HOLOS
ISSN 1807 - 1600

THE PRESENCE OF SCIENTIFIC AND EPISTEMIC PRACTICES IN NATURAL SCIENCES TEXTBOOKS: A LOOK AT CHEMICAL KNOWLEDGE IN THE EARLY YEARS

C.F.MATOS, L.LORENZETTI*
Universidade Federal do Paraná*
ORCID-ID: https://orcid.org/0000-0002-0208-2965*
leonirlorenzetti22@gmail.com*

Submetido 11/11/2022 - Aceito 08/02/2023

DOI: 10.15628/holos.2023.14447

ABSTRACT

The main point of this paper is to analyze the presence of scientific and epistemic practices in the contents that involve chemical knowledge displayed in Science textbooks, focused on the early years, approved by the Programa Nacional do Livro Didático (PLND) 2019. The research is of a qualitative nature, made use of documentary analysis as a research methodology, using Bardin's Content Analysis as the methodology of analysis. Nine science book collections were approved. As main results, we highlight the presence of 385 verbs or terms of action related to scientific practices and the presence of 282 verbs or terms of action related to epistemic practices. The high frequency of scientific practices, to the detriment of epistemic practices, can be justified by the historical and traditional way that science teaching was developed over the years, in which traditional approaches that tended towards technicality were valued.

KEYWORDS: elementary school; scientific practice; epistemic practice, Science

A PRESENÇA DAS PRÁTICAS CIENTÍFICAS E EPISTÊMICAS NOS LIVROS DIDÁTICOS DE CIÊNCIAS DA NATUREZA: UM OLHAR PARA O CONHECIMENTO QUÍMICO NOS ANOS INICIAIS

RESUMO

O objetivo desse trabalho é analisar a presença de práticas científicas e epistêmicas nos conteúdos que envolvem o conhecimento químico dispostos nos livros didáticos de Ciências, voltados para os anos iniciais, aprovados pelo Programa Nacional do Livro Didático de 2019. A pesquisa é de natureza qualitativa, fez uso da análise documental como metodologia de pesquisa, tendo como metodologia de análise a Análise de Conteúdo de Bardin. Foram selecionadas 9 coleções de livros de Ciências. Como resultados principais, evidenciamos a presença de 385 verbos ou termos de ação relacionados às práticas científicas e a presença de 282 verbos ou termos de ação relativos às práticas epistêmicas. A alta frequência de práticas científicas, em detrimento das práticas epistêmicas, pode ser justificada pelo modo histórico e tradicional que o ensino de Ciências foi desenvolvido ao longo dos anos, no qual eram valorizadas abordagens tradicionais que tendiam para o tecnicismo.

PALAVRAS-CHAVE: Anos iniciais; Práticas científicas; Práticas epistêmicas; Ciências

1 INTRODUCTION

Science teaching in Brazil has been through many didactic, historical and epistemological changes through the decades, from the relations between science, technology and society, to the training of the Science teachers. These changes impacted or were also results from the scientific and technological production (Nascimento; Fernandes & Mendonça, 2010).

When it is about Science teaching for children, some aspects must be considered, such as the epistemological aspects, relative to the knowledge one wishes to teach. In the first years, the goal of Science teaching is aimed towards the development skills or capabilities, without emphasizing the conceptual approach (Rosa; Perez & Drum, 2007). For Borges (2012), there is a significant number of skills that must be developed respecting the students' characteristics.

Since the 1990's, the articulations between science, technology and society have emerged, and Science teaching started to incorporate the formation of the critical, aware and participant citizen, encouraging educational proposals that assisted the reflective thinking (Delizoicov & Angotti, 1990). In this period, there was the incorporation of the ideas of Vygotsky on the construction of the subjects' thinking by means of interactions, in the sociocultural context.

The socio-interactionist vision shows the importance, in a learning process, of social interaction with others, more experienced in the uses of the intellectual tools. The implication of this for Science teaching is that the interactions between the students, and mainly between the teacher and the students, must lead them to scientific argumentation and scientific literacy.

