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Abstract

In this work we tackled the question of whether research articles that analyze school science textbooks are theoretically grounded when considering contextualization. To answer this question we conducted a systematic literature review of the formulations of the notion of contextualization developed in scientific research that analyze science textbooks. For the selection of journals, we used the information available in Brazilian Qualis Journals, rated A1 or A2 in the Teaching area, which has Science Teaching as their scope. The research resulted in a sample of 48 articles between 2004 and 2021. The methodological framework was based on content analysis. Among the results, we highlight five different contextualization approaches in research articles that analyze textbooks. Furthermore, we notice that the contextualization perspective is not conceptualized in any predominant theoretical framework, either in official documents or academic literature. This work offers a basis for understanding how Brazilian Common National Basis (BNCC) will influence contextualization perspectives and its reflection in academic literature.

Introduction

The context-based approach in Science education has been gaining traction in the last decades and, to some extent, has started to guide Science curriculum reforms (Bennett et al., 2005). It attempts to connect conceptual learning with real-world experiences (Fensham, 2009). Despite some consensus around the need for context in Science education, the term can be connected with a variety of approaches and practices that runs from Science-Technology-Society (STS) (Rannikmae, Teppo & Holbrook, 2010) to inquiry (Herranen et al., 2019). Such a loose conceptualization might challenge science teachers, researchers, policymakers, and textbook authors' interest in enacting a context-based curriculum.

As discussed by Krasilchik (2000), the science curriculum reforms historically are guided by the social goals and expectations projected upon scientific education. The Brazilian educational curriculum in the first Law of Directives and Bases for National Education (LDB) of 1961 consolidated an increase in science (Biology, Chemistry, and Physics) class hours driven by the post-war historical context. Towards the end of the 1960s and throughout the 1970s, under a military dictatorship, Brazilian Science Education underwent several changes to match the demands of the labor market through the unification of professional and academic education. These changes and goals extend to the 1980s with the addition of another perspective: bringing technology and society

together. However, Rosa and Rosa (2012) point out that Brazilian Science education has failed to bring these two spheres together primarily due to the insufficiency of teachers' training in this new framework. According to Francisco Filho (2014), over the years and under the current LDB (1996), strong influences of interactionist educational theories, referenced in Piaget and Vygotsky, have modified the educational system and, consequently, Science teaching.

The establishment of LDB in 1996 provoked a shift in the educational frame. It emphasized the development of the individual citizen, which is something opposed to the goals proposed by then (Palmieri, 2019). The national educational policies for basic education, the National Curriculum Parameters (PCN-1997), and the Common National Basis for the Curriculum (BNCC-2017) presented the guidelines for school subjects across the country. These guidelines promote notions of active student performance and closer ties among scientific developments and social, historical, and technological contexts, as well as conducting stronger relations between scholar disciplines and the so-called interdisciplinarity. Additionally, the National Curriculum Parameters for the High School (PCNEM-1999) presented Science education toward fostering autonomous students through building relations between Science and several other contexts. In the BNCC, the integration of Science and different contexts arises from the relations between Science, Technology, Society, and Environment:

> The social, historical, and cultural contextualization of Science and technology is essential to be understood as a human and social venture. At the BNCC, therefore, it is also proposed to discuss the role of scientific and technological knowledge in social organization, environmental issues, human health, and cultural formation; in other words, to analyze the relationships among science, technology, society, and the environment (Brasil, 2017, p. 549)

Contextualization has been one of the approaches or methodological resources in education promoted by the national guidelines for the last two decades. Thus, in different levels, documents, and practices, the national guidelines, teaching materials, textbooks, teaching approaches, and methodologies presents contextualization as one pillar of contemporary Science education in Brazil. Nonetheless, there is a plurality of interpretations about what contextualization exactly means. In a recent literature review, Medeiros and Júnior (2021, p. 294) pointed out that several works "mention the importance of contextualization in their theoretical foundation, but there is some confusion between what the authors say is contextualization." Recent studies that carried out literature reviews regarding contextualization, such as Pereira (2017) and Luz (2018), also indicate the lack of consensus regarding its conceptualization. According to Ferreira et al. (2018), schoolteachers have many tasks, including knowing content from different knowledge fields and integrating different methodologies. In this context, textbooks become one of the main sources of research and support for teachers when planning classes and activities. Although these materials offer ready-made texts and activities, teachers have the freedom and the possibility to make changes or modifications they judge convenient to their needs in the classroom.

