, Prêmio Nobel de Física em 1997, "que a unidade de massa ainda seja um objeto físico." [...]

[...]

Quando o IPK [Protótipo Internacional do Quilograma, na sigla em inglês] foi criado, com a ideia de homologar o peso de um litro de água líquida, foram também criadas cópias de referência internacionais, em teoria, idênticas. No entanto, ao tentar calibrar novos pesos, observou-se que as massas dos diferentes padrões do quilo, incluindo o original, variavam entre si em valores de pelo menos 50 microgramas (milionésimos de grama). [...] Na ciência, esta discrepância é "intolerável", diz Phillips [...].

[...]

A inspiração veio finalmente do metro, outra unidade básica que, em 1983, deixou de ser legalmente "o comprimento de uma barra de platina em Paris" para ser "a distância percorrida pela luz em 1/299 792 458 segundos". [...] Sabendo exatamente que fração de um segundo a luz leva para percorrer o comprimento da barra, estabeleceram oficialmente a velocidade da luz em 299 792 458 metros por segundo.

[...]

Para imortalizar o quilo, também é necessário definir o valor numérico de uma constante natural. Os químicos escolheram o número de Avogadro – que relaciona a quantidade de átomos ou moléculas com a massa de uma amostra – e os físicos, a constante de Planck – que relaciona a energia de um fóton com a frequência de sua onda. Mais do que competir, os dois métodos são complementares, já que o consenso tem sido alcançar um nível de precisão que permita usar números fixos de ambas as constantes para obter o mesmo valor numérico do quilo.

[...]

MARTÍN, B. A batalha científica para que um quilo seja sempre um quilo. *El País*, Barcelona, 31 jul. 2018. Disponível em: https://brasil.elpais.com/brasil/2018/07/30/ciencia/1532936144_774322.html. Acesso em: 17 abr. 2020.

1. Segundo o texto, qual é o problema de a unidade de massa ser um objeto?
2. Qual é a relação entre o quilo e a constante de Avogadro?
3. De que forma pode-se utilizar a constante de Avogadro para determinar a unidade de massa?

Source: CL1, vol. 1, p. 98 (2020).

Regarding the insertion via boxes, collections such as CL1 "Action and Citizenship" and CL4 "Science Discussed" stand out, as they are crucial for establishing a connection between students' everyday lives and the topics being studied, reflecting their reality or that of other regions of the planet. Iglesias and Petrucci-Rosa (2016, p. 36) understand "that the purpose of these boxes is to emphasize concepts and ideas discussed throughout the chapter or even those that have not been discussed."

FINAL CONSIDERATIONS

Throughout this analysis, a significant number of DC insertions in Natural Sciences and their Technologies LDs approved in PNLD 2021 are highlighted. In the vast majority, these insertions occurred through references from institutional websites, magazines, and newspapers, via excerpts from the original text, through exercises and charts.

It is worth noting, firstly, the wide variation in the number of DC texts found in the 7 collections, ranging from 40 to 134 texts. CL7 presented the highest number of DC Texts (134), distributed across only 8 themes, while collections like CL1, CL3, and CL4 presented 90, 82, and 77 DC texts respectively. Among the themes of the texts, the environmental area stands out, being common across all collections and leading in the quantity of DC texts in CL1, CL2, CL3, CL4, and CL7.

Regarding the form of the text and its original reference version, considering the prevalence of adapted texts, it is emphasized that these mostly end up being less interesting; they are incomplete, with little information and lacking the context of news.

Regarding the cited sources, it is observed that only CL1 and CL2 collections do not have texts from all the sources cited in the graph, with CL1 lacking texts from websites and DC books, the latter also absent in CL2. Furthermore, references from DC books were found in the lowest quantity among all sources. As for the form of entry of these texts, it was quite varied across most collections.

The BNCC for High School brought about significant changes, including the blending of specific knowledge areas. However, the insertion of DC texts is seen as an opportunity to delve deeper into certain subjects, demonstrating their significance in different societal contexts. Nevertheless, it is up to the teacher to determine the best way to work with such texts, according to their planning, and to understand how these insertions function and can assist in their teaching practice.