The perspective of scientific literacy is presented by Lorenzetti (2000, p. 77) as the "process by which the language of the Natural Sciences acquires meanings, constituting and environment for the subject to widen their universe of knowledge, their culture, as a citizen inserted in society". In this process, the student is inserted in contexts that allow the contact with the scientific world before the acquisition of reading and writing.

With the release of the National Curricular Parameters (PCN) in 1998, there is the construction of different proposals that approached the relations of Science with Technology, social and environmental questions, without separating the human values from the scientific learning (Brasil, 1998). The organization of contents in the PCN is in thematic sections – Environment, Human Being and Health, Technological Resources, and Earth and Universe, - without discussing any subject in an isolated way, which according to the document:

> [...] make it possible to establish different internal sequences to the cycles, to treat contents of local importance and make connection with contents of the different sections, the other areas and the transversal themes. […] In each thematic section, concepts, procedures and central attitudes for the understanding of the thematic in focus are presented.

In the beginning of the 2000's, there is the growth of the movement of scientific-technological education and the idea of scientific literacy. The production of the National Plan of Education (PNE) in 2014 built the goals related to the National Common Curricular Base (BNCC), and in the years 2015 and 2016, an intense debate about this document started, which was predicted in the Federal Constitution of 1988 and in the LDB. Among political, epistemological and cultural discussions, there are still ongoing studies, with highlight for researchers of the field and author from the private sector (Frade, 2020, p. 1).

Some authors, groups and private and public movements show points of attention in relation to the BNCC, since there were disputes between scientific institutions and epistemological points of view, between supporters of expansion of rights and defenders of specificities, and also between the public and the private systems (Frade, 2020, p. 2). Thus, although the alignment of the books with the guiding document does exist, many questions remain unanswered, such as: in which way the imminent political, conceptual and didactic-pedagogical disputes influenced the elaboration of the BNCC and, consequently, reflected in the elaboration of the textbooks? What is the intentionality of the BNCC and its consequences for the autonomy of the systems and the teachers? What is the real reach of the textbooks in a territory of gigantic dimensions? How will the polyvalent teacher make use of these books in the classroom? There are many questions of reflective nature that give margin for the dialogue and the debate about the role of this new document in Elementary Education.

Currently, the National Common Curricular Base is the official document that must guide the curricula of the teaching systems and networks of the Federal Units, as well as pedagogical proposals of all public and private schools of Elementary Education, Middle School, and High School in all of Brazil. According to this directive, Science teaching “needs to secure to the Middle School students the access to the diversity of scientific knowledges produced throughout History, as well as the gradual approach to the main processes, practices and procedures of scientific investigation” (Brasil, 2017, p. 319).

> Definition of problems: to observe the world around you and to question; to analyze demands, outline problems and plan investigations; to propose hypotheses.
> Gathering, analysis and representation: to plan and execute field activities (experiments, observations, readings, visits, virtual environments etc.); to develop and use tools, including digital ones, for the gathering, analysis and data representation (images, schemes, tables, graphs, figures, diagrams, maps, models, system representations, flowcharts, conceptual maps, simulations, applications etc.); to evaluate information (validity, coherence and adequation to the formulated problem); to elaborate explanations and/or models; to associate explanations and/or models to the historical evolution of the scientific knowledges involved; to select and build arguments based on evidence, models and/or scientific knowledge; to improve their knowledge and to incorporate, gradually and significantly, the scientific knowledge; to develop solutions for day-to-day problems using various tools, including digital ones.
> Communication to organize and/or extrapolate conclusions; to relate information in oral, written or multimodal form; to present, in a systematic way, data and results of investigations; to participate in discussions of scientific character with colleagues, teachers, family members and community in general; to consider counter-arguments to review investigative processes and conclusions.
> Intervention: to program solutions and evaluate their efficacy to solve day-to-day problems; to develop intervention actions in order to improve the individual, collective and socioenvironmental quality of life (Brasil, 2017, p. 321).

From the PCN to the BNCC, there were considerable changes for Science teaching, with the promotion of approaches that pervade the scientific and technological development, with the commitment to the scientific literacy. The contents start to be based on specific competences, thematic units, objects of study and skills.