Such a lack of consensus is also present in the Brazilian curricular guidelines. While the PCN (Brasil, 1997) presented contextualization mostly from a historical perspective, the PCNEM (Brasil, 1999) formulated it based on the relationship between the student and the world. At BNCC, contextualization is the process of overcoming everyday life and technology as examples of scientific concepts. The curricular guidelines increasingly highlight

the importance of working with context-based approaches. However, their conceptualization does not point to a well-defined path. Some consequences can be observed in the various forms of contextualization present in textbooks. From the perspective of researchers in education, not having a clear guideline for what is meant by contextualization also has consequences when analyzing textbooks.

There is a need to delineate this concept since public policies and official documents guide education and, consequently, the production of teaching materials that support classroom practices. Moreover, several stakeholders benefit from an in-depth discussion about the boundaries regarding the meaning of contextualization in basic education: textbook authors, education researchers, and education policymakers. Our main goal is to examine the formulations of the notion of contextualization expressed in research articles that analyze Science textbooks. Therefore, our research addresses the following research questions:

RQ1) What contextualization perspectives are adopted by the authors of research articles that analyze Science textbooks?

RQ2) Are there any dominant theoretical frameworks for the contextualization perspectives used by the authors of the research articles?

Different Understandings of Contextualization

Several authors recognize the importance of contextualizing content in textbooks (Abreu, Gomes & Lopes, 2005; Macedo & Silva, 2010; Medeiros & Lobato, 2010). There is a strong consensus around its importance, and most conclusions indicate that contextualized content positively contributes to meaningful learning. According to Lopes (2002), the concept of contextualization presented by the Brazilian Education Ministry encompasses several conceptions arising from multiple curricular discourses and national as well as international references. Wartha, Silva, and Bejarano (2013, p. 87) emphasize that the term everyday life has been replaced by contextualization. For the authors, the diversity of contextualization conceptions in Science teaching is related to "reality, everyday life, world, citizenship, social context, historical contexts, cultural context, students prior knowledge, and scholar disciplines". Therefore, we can say that there is a consensus about the importance but disagreements around the meaning.

The expressive increase of the presence of the contextualization concept on official documents, although ambiguous, pushed its appropriation in various means and also in textbooks. Santos and Mortimer (1999), when analyzing the concept of contextualization for science teachers, identified this concept mostly relates to everyday life facts, exemplifications of scientific concepts or strategies to facilitate the learning process. Hence, it can be seen that different conceptions of contextualization are also reflected in multiple understandings of this concept. Consequently, it is expected that textbook researchers will be interested in investigating problems and situations related to this concept. Macedo and Silva (2010) present and discuss five different perspectives of contextualization: *Aspects of everyday life; Illustration or exemplification of scientific concepts; Historical/socio-cultural; Work-related; and Criticism*. These categories synthesized different conceptions identified by contextualization in several academic works and official documents. This categorization is the analytical tool of this study.

Brief History of Brazilian Textbooks

Batista, Galvão and Klinke (2002) point out that national reading books began to appear in Brazil from the second half of the 19th century onwards. During this period, the authors emphasize the change in school dynamics in Brazil demanded the production of teaching materials, including blackboards, posters, and textbooks. At the beginning of the 20th century, a greater diversity of national publications appeared.

Santos and Carneiro (2006) report expressive growth in the publishing market due to the expansion of the educational system in the 1970s. Thus, the standardization of the publishing market occurred primarily due to demands from private schools. While private schools receive textbooks with a greater number of pages and higher quality, the textbooks for public schools were summarized and with lower quality. According to the author, only before 1996, with the establishment of the National Program for Textbooks and Teaching Materials (PNLD), the publishing market began to set up criteria for the production and distribution of elementary school textbooks. In 20004, the National Program for Textbooks and Teaching Materials for High Schools (PNLEM) established those criteria for high school textbooks. Recently, the PNLD goals were aligned with BNCC implementation. Thus, textbooks also started to follow standards related to the content covered by this national guideline and their progression to support the development of competencies and abilities proposed by BNCC.