Finally, based on this characterization, further research can explore, for example, the themes addressed in textbooks. There are thus several open questions about the new configuration of these books, as well as implications for the use of scientific dissemination via textbooks in schools.

CARACTERIZAÇÃO DE TEXTOS DE DIVULGAÇÃO CIENTÍFICA INSERIDOS EM LIVROS DIDÁTICOS DE CIÊNCIAS DA NATUREZA E SUAS TECNOLOGIAS

RESUMO

A Divulgação Científica é uma forma de circulação do conhecimento, que está presente em diferentes espaços, destaca-se nesse trabalho a sua entrada em livros didáticos de Ciências da Natureza e suas Tecnologias, aprovados no Plano Nacional do Livro Didático (2021). Esta análise[1] compreendeu as sete coleções aprovadas, buscando identificar as formas de entrada da Divulgação Científica nas obras, observando por exemplo os temas escolhidos, as fontes citadas, relação entre a forma do texto e sua versão original. Verificou-se grande diversidade de temas como questões ambientais, saúde, esporte, tecnologia, etc. Além de diferentes formas de entrada destes textos, se sobressaindo o formato de exercícios e quadros. Percebeu-se que tais textos, podem contribuir na contextualização dos temas, bem como ampliar as discussões dos conceitos que foram reduzidos com a nova configuração dos livros didáticos.

PALAVRAS-CHAVE: Divulgação da ciência. BNCC. Ensino de Ciências.

NOTE

1. This article is derived from a comprehensive work presented at the National Symposium on Science and Technology Teaching (SINECT 2022) and is presented in a more complete, revised, and detailed version.

2. It is important to note that the focus of this research is on characterizing the forms of entry of Scientific Dissemination in Textbooks, and we did not quantify other types of entries that did not have the characteristics of this form of scientific textualization.

BIBLIOGRAPHIC REFERENCES

BATISTELE, M. C. B.; DINIZ, N. P.; OLIVEIRA, J. R. S. de. O uso de textos de divulgação científica em atividades didáticas: uma revisão. **Revista Brasileira de Ensino de Ciência e Tecnologia**, v. 11, n. 3, p. 182-210, 2018. Available at: http://dx.doi.org/10.3895/rbect.v11n3.6002. Access on: Feb. 20th, 2024.

BRASIL. **Base Nacional Comum Curricular**. Brasília: MEC, 2018c. Available at: http://basenacionalcomum.mec.gov.br/images/BNCC_EI_EF_110518_versaofinal_site.pdf. Access on: May 12th, 2022.

BRASIL. Fundo Nacional de Desenvolvimento da Educação. **Histórico**. MEC, 2018b. Available at: http://www.fnde.gov.br/component/k2/item/518-hist%C3%B3rico. Access on: Feb. 10th, 2022.

BRASIL. Ministério da Educação. **PNLD**. MEC, 2018a. Available at: http://portal.mec.gov.br/pnld/apresentacao. Access on: Jan. 8th, 2022.

CAMPOS, A. F.; FREITAS A. P. A divulgação científica no ensino de Química. **Revista de Ensino de Ciências e Matemática**, v. 12, n. 1, p. 1-18, 2021. DOI: 10.26843/rencima.v12n1a35. Available at: https://revistapos.cruzeirodosul.edu.br/rencima/article/view/2825. Access on: Feb. 24th, 2024.

FERREIRA, L. N. A; QUEIROZ, S. L. Textos de divulgação científica no ensino de ciência: uma revisão. **ALEXANDRIA, Revista de Educação em Ciência e Tecnologia**, v. 5, n. 1, p. 3-31, 2012. Available at: http://alexandria.ppgect.ufsc.br/files/2012/05/Luciana.pdf. Access on: Feb. 24th, 2024.