The BNCC walks through the "spiralization" of the contents throughout each school year, with the organization via learning situations that start from defying questions that recognize "the cultural diversity, stimulate the interest and scientific curiosity of the students and make it possible to define problems, lift, analyze and represent results; to communicate conclusions and propose interventions" (Brasil, 2017, p. 322).

The National Common Curricular Base, published in 2018, proposes the development of the work with competences and skills. Beyond the competences, the curricular component is organized in three thematic units: Matter and Energy, Life and Evolution, and Earth and Universe. This guideline for Elementary Education has, as one of its many intentions, to serve as support in building the curricula of the States and cities. Furthermore, the teaching systems and publishers, via technical readings and adequation to the National Program for Textbooks, structure their projects, uniting these skills and competences to their ideological views, and also to the pedagogical proposal that they follow.

In this sense, considering the importance of the scientific and epistemic practices for Science teaching, the present work analyses the presence of scientific and epistemic practices present in the contents that involve knowledge of Chemistry available in Science textbooks, aimed at the initial years, approved by the National Program for Textbooks.

2 SCIENTIFIC PRACTICES: FROM GATHERING NEW INFORMATION TO THE ELABORATION OF JUSTIFICATIONS

There are many definitions on what would be a scientific practice (SP), however, the origin of this term applied to Science Education is related to, literally, the practice of the scientists.

Sasseron (2018) evaluates the Scientific Practices in Science classes on Middle School, considering them as being "the work with new information; the formulation and the test of hypotheses; and the construction of explanations, the elaboration of justifications, limits and predictions of the explanations" (Sasseron, 2018, p. 1067).

Thus, the PC are intrinsically connected to investigative actions such as the evaluation and the development of explanations for them, i.e., are directed to solving problem situations.

The National Research Council (NRC), an American council for matters related to research, engineering and some school curricula, elaborated "A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas", a document that brings other concepts of SP, such as the ones employed by scientists themselves (NRC, 2012).

Solino, Ferraz and Sasseron (2015) discuss in an article about teaching by investigation the didactic approach by means of development of school scientific practices. The authors outlined the precepts for Science teaching with investigative character associated to the development of practices by mean of problem solving, also making the reading and discussion of research about the theme. They highlighted the school scientific activity as being a craft practice, idea presented by the study of Gómez and Andúriz-Bravo (2007), which differs from scientific practices performed in laboratory. About the importance of incorporating aspects of the scientific practice to the school scientific activities, the authors emphasize that:

> [...] an investigative approach must allow for not only the involvement of the students in the process of solving experimental problems, but also theoretical problems, like, for example, those generated from situations that involve scientific questions, analysis of tables, figures and graphs, as well as reading of texts (Solino; Ferraz & Sasseron, 2015, p. 5).

Nora, Broietti and Passos (2017) list some scientific practices as being related to the ability to investigate, build models and theories; to analyze and interpret data; to use computational and mathematical thinking during the predictions; to build explanations, to argument from evidence and, at last, to evaluate and communicate a fact.

PC1 is about the *formulation of questions*, an action inherent to the day-to-day of scientists and researchers, since asking questions and developing theories to solve a problem is the start of every phenomenon to be explained. PC2, however, speaks about the *development and use of useful models* for the explanation of a phenomenon. PC3 involves the *planning and realization of investigations*, which is supported by the systematization of the investigative pathways, where the scientist reflects about how they will treat the variables. PC4 is related to the *analysis and data interpretation*, where the data is obtained by the development of the previous practices and it is analyzed in a systemic way, and tested with initial hypotheses (NRC, 2012). PC5 is about the *use of mathematical and computational thinking*, which consists on the treatment of the mathematical approaches, here is where the testing of the hypotheses is done, and consequently, the applications and quantitative relations. PC6 approaches the *building of the explanations*, essential after the application of a theory that explains and justifies, coherently, the available evidence. PC7 is about the use of *argumentation*, a scientific practice that is essential in research, once it is in this stage that the strong and the weak points obtained a priori are identified. PC8, at last, brings discussions on the *gathering, evaluation and communication of information*, considering that every previous practice has already come up, the way to communicate what one has as results is essential, since everything will be evaluated by other scientists (NRC, 2012).