Many researchers (Batista, Galvão & Klinke, 2002; Mortimer, 1988) indicate the transformation the in the supporting role of science textbooks for teachers and students, even though this material assumes different functions. At the beginning of the 20th century, science textbooks did not offer exercises and activities, mostly composed of scientific dissemination texts. Over the decades, this scenario has been modified so that at the present time, textbooks are composed of a large number of activities to be held as classroom practices, losing their role as a reference and documental function in the student's perspective (Santos & Carneiro, 2006). However, with the constant deterioration of teachers' working conditions, textbooks become facilitators of the teaching routine once they serve as a source of information and currently present a significant number and diversity of activities. It indicates that textbooks are now the largest and most frequent resource used by teachers and students in basic education.

Methodology

We conducted a systematic literature review (Bennett et al., 2005). According to Teixeira, Greca and Freire (2012), this type of review enables the gathering of relevant information from the mass of specialized literature in a specific area of research. The theoretical-methodological framework is content analysis (Bardin, 2016). According to Bowen (2009, p. 32), content analysis is “the process of organizing information into categories related to the central questions of the research.” This methodology allows researchers to identify topics commonly examined in articles and make inferences about their content. Thus, this methodological framework allows us to understand the articles through the process of description, inference, and interpretation of the characteristics of the texts (Menezes, Ovigli & Junior, 2018). According to Bardin (2016), content analysis can be divided into three main phases: a) pre-analysis; b) material exploration; c) treatment of results, and inferences and interpretation. In

the present study, the pre-analysis process was based on the choice of the study material. That is, the research articles were initially selected within the given period (from 2000 to 2021). Subsequently, research articles were chosen considering if they analyze contextualization in science textbooks to undertake an in-depth review which involves a process called data extraction, in which the contents of the studies are summarized and evaluated (Bennett et al., 2005). Then, a detailed description of the studies was carried out, followed by a quantitative-qualitative analysis, and finally a synthesis of the results.

To select the journals, we consulted the Brazilian journal evaluation system and database (Qualis Journals), which is conducted by CAPES (Brazilian Coordination for the Improvement of Higher-Level Personnel), and evaluates Brazilian and foreign journals (Fontes & Rodrigues, 2022). We selected Science or Physics Education journals classified on the top two quality tiers (A1, A2) out of eight possible in the Teaching category from the 2010-2016 classification. Our research was conducted in the first week of July 2021. We searched each journal's website for the keyword textbook in the research articles' abstracts. We limited the search period from January 2000 to June 2021.

We found 464 research articles. After reading their titles and abstracts, the total number of research articles was reduced to 77. The next step consisted in reading the research article content by two of the authors. In the end, the number of research articles considered for analysis was settled at 48. The newest research article was printed in 2004, and the latest in 2021.

Thus, the 48 research articles were classified according to their contextualization perspectives. To do so, we used the contextualization perspectives outlined by Macedo and Silva (2010) and detailed in Table 1. We emphasize that in some research articles, we identified more than one contextualization perspective since the categories are not mutually exclusive. To verify the significance, we used the chi-square statistical test.

Table 1. Categories of Contextualization Perspectives Based on Macedo e Silva (2010)

Categories	Description
Illustration or exemplification of scientific concepts (*Sci. C.*)	Mention of the concrete applications of Science and Technology concerning the conceptual aspects of the studied theory.
Aspects of everyday life (*E. life*)	Articulate the content taught in the classroom with the reality experienced by the student in their daily lives.
Critical (*Criticism*)	Articulate social issues and problem situations that allow discussions involving scientific and technological concepts to address environmental, political, economic and ethical issues.
Socio-cultural historical (*SCH)*	Knowledge of some important aspects of the process that determines the construction of scientific theories from the historical contexts that involved the studies of scientists in two periods.
Work-related (*Work*)	Applicability of concepts can often be referred to the productive world.

Macedo and Silva (2010), for the analysis of the theme of electric energy production in Physics textbooks

approved in PNLEM 2007, grouped excerpts taken from textbooks by approaching them with one of the five contextualization categories described above. We opted for the contextualization categories as presented by these authors since they are broad enough to encompass the diversity of the contextualization perspectives that appears both in the literature and in official documents. Other authors, such as Luz (2018), categorize the concept of contextualization into three perspectives as they do not explicitly categorize it from the work environment or separate the illustration of scientific concepts from everyday life. We found it useful, during the analysis, to distinguish the *Scientific concepts* and *Everyday life* categories, as well as the *Work-related* category that reflected contextualization in relation to the productive world. Kato and Kawasaki (2011) surveyed perspectives of contextualization based on curriculum documents and science teachers. According to them, the concepts raised can be grouped into three groups, each relating to the student's daily life; school subjects; historical, social, and cultural contexts. In any case, we are aligned with Santos, Almeida, and Santos Filho (2020) when they suggest that:

> There is something in common between them [perspectives of contextualization]: the idea of relationship and connection. Regardless of what is meant by context or the depth that is given to it, contextualization seems to be understood as the creation of relationships between formal and informal knowledge, therefore, connecting them (Santos, Almeida & Santos Filho, 2020, p. 2, our translation).