FIORESI, C. A. **Circulação da divulgação científica em livros didáticos de química**: a textualização da radioatividade enquanto fato científico. 2020. 211 f. Tese (Doutorado) - Curso de Química, Universidade Federal de Santa Catarina, Florianópolis, 2020. Available at:

https://repositorio.ufsc.br/handle/123456789/220456?show=full. Access on: Feb. 24th, 2024.

FIORESI, C. A.; SILVA, H. C. Textos de Divulgação Científica em Livros Didáticos de Química: um olhar sobre a circulação do tema Radioatividade. *In*: MACEDO, B.; SILVEIRA, S. MEZIAT, D. ASTETE, M. BENGOCHEA, L. (Org.). **Ciencias de la Tierra, Ambientales y para la Salud Apropiación social de las ciencias Calidad de los procesos formativos de los docentes de Ciencias**. 1ed. Alcalá: Universidad de Alcalá, 2019, v. 2, p. 407-417.

FIORESI, C. A; SILVA, H. C. Ciência popular, divulgação científica e Educação em Ciências: elementos da circulação e textualização de conhecimentos científicos. **Ciência & Educação (Bauru)**, 28, 1-17, 2022. DOI https://doi.org/10.1590/1516-731320220049. Access on: Feb. 20th, 2024.

IGLESIAS, J. O. V; PETRUCCI-ROSA, M. I. Tradições Curriculares em "Boxes" nos livros didáticos de Biologia. **Ciências em Foco**, vol. 9, n. 1, p. 32-41, 2016. Available at: https://econtents.bc.unicamp.br/inpec/index.php/cef/article/view/9696. Access on: Feb. 20th, 2024.

JACOMINI, L.; ZEFERINO, A.; FIORESI C. A. A Divulgação Científica em Livros Didáticos de Ciências da Natureza e suas Tecnologias: um olhar para nova Base Nacional Comum Curricular. *In*: CONGRESSO PARANAENSE DE EDUCAÇÃO EM QUÍMICA, 3., Campo Mourão, 2021. **Anais do VII CPEQUI**. Available at: https://www.even3.com.br/anais/cpequi/. Access on: Feb. 20th, 2024.

LIMA, G.; GIORDAN, M. Características do discurso de divulgação científica: implicações da dialogia em uma interação assíncrona. **Investigações em Ensino de Ciências**, v. 22, n. 2, p. 83, 2017. Available at: http://dx.doi.org/10.22600/1518-8795.ienci2017v22n2p83. Access on: Feb. 20th, 2024.

LORENZETTI, C. S.; RAICIK, A. C.; DAMASIO, F. Divulgação Científica: Para quê? Para quem? Pensando sobre a História, Filosofia e Natureza da Ciência em uma Revisão na Área de Educação Científica no Brasil. **Revista Brasileira de Pesquisa em Educação em Ciências**, p. e29395-27, 2021. DOI: 10.28976/1984-2686rbpec2021u14871513. Available at: https://periodicos.ufmg.br/index.php/rbpec/article/view/29395. Access on: Feb. 20th, 2024.

MARTINS, I. Analisando livros didáticos na perspectiva dos Estudos do Discurso: compartilhando reflexões e sugerindo uma agenda para a pesquisa. **Pro-Posições**, vol. 17, n. 1, p. 117–136, 2006. Available at:

https://periodicos.sbu.unicamp.br/ojs/index.php/proposic/article/view/8643659. Access on: Feb. 20th, 2024.

MARTINS, I.; DAMASCENO, A. R. Uma análise das incorporações de textos de divulgação científica em livros didáticos de ciências. *In*: ENCONTRO DE PESQUISA EM ENSINO DE FÍSICA. ÁGUAS DE LINDÓIA, 7., 2002. **Atas do VIII Encontro de Pesquisa em Ensino de Física**. Available at: https://www.fep.if.usp.br/~profis/arquivos/viiiepef/menu/listatrabalhos.html. Access on: Feb. 20th, 2024.