For Stroupe (2014), inside the corricular component of Science, the scientific practices constitute the actions that involve the teachers and the students inserted in school environment, bringing, in their discourse, practices that refer to the scientific communities. There are for main axes that guide the proposals for this component, which are: (1) Science teaching on the logical point of view, and making use of argumentations; (2) Science teaching bringing advancements and conceptual changes; (3) Science teaching seen as something transmissive, memoristic, and solidified in the textbooks; and (4) Science teaching as a conceptual and methodological presentation, without facing the social and epistemic aspects (Stroupe, 2014).

3 EPISTEMIC PRACTICES: FROM THE PROPOSITION TO THE LEGITIMATION OF IDEAS

Concepts about the epistemic practices (EP) are worked in Science teaching by various authors, such as Jiménez-Aleixandre e Crujeiras (2017), that relate the epistemic objectives to the previously existent knowledges and to the constructed scientific knowledge. Duschl (2008) proposes that, precisely for scientific education, there should be an equilibrium between the conceptual, epistemic and social learning objectives.

Crujeiras (2014) and Jiménez-Aleixandre & Crujeiras (2017) exemplify as epistemic objectives the comprehension of evaluation criteria for explanations, theories or models, or the criteria to choose an explanation over the alternatives. Thus, the construction of scientific knowledge may be considered an epistemic activity where there are criteria about what comes to be knowledge. The EPs are connected to the appropriation of the scientific language, as well as the way a scientific community evaluates, justifies and communicates their ideas. (Jiménez-Aleixandre & Agraso, 2006; Kelly, 2005). Sandoval (2001) defines EP, in the context of Science teaching, as cognitive and discursive activities where the students are involved in the search of epistemologic understanding of the scientific knowledge. The Eps occur in association to the epistemic operations, which consist in actions related to the production, communication and evaluation of ideas (Kelly & Duschl, 2002; Sasseron, 2018).

Araújo (2008) investigated the use of the time, by the students and the teacher, in six practical Chemistry lessons in High school, based on the analyses of the epistemic practices that emerged in the classroom's speeches, aiming to understand the interactions. The author had as theoretical reference the relations between the social and epistemic practices of Jimenez-Aleixandre et al. (2008), classified in PE1, PE2 and PE3. The activities related to the production of knowledge, falling under PE1, consist on the proposition of ideals, with the observation and the construction of the investigative process as a whole from start to finish. In this type of action, there is the articulation between conceptual and technical knowledges, with the valorization of the efforts to understand the phenomenon that is being studied. PE2 brings concepts related to the communication of knowledge or ideals, with translations from the scientific language. In these practices, there is also the support to the construction of different textual genres, that are aimed toward the explanation, the negotiation of ideas, and the use of classifications. PE3 develops the conceptions about the evaluative processes of the knowledge or the evaluations of ideas, of how they can one distinguish assertions from evidence, properly said. At this stage, there is a broad use of data to evaluate theories, to interpret concepts under different perspectives and with their own justifications. Regarding the Eps, Araújo (2008) found terms referring to the production of knowledge, the most recurrent being: "to problematize, elaborate hypotheses, build data, check the understanding and to deduce". In the category referring to the evaluation of knowledge, he identified the following practices: "to complement and to counter ideas; to use data to evaluate theories and to evaluate the consistency of the data". And in the category relative to the communication of knowledge, appeared most frequently: "to argue; to explain; to narrate; to describe; to classify; to exemplify; to define; to generalize; to present one's own ideas; to negotiate explanations and to use representational language" (Araújo, 2018).

Sasseron and Duschl (2016) reflect on Science teaching for the initial years, highlighting that it occurs by means of developing epistemic practices during the approach of concepts, laws, models and scientific theories. The authors stress the importance of the teacher as promoter of the discursive interactions in the classroom, essential to encourage student engagement.