When the scope is not the analysis of textbooks, the concept of contextualization assumes other complexities. From an epistemological perspective, the concept of contextualization also assumes a "possible way to minimize the damage caused in the didactic transposition process" (Macedo & Silva, 2014, p. 60). The epistemological dimension is also pointed out by Ricardo (2005) when he recognizes that:

> There are those who understand it as an articulation of what is close to the students or their daily life. However, some put it in the epistemological field and remember that the school would also have the role of offering students the ability to abstract and understand the relationship between theory and reality. This is the second way of understanding contextualization (Ricardo, 2005, p. 214, our translation).

Once we had the categories of contextualization defined, we resumed the third phase described by Bardin (2016) regarding the treatment of results, inferences, and interpretations. We read the research articles to their full extent and highlighted the passages that represented the concept of contextualization according to the categories above.

Results and Discussion

There are 48 research articles distributed over the years. In this distribution, the highest frequency or research articles (9) is in the journal *Ensaio*. On average, there are 2.4 articles per year in the 15 different peer-reviewed journals. This diversified representation reflects that the scientific community of Science Education recognizes the importance of research on contextualization in textbooks due to a homogeneous distribution of publications on this theme since 2008. In some journals, however, this theme has little or no visibility. The list of the 15 journals with the number of research papers in each of them is as follows: *Acta Scientiae Ulbra* (6); *Alexandria – Revista de Educação em Ciência e Tecnologia* (6); *Amazônia – Revista de Educação em Ciências e Matemáticas* (1); *Areté – Manaus* (1); *Caderno Brasileiro de Ensino de Física* (1); *Ciência & Educação* (4); *Contexto & Educação*

(1); *Educação em Revista* (1); *Ensaio: Pesquisa em Educação em Ciências* (9); *Ensino em Re-Vist*a (1); *Investigações em Ensino de Ciências* (6); *Revista Brasileira de Ensino de Ciência e Tecnologia* (3); *Revista Brasileira de Pesquisa em Educação em Ciências* (2); *Revista de Educação, Ciências e Matemática* (3); *Revista de Ensino de Ciências e Matemática* (3). Table 2 indicates the distribution of articles in relation to the main areas of Science Teaching and the respective educational level.

Table 2. Distribution of Publications by Educational Level and Knowledge Area

	Middle school	High school	Higher education	Total
Biology	2 (4.2%)	18 (37.5%)	0	20
Physics	2 (4.2%)	6 (12.5%)	0	8
Chemistry	7 (14.6%)	4 (8.3%)	0	11
Combination of areas	1 (2.1%)	7 (14.6%)	1 (2.1%)	9
Total	12	35	1	48

From the data in Table 2, it is evident a greater concentration of articles that analyze the contextualization in the area of Biology in High school. The small number of articles that analyze higher education textbooks compared to basic education was expected, as books in higher education often dedicate more pages to valuing the presence of calculations and mathematical equations through exercises and examples, as also pointed out by Rodrigues, Sá and Sá (2021).

Regarding the different perspectives of contextualization, in Figure 1, we note that the *Work-related* category is present only in 4 of the 48 articles in the sample, with 3 of these appearances in articles published until the year 2010. This can be explained due to the influence of documents such as the PCNEM, which more explicitly brings the notion of work related to education. One of the aspects to be observed in the coming years with the implementation of the BNCC is the maintenance of this scenario in which there is little presence of contextualization related to the notion of work since the BNCC does not explicitly address it.

The *Everyday life* category is the only contextualization perspective in which it is possible to affirm a growth trend over the years. Until 2015, it appeared on average once a year. From 2015 onwards, its presence increased to approximately four times a year.