MORTIMER, E. F. A Evolução dos Livros Didáticos de Química Destinados ao Ensino Secundário. **Em Aberto**, vol. 7, n. 40, p. 25–41, 1988. Avilable at: https://doi.org/10.24109/2176-6673.emaberto.7i40.%25p. Access on: Feb. 20th, 2024.

PASSERI, M. G.; AIRES, R. M.; ROCHA, M. B. Reelaboração discursiva de um texto de divulgação científica sobre crise hídrica em um livro didático de ciências. **Ensino, Saúde e Ambiente**, v. 10, n. 1, p. 142-162, 2017. Available at: https://doi.org/10.22409/resa2017.v10i1.a21253. Access on: Feb. 20th, 2024.

ROCHA, M. B. O potencial didático dos textos de divulgação científica segundo professores de ciências. **RBECT – Revista Brasileira de Ensino de Ciência e Tecnologia**, vol. 5, n. 2, p. 47-68, 2012. DOI http://dx.doi.org/10.3895/S1982-873X2012000200005. Access on: Feb. 20th, 2024.

SILVA, H. C. **A noção de textualização para pensar os textos e as práticas de leituras da ciência na escola**. *In*: PINTO, G. A. (Org.). Divulgação científica e práticas educativas. Curitiba: CRV (2010), p. 25-42.

SILVA, H. C. Discurso e Epistemologia: um olhar sobre as relações entre texto, ciência e escola a partir da noção de textualização. *In*: S. CASSIANI; H. C. SILVA; PIERSON, A, (orgs). **Olhares para o ENEM na Educação Científica e Tecnológica**. Araraquara, SP: Junqueira & Marin Editores, 2013.

SILVA, H. C. O que é divulgação científica? **Ciência & Ensino**, v. 1. n. 1. dez., 2006. Available at: https://pt.slideshare.net/clebersonmoura/o-que-divulgao-cientfica-henrique-csar-da-silva. Access on: Feb. 20th, 2024.

SILVA, M. R. A BNCC da reforma do ensino médio: O resgate de um empoeirado discurso. **EDUR - Educação em Revista**, v. 34, p. 1-15, 2018. Available at: https://doi.org/10.1590/0102-4698214130. Access on: Feb. 20th, 2024.

SOUZA, P.H.R. **Análise dos textos de Divulgação Científica referentes à Biologia Animal em Livros Didáticos de Biologia para o Ensino Médio**. Tese – Doutorado em Ciência, Tecnologia & Educação, CEFET/RJ, Rio de Janeiro, p. 1- 223, 2017. Available at: https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/trabalhoConclusao/viewTrabalhoConclusao.jsf?popup=true&id_trabalho=5066527. Access on: Feb. 20th, 2024.

SOUZA, P. H. R; ROCHA, B. M. Caracterização dos textos de divulgação científica inseridos nos livros didáticos de biologia. **Revista Práxis**, v. 12, n. 23, p. 97-108, 2015. Available at: https://ienci.if.ufrgs.br/index.php/ienci/article/view/46. Access on: Feb. 22nd, 2024.

STRACK, R; LOGUÉRCIO, R; DEL PINO; J. C. Percepções de professores de ensino superior sobre a literatura de divulgação científica. **Ciência & Educação**, vol. 15 n. 2, p. 425-442, 2009. Available at: https://doi.org/10.1590/S1516-73132009000200012. Access on: Feb. 22nd, 2024.

Received: May 20th, 2023.
Approved: May 17th, 2024
DOI: 10.3895/rbect.v17n2.16988
How to cite: FIORESI, C. A.; TURRA, L. D.; JACOMINI, L.; ZEFERINO, A. Characterization of Scientific Dissemination Texts inserted in Nature Science Textbooks and Their Technologies. **Brazilian Journal of Science Teaching and Technology**, Ponta Grossa, v. 17, Special Edition, p. 1-21, 2024. Available at: <https://periodicos.utfpr.edu.br/rbect/article/view/16988>. Access on: XXX.
Mailing address: Claudia Almeida Fioresi - clau_fioresi@hotmail.com