Silva, Gerolin and Trivelato (2017) analysed the discursive interactions between students and the teacher during an investigative activity for the curricular component of Biology. The results obtained by the authors show that the participation and the interactive group practices, during the activity, were useful in establishing criteria that counts as knowledge, evidence and justification in the development of the investigation.

Silva, Gerolin and Trivelato (2018) investigated the relation between the decision making and the autonomy of students in an investigative teaching activity from the curricular component of Biology, with focus on the engagement of epistemic practices. The authors used as theoretical reference the structure proposed by Kelly and Duschl (2002), named Evidence Explanation continuum (EE continuum). As a result, the authors deduced that there is greater diversity of epistemic practices in moments where there was transformation of knowledge, inside the context of the investigation, which ended up promoting the autonomy of the students during the investigative educational process.

Batinga and Silva (2018) discuss in an article about the POE (prediction – observation – explanation) as a possibility for the development of epistemic practices by the Sciences-Chemistry undergraduatesin the academic context, with experimental activities. The authors used an adaptation of Kelly and Licona (2017) as theoretical reference. According to the authors, in the first stage, Prediction, there was the propositions of ideas with the raising of a scientific question, which requires from the students the elaboration of initial hypotheses. In the second stage, Observation, there is the execution of experimental activities, where the initial hypotheses are tested. In the third stage, Explanation, there is the confrontation of data with the hypotheses and later confirmation or non-conformation, followed by the elaboration of new explanatory models and arguments aimed towards reflection. Thus, Batinga and Silva (2018) argue that the POE strategy makes possible the development of some epistemic practices, such as the proposition of communication of knowledge.

Thus, this article will resort to adapted methodologies proposed by the main theoretical references used in academic research currently.

4 METHODOLOGICAL COURSE

The research, characterized as of qualitative and documental nature, has as general objective to investigate how the scientific and epistemic practices are present in the contents that involve Chemistry knowledge disposed in Science textbooks, aimed to the initial years, approved by the National Program National Program for Textbooks, edition that has required by contract to be aligned to BNCC. Thus, we resorted to research of qualitative nature, with documental analysis based on the methodology of Bardin's Content Analysis (2011).

Regarding the qualitative research in the education field, Alves (1991) highlights that this type of approach is broad and hard to conduct, which may make the production of knowledge more complex. For the author, the qualitative study requires a clear methodological rigor, with well-constructed interpretative objectives and depth.Among the 17 collections approved by the Announcement of the PNLD 2019, published in the Federal Official Gazette, the 12 most commercialized were chosen, according to the report available in the Education Ministry's Transparency Portal (Brasil, 2019). From these 12 collections, we had integral access to only 9 physical collections, totalizing 45 books. As we chose to work specifically with Science textbooks (LD), we selected for the analysis, from the first to the fifth year. The textbooks analyzed will be from the category Teacher's Manual, which provide greater richness of detail for the analyses.

Table 1 shows the codes of the collections, the titles of the works, the names of the authors, the editors and to which segment (year) they belong.

Table 1: List of the Science LD collections for the initial years of primary education chosen as objects of analysis.

Code	Title	Authors	Publisher	Year
LD1	Encontros	GIL, A.; FANIZZI, S.	FTD	1st to 5th
LD2	Conectados	BUENO, R.	FTD	1st to 5th
LD3	Ligamundo	SILVA, C.S. SASSON, S.; SANCHES, P.S.B.; CIZOTO, S.A.; GODOY, D.C.A.	Saraiva	1st to 5th
LD4	Quatro Cantos	PORTO, A.; RAMOS, L.; GOULART, S.	Dimensão	1st to 5th
LD5	Anapiã	TRIVELATTO; LICO, C.	Escala	1st to 5th
LD6	Akpalô	BIGAINSKI, D; SOURIENT, L.	Do Brasil	1st to 5th
LD7	Crescer	MANTOVANI, K.	Do Brasil	1st to 5th
LD8	Aprender juntos	OBRA COLETIVA CONCEBIDA, DESENVOLVIDA E PRODUZIDA POR EDIÇÕES SM.	SM	1st to 5th
LD9	Ciências	COELHO, G.	FDT	1st to 5th

The research used Bardin's Content Analysis (2011) as analysis methodology, which basically involves four moments, which are not necessarily chronological, according to the author. They are: a) pre-analysis; b) codification; c) categorization; d) treatment of the results (Bardin, 2011).