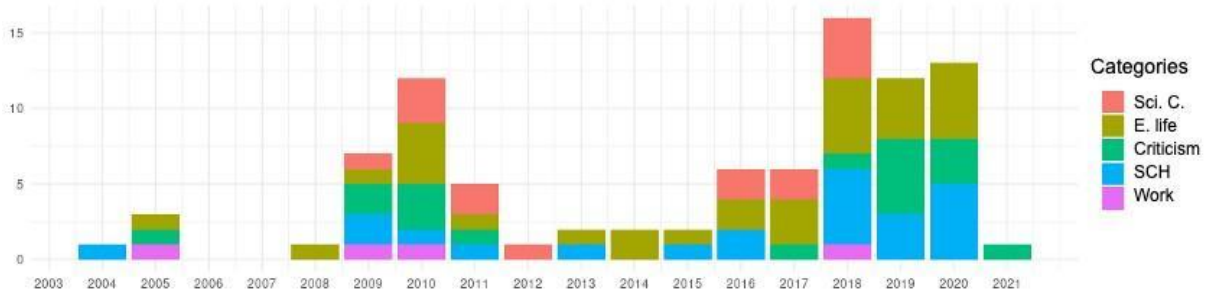

Figure 1. Distribution of the Contextualization Perspectives over the Years

Our analysis also allows for an important conclusion: the contextualization perspective does not point to a predominant reference in official documents or literature. For example, Medeiros and Lobato (2010) use the references of Gouvêa and Machado (2005), Wartha and Faljoni-Alário (2005), and Silva et al. (2009) to explain their understanding by contextualization. These references did not appear in any other research article we analyzed.

In general, each article relies on different authors when they explain what they mean by contextualization. The same can be said in relation to the official documents: we found citations referring to the PCN, PCNEM, PNLD, PCN+, and BNCC dispersed throughout the analysis. That is, it cannot be said that there is a single official document that is significantly more used when it is necessary to explain what is meant by contextualization. Part of this may be associated with the long period considered for the review. In Table 3, we present the frequency that authors use academic literature or official documents when explaining what they understand by contextualization.

Table 3. Framework Source for the Contextualization Perspective

Does the article support the perspective of contextualization in academic literature and/or official documents?			
Official documents	Academic literature		
	No	Yes	Total
No	20 (41.7%)	10 (20.8%)	30
Yes	15 (31.2%)	3 (6.2%)	18
Total	35	13	48

Our analysis allows us to conclude that contextualization is a concept mainly referenced in official documents compared to academic literature. That is the case of 15 (31.2%) articles. Thus, this concept may be subject to more contingent interpretations than other concepts that arise and develop within the academy. It is also interesting to point out that the four articles that support the contextualization perspective in the *Work-related* category use official documents. This may indicate that the academic literature does not emphasize the applicability of scientific concepts to the productive world as a contextualization perspective.

Only ten articles use sources in the academic literature to support their concept of contextualization. A smaller number of them (3 articles) combine official documents and literature. It is noteworthy that in most cases (20 articles) the contextualization perspective is not referenced. Thus, the hypothesis was raised that in these 20 articles, the most present contextualization category would be *Scientific concepts* and *Everyday life*, as it refers to a common sense understanding of the concept of contextualization. In Table 4, we cross the contextualization categories with the presence of at least one reference, either in the literature or in official documents.

From Table 4, it is noted that there is no clear trend of categories when the articles do not use references to support the contextualization perspective. We performed the chi-square test and obtained a significance $p > 0.05$. In simplified terms, we cannot say that there is an association between the variables (contextualization perspectives and the non-reference to literature or official documents). This result may be chance, requiring a larger sample of studies to assess this issue.

Table 4. Reference to Support the Contextualization Perspective

Does the article base the perspective of contextualization in any reference?			
Contextualization perspective	No	Yes	Total
Scientific concepts	6 (6.7%)	9 (10%)	15
Everyday life	12 (13.3%)	19 (21.1%)	31
Criticism	7 (7.8%)	11 (12.2%)	18
Historical/socio-cultural	8 (8.9%)	14 (15.6%)	22
Work-related	0	4 (4.4%)	4
Total	33	57	90

Finally, in Table 5, we present the research articles' authors own judgment regarding contextualization.

Table 5. Contextualization of the Analyzed Material

According to the authors, is the textbook properly conceptualized?			
	No	Yes	Total
Middle School	9 (18.8%)	3 (6.2%)	12
High School	19 (39.6%)	16 (33.3%)	35
Higher Education	1 (2.1%)	0	1
Total	29 (60.5%)	19 (39.5%)	48
Biology	10 (20.8%)	10 (20.8%)	20
Physics	6 (12.5%)	2 (4.2%)	8
Chemistry	8 (16.7%)	3 (6.2%)	11
Combination os areas	5 (10.4%)	4 (8.3%)	9
Total	29 (60.4%)	19 (39.5%)	48

From Table 5, we can conclude that in general (60% of the cases), the analyzed textbooks from the different science areas and educational levels were not contextualized according to the perspectives adopted by the authors. In particular, one of the most recurrent justifications presented by authors who analyzed textbooks to claim that the textbooks were not contextualized was an attempt to contextualize through citations. For example, Xavier and Maciel (2009), when analyzing the content of organic functions in Chemistry textbooks stated:

> Most of the textbooks seek to associate the scientific knowledge of Organic Chemistry with everyday facts, although this contextualization is often a mere citation in the text, as a way of exemplifying the applications of its functions, not allowing students to fully understand comprehend the social implications of using science and technology in their social context (Amaral, Xavier & Maciel, 2009, p. 107, our translation).

This criticism is also present in Ferreira and Justi (2004, p. 48) when analyzing the approach to DNA in high school biology and chemistry textbooks: “historical quotations (and not contextualization) were more frequently observed. However, nothing that contributed to the student's understanding of the development of scientific knowledge and its importance in the social context”.

Conclusion

This review confirmed the relevance and multiple meanings of contextualization in research articles. In addition, the increase in the number of articles with this theme over the last two decades may indicate an increasing trend regarding discussions on contextualization. We have the following considerations regarding the research questions:

RQ1) What contextualization perspectives are adopted by the authors of articles that analyze Science textbooks? Is there a prevailing contextualization perspective?

The contextualization perspectives can be classified with five different approaches: *Scientific concepts*, *Everyday life*, *Criticism*, *Historical/socio-cultural*, and *Work-related*, with the *Everyday life* perspective being the most present, appearing 31 times (34,4%).

RQ2) Are there any dominant theoretical frameworks for the contextualization perspectives used by the authors of the articles?

We did not find a predominant theoretical framework, either in official documents or in academic literature. Although the authors of the articles mostly cite official documents when conceptualizing their perspectives of contextualization, there is no single official document that guides them. In addition, 20 articles (41.7%) do not base their contextualization perspectives on any theoretical framework.

The reformulation of national documents in a relatively short period of time are reflected in a slight change in the perspectives of contextualization identified in the analyzed articles. We conclude that the *Work-related* perspective was influenced by the PCNEM and, later, the *Everyday life* perspective became more frequent, under the light of the BNCC. Although official documents have more complex objectives than the categories adopted in this review, we recognize that their objectives converge toward such categorization. However, the polysemy about contextualization remains and, currently, its concept is more present in what is understood by everyday life in a broad sense. As the BNCC is the most recent and current document, we consider that the *Everyday-life* perspective will still appear frequently in future categorizations of articles that analyze textbooks.

Furthermore, according to our review, we noticed that the articles base their theoretical perspectives of contextualization on official documents when compared to the literature. This may be due to the evaluative role of the PNLD when analyzing textbooks, which have in their public notices the alignment with the BNCC as one of the approval criteria. This work offers bases to understand how the BNCC understands other perspectives of contextualization beyond the *Everyday-life*.

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References

Abreu, R. G., Gomes, M. M., Lopes, A. C. (2005). Contextualização e Tecnologias em Livros Didáticos de Biologia e Química. *Investigações em Ensino de Ciências*, *10*(3), 405-417.

Amaral, C. L. C., Xavier, E. S., & Maciel, M. D. (2009). Abordagem das relações ciência/tecnologia/sociedade nos conteúdos de funções orgânicas em livros didáticos de química do ensino médio. *Investigações em Ensino de Ciências*, *14*(1), 101-114.

Bardin, L. (2016). *Análise de conteúdo*: edição revista e ampliada. Edições 70.