In the first stage, called pre-analysis, there was the choice and recognition of the LDs that were analyzed, highlighting the thematic units where the Chemistry content is prominent. In the second stage, called codification, we elaborated the analysis matrix containing the categories, with the creation of context units and analysis units. In the third stage, called categorization, we performed the analysis pre-test and the matrix validation, with the construction of the enumerations and classifications. In the fourth stage, called exploration, we performed a deepened analysis of the selected documents, using the matrix. In the fifth stage, which contemplates the interpretation and discussion of the analyses, the data were systematized with the interpretation and the discussion of the information obtained by the analysis. And the sixth stage contemplated the elaboration of the results.

As analysis matrix, two categories were used: the presence of scientific practices and the presence of epistemic practices.

Category 1 aimed to identify and list the scientific practices, according to adaptations of the theoretical references discussed. It was created by adaptations on the eight CPs discussed by Nora, Broietti and Passos (2016), making them more accessible for the initial years. Furthermore, we used adaptations of the PC worked by Stroupe (2014) and Sasseron (2018). Thus, three criteria

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ISSN 1807 - 1600

were created to guide the search for the scientific practices in the selected didactic units that presented Chemistry content.

Table 2 shows the structure of the analysis category referring to the presence of scientific practices. The PC related to gathering, the analysis of new information and the development of representative models have code (PC1). The PCs related to the systematic data gathering and the test of hypotheses have code (PC2). And the PCs connected to the elaboration of justifications have code (PC3).

Table 2: List of the analysis category in reference to the presence of scientific practices in the didactic units that make up the Science textbooks chosen as objects of research

Scientific Practices (PC)	Searched action verbs or terms
PC1 – Gathering, analysis of new information and development of representative models	To collect; to compare data; to understand; to experiment; to explore; to define; to draw; to develop; to identify; to locate; to mesure; to name; to observe; to obtain; to look; to represent; to select; to see.
PC2 – Systematic data gathering and hypotheses test	To decipher; to discover; to interview; phrases with causal relations; to hypothesie (raise hypotheses); to inquire; to investigate; to ask; to research; to predict; to search; to question; to assume; to test; to try; to verify.
PC3 – Elaboration of justifications	To describe; to justify the answer; to recognize; for which reason? Why?

The location of the verbs and action terms inside the context units determined the presence of scientific practices in the statements of proposed activities, such as discursive exercises, individual and collective experiments and further activities. The action verb will be linked to the cognitive process involved in the activity, and the complement will be linked to the objects of knowledge studied in the didactic units, which in turn may be related to the skills proposed by BNCC.

Category 2 is related to the epistemic practices and was created by adaptations of the methodologies proposed by Jiménez-Aleixandre (2008), Araújo (2008), Kelly and Licona (2017) and Sasseron (2018). Thus, four criteria were created to guide the search for the epistemic practices in the selected didactic units that presented Chemistry content.

Table 3 shows the structure of the analysis category referring to the presence of epistemic practices. The epistemic practices related to production have code (PE1), the ones related to communication have code (PE2), the ones related to the evaluated have code (PE3) and the ones relative to legitimation of ideas have code (PE4).

Table 3: List of the analysis category in reference to the presence of epistemic practices in the didactic units that make up the Science textbooks chosen as research object.

Epistemic practices (PE)	Searched action verbs or terms
PE1 – Proposition of ideas	To think...; how would you answer...; to build data; to monitor processes; to opine; what would you say…; what would you do…; to project; to propose; to solve problems; to sugest.

PE2 – Communication of ideas	To annotate; to show ideas; to cite; to classify; to comment; to share; to communicate; to tell; to converse; to divulge; to say; to write; to exemplify; to explain; to speak; to indicate; to inform; to list; to register; to connect; to report; to exchange ideas.
PE3 – Evaluation of ideas	To analyze; to argue; to evaluate; to deduce; to distinguish; to choose; to evidence; to justify; to perceive.
PE4 - Legitimation of ideas	To build consensus; to build collective texts (oral or written); to debate with the class; to decide collectively; to discuss in pair.

The location of the verbs and action terms in the context units determined the presence of epistemic practices in the statements of proposed activities, such as discursive exercises, individual and collective experiments and further activities. The action verb will be linked to the cognitive process involved in the activity, and the complement will be linked to the knowledge objetcts studied in the didactic units, which in turn, may be related to the skills proposed by BNCC.

5 SCIENTIFIC PRACTICES IN THE DISCURSIVE, EXPERIMENTAL AND INVESTIGATIVE ACTIVITIES PROPOSED IN THE SCIENCE TEXTBOOKS

Scientific Practice 1 is related to the way of gathering, of representation analysis on new information. We searched for action verbs or terms that refer, in the context of the didactic unit and the activities, to the practice studied in this category. Although there are verbs that may be considered synonymous, they were searched for individually.

In total, 239 action verbs were found, corresponding to the type PC1, with 51.8% of them corresponding to the practice of "to observe", highlighting the match with the synonym "to see" with 10.0%. Next, there is the action verb "to draw" with 15.9%, and the action verb "to experiment" with 5.8% frequency. The action verbs corresponding to the exploration, development, naming and representation were not located in the analyses. Table 4 shows examples of the context unities found in the materials analyzed, as well as the action verb, highlighted.

Table 4: Context unities identified in three books analyzed.

LD	PAGE	PC1s	Context units
LD8_3	128	to observe to identify	*"**Observe** the figures and do what is told. **Identify** what materials make up the objects (…)"*
LD8_5	55	to observe	*"**Observe** the image of a saltern below. (...) What might remain in the reservoirs after some time?"*
LD9_1	27	to draw	*"**Draw** or glue the picture of a glass objects, next **write**[1] its name.".*

In the items related to LD8_5 and LD8_3, there is the presence of the verb "to observe". The observation is related to the action mode of problem solving, which is defined by BNCC for teaching Natural Sciences as one of the investigative actions. The importance of the observation in Science teaching is related to the process of construction of knowledge by means of investigative procedures, thus, "it is expected, thus, to make possible that these students have a new look on the world that surrounds them, as well as make conscious choices and interventions based on the principles of sustainability and the common good" (Brasil, 2017, p. 321). It is worth stressing that, according to BNCC, "when the verb 'to observe' is used, one has in mind the sharpening of the students' curiosity about the world, in search of questions that make possible to elaborate hypotheses and to build explanations about the reality that surrounds them" (Brasil, 2017, p. 331).

In LD9_1, there is the presence of the action verb "to draw", which consists in a scientific practice connected to the construction of representative models resorting to visual language, being essential to the scientific activity. For Lemke (1998(, this action is a practice inherent to the propagation of findings, common to scientists.

Thus, the school scientific practice based on drawing consists in an action loaded with signs for the child, which allows for the understanding of the reality represented there, respecting the interpretation founded in their social context (Vygotsky, 1982). This type of activity enables the student to build an imagery model via drawing, i.e., there will be the transcription of information to the paper. Furthermore, the imagination is widely stimulated, as highlights Girardello (2011, p. 76):

> The imagination is for the child a space of freedom and of take-off in the direction of the possible, whether realizable or not. The child's imagination moves – is moved – together with the new that they see everywhere in the world. Sensitive to the new, the imagination is also a dimension in which the child glimpses new things, envisions or sketches possible futures. They need the imaginative emotion that lives through playing, the stories the culture offers, the contact with art and nature, and the adult mediation: the finger that points, the voice that speaks or listens, the day to day that accepts.

An important factor found in the books was the presence of two or more action verbs related to the distinct scientific practices, as shows the example of LD9_1, with the verb "to write". In general, the collection that showd PC1 the most was Ligamundo – Editora Saraiva, with 44 ocurrences.