Batista, A. A. G., Galvão, A. M. de O., & Klinke, K. (2002). Livros escolares de leitura: uma morfologia (1866-1956). *Revista Brasileira de Educação*, (20), 27-47. https://doi.org/10.1590/S1413-24782002000200003

Bennett, J., Lubben, F., Hogarth, S., & Campbell, B. (2005). Systematic reviews of research in science education: Rigour or rigidity? *International Journal of Science Education*, *27*(4), 387-406. https://doi.org/10.1080/0950069042000323719

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27-40. https://doi.org/10.3316/QRJ0902027

Brasil. Ministério da Educação e do Desporto. (1997). *Parâmetros curriculares nacionais para o ensino fundamental*. Brasília, DF: MEC.

Brasil. Ministério da Educação e do Desporto. (1999). *Parâmetros curriculares nacionais do ensino médio*. Brasília, DF: MEC.

Brasil. Ministério da Educação. (2017). *Base Nacional Comum Curricular*. Brasília, DF: MEC.

Fensham, P. J. (2009). Real world contexts in PISA science: Implications for context-based science education. *Journal of Research in Science Teaching*, *46*(8), 884–896. https://doi.org/10.1002/tea.20334

Ferreira, M. G., Giordani, S., Oliveira, R. M., Strieder, D. M., & Malacarne, V. (2018). Educação ambiental nas coleções de livros didáticos de Ciências aprovados pelo Programa Nacional do Livro Didático (2016-2018). *Brazilian Journal of Development*, *4*(6), 3507-3517. https://doi.org/10.34117/bjdv4n6-356

Ferreira, P. F. M., & Justi, R. D. S. (2004). A abordagem do DNA nos livros de biologia e química do ensino médio: Uma análise crítica. *Ensaio Pesquisa em Educação em Ciências*, *6*(1), 38-50. https://doi.org/10.1590/1983-21172004060104

Fontes, D. T. M., & Rodrigues, A. M. (2022). Tendencias de investigación en la enseñanza de la física en revistas académicas iberoamericanas. *Revista de Enseñanza de la Física*, *34*(2), 33–45. https://doi.org/10.55767/2451.6007.v34.n2.39481

Francisco Filho, G. (2014). *A educação brasileira no contexto histórico* (3rd ed.). Alínea.

Gouvêa, L. R., & Machado, A. H. (2005). *Trilhando caminhos para compreender a contextualização da ação no ensino de Química* [Bachelor's dissertation, Universidade Federal de Minas Gerais]. Universidade Federal de Minas Gerais Publishing.

Herranen, J., Kousa, P., Fooladi, E., & Aksela, M. (2019). Inquiry as a context-based practice – a case study of pre-service teachers' beliefs and implementation of inquiry in context-based science teaching. *International Journal of Science Education*, *41*(14), 1977–1998.

https://doi.org/10.1080/09500693.2019.1655679

Kato, D. S., & Kawasaki, C. S. (2011). As concepções de contextualização do ensino em documentos curriculares oficiais e de professores de ciências. *Ciência & Educação (Bauru)*, *17*(1), 35-50. https://doi.org/10.1590/S1516-73132011000100003

Krasilchik, M. (2000). Reformas e realidade: o caso do ensino das ciências. *São Paulo em Perspectiva*, *14*(1), 85-93.

Lopes, A. R. C. (2002). Os Parâmetros Curriculares Nacionais para o Ensino Médio e a submissão ao mundo produtivo: o caso do conceito de contextualização. *Educação & Sociedade*, *23*(80), 386-400.

Luz, M. R. B. (2018). *Contextualização para o ensino de ciências: concepções e práticas de professores de biologia e as tendências nos trabalhos de pesquisadores da área* [Master's thesis, Universidade Estadual de Maringá]. Universidade Estadual de Maringá Publishing.

Macedo, C. C., & Silva, L. F. (2010). Contextualização e visões de ciência e tecnologia nos livros didáticos de física aprovados pelo PNLEM. *Alexandria: Revista de Educação em Ciência e Tecnologia*, *3*(3), 1-23.

Macedo, C. C., & Silva, L. F. (2014). Os processos de contextualização e a formação inicial de professores de física. *Investigações em Ensino de Ciências*, *19*(1), 55-75.

Medeiros, M. A., & Lobato, A. C. (2010). Contextualizando a abordagem de radiações no ensino de Química. *Ensaio Pesquisa em Educação em Ciências*, *12*(3), 65-84. https://doi.org/10.1590/1983-21172010120306

Medeiros, J. S. S., & Júnior, C. N. S. (2021). Revisão das principais propostas do processo de ensino e aprendizagem da eletroquímica no período de 2007 a 2017 no Brasil. *Revista Debates em Ensino de Química*, *7*(1), 281-309.

Menezes, I. M. C. A., Ovigli, D. F. B., & Junior, P. D. C. (2018). The relationship between formal education and non-formal education: a descriptive and analytical review of the publications about Astronomy Education in Journals and Events related to Science Teaching in the Brazilian Context. *Science Education International*, *29*(1), 11-19. https://doi.org/10.33828/sei.v29.i1.2

Mortimer, E. F. (1988). A evolução dos livros didáticos de Química destinados ao ensino secundário. *Em aberto*, *7*(40), 25-41.

Palmieri, M. (2019). *Aspectos epistêmicos e conceituais em interações discursivas possibilitadas por atividades investigativas em aulas de física* [Master's thesis, Universidade de São Paulo]. Universidade de São Paulo repository. https://www.teses.usp.br/teses/disponiveis/48/48134/tde-09062021-175332/pt-br.php

Pereira, L. C. (2017). *Ensino contextualizado de biologia no ensino médio: desafios e possibilidades* [Master's thesis, Universidade Estadual de Goiás]. Universidade Estadual de Goiás Publishing.

Rannikmae, M., Teppo, M., & Holbrook, J. (2010). Popularity and Relevance of Science Education Literacy: Using a Context-Based Approach. *Science Education International*, *21*(2), 116–125.

Ricardo, E. C. (2005). *Competências, interdisciplinaridade e contextualização: dos Parâmetros Curriculares Nacionais a uma compreensão para o ensino de ciências* [Doctoral thesis, Universidade Federal de Santa Catarina] Universidade Federal de Santa Catarina Publishing.

Rodrigues, R. F., Sá, E. L. A., & Sá, É. R. A. (2021). A Química Geral em livros didáticos na educação superior: uma análise acerca da contextualização e interdisciplinaridade. *Revista Científica do Instituto Federal de Educação, Ciência e Tecnologia do Piauí*, *7*(1), 1-17. https://doi.org/10.51361/somma.v7i1.168

Rosa, C. W. D., & Rosa, Á. B. D. (2012). O ensino de ciências (Física) no Brasil: da história às novas orientações educacionais. *Revista Ibero-americana de Educação*, *58*(2), 1-24.

Santos, M. D. C., Almeida, L. R., & Santos Filho, P. F. D. (2020). O ensino contextualizado de interações intermoleculares a partir da temática dos adoçantes. *Ciência & Educação (Bauru)*, *26*(e20028), 1-16. https://doi.org/10.1590/1516-731320200028

Santos, W. L. P., & Carneiro, M. H. S. (2006). Livro Didático de Ciências: Fonte de Informação ou Apostila de Exercícios? *Revista Contexto & Educação*, *21*(76), 201–222. https://doi.org/10.21527/2179-1309.2006.76.201-222

Santos, W. L. P., & Mortimer, E. F. (1999). Concepções de professores sobre contextualização social do ensino de Química e Ciências. In *Reunião Anual da Sociedade Brasileira de Química*, 22. Sociedade Brasileira de Química.

Silva, R. T. D., Cursino, A. C. T., Aires, J. A., & Guimarães, O. M. (2009). Uma análise dos artigos publicados na seção "Experimentação no ensino de química" da revista Química Nova na Escola 2000-2008. *Ensaio Pesquisa em Educação em Ciências*, *11*(2), 245-261. https://doi.org/10.1590/1983-21172009110206

Teixeira, E. S., Greca, I. M., & Freire, O. (2012). The history and philosophy of science in physics teaching: a research synthesis of didactic interventions. *Science & Education*, *21*(6), 771-796. https://doi.org/10.1007/s11191-009-9217-3

Toledo, E. J. L., & Ferreira, L. H. (2017). Concepções estereotipadas sobre o aquecimento global em livros didáticos de química. *Revista Brasileira de Ensino de Ciência e Tecnologia*, *10*(2), 1-22.

Wartha, E. J., Silva, E. L., & Bejarano, N. R. R. (2013). Cotidiano e contextualização no ensino de química. *Química Nova na Escola*, *35*(2), 84-91.

Wartha, E. J., & Faljoni-Alário, A. F. (2005). Contextualização no ensino de Química através do livro didático. *Química Nova na Escola*, *22*(2), 42-47.

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