PC2 is related to the systematic data gathering and hypotheses test, they are related to teaching by investigation and are described by BNCC:

> To plan and execute field activities (experiments, observations, readings, visits, virtual environments etc.).
> To develop and use tools, including digital ones, for collection, analysis and representation of data (images, schemes, tables, graphs, figures, diagrams, maps, models, system representations, flowcharts, conceptual maps, simulations, applications etc.).
> To evaluate information (validity, coherence and adequation to the formulated problem).
> To elaborate explanations and/or models.
> To associate explanations and/or models to the historical evolution of the scientific knowledges involved.
> To select and build arguments based on evidence, models and/or scientific knowledge.
> To improve their knowledge and to incorporate, gradually and significantly, the scientific knowledge.
> To develop solutions for day-to-day problems using various tools, including digital ones.

Although there are verbs that may be considered synonyms, they were searched for individually. Furthermore, we analyzed the texts, the activities and the pictures proposed as a whole, with the goal to find causal relations and openings related to hypothesizing, for example.

In total, we found 73 occurrences of action verbs or terms linked to the scientific practice of systematic data gathering and hypotheses test. Of those, 26% correspond to the action verb "to investigate" and 20% to the action verb "to discover". We did not find occurrences for the verbs "to inquire" and "to question", although they are synonyms with the verb "to ask". Table 5 shows examples of the context units found in the materials analyzed, as well as the action verb, highlighted.

Table 5: Context units identified in three books analyzed.

LD	PAGE	PC2s	Context units
LD2_5	97	to try	*"(...) **Try** to make the following mixtures and **see** what happens. (…) b) How did you reach this **conclusion**[1]?"*
LD4_1	77	to investigate to try to discover	*"**Investigating** objects. Bring to class an object (...). With eyes covered, hold and feel the object. **Try to discover** what it is."*
LD5_4	15	to observe to assume	*"**Observe** the following images. **Assume**[2] that screws and nails are mixed (...) **If**[2] you received the task to sort out (…) how would you **do** (…). **Discuss**[1] with your colleagues."*

In the item presented by the code LD4_1, we found three action verbs corresponding to PC2. It is possible to observe that this command involves practices that refer to investigation and hypothesizing. In the item presented by the code LD2_5, we found one action verb linked to PC2 and one action verb linked to PC1. At last, in this command, we found one action verb ("to conclude") relative to PE2 – Evaluation of ideas.

In the item presented by the code LD5_4, we found one verb and one action term linked to PC2 (assumptions), with the presence of an action verb linked to PE4 – Legitimation of ideas. The simultaneous presence of scientific and epistemic practices is seen as complementary in the activities, aiding in the development of the teaching and learning process. Thus, thus activity brings an example of conjunct and positive action of the practices, once "thus conjunct occurrence could allow the students to have a more direct contact with the investigation process, performing the practices that characterize it and learning the concepts of science together with ways to organize, evaluate, propagate and legitimize knowledge in this area" (Sasseron, 2018, p. 1075). In general, the collection that showed PC2 the most was Quatro Cantos – Editora Dimensão, with 19 occurrences.

PC3 is related to the elaboration of justifications, i.e., the establishment of limits and predictions of explanations. It is a very delicate practice and it is similar to the epistemic practice (PE3) that refers to the evaluation of ideas, which will be discussed later. The thin line between the two actions is in the way the commend or base text are organized. Thus, we analyzed case by case, taking all of the context of the didactic unit as analysis unit. We searched for action verbs or terms that referred to the practice studied in this category.

In total, we found 73 occurrences of action verbs or terms related to the scientific practice of elaboration of justifications (PC3). Of those, 53.4% correspond to the action term "why" and 20.5% to the action term "justify the answer". In a similar research performed by Nora, Boietti and Passos (2017) about the Science questions on PISA – for students in the age group of 15 years old, the authors found the presence of approximately 50% frequency of the scientific practice related to finding justifications, a value close to the one found in this work. Table 6 shows examples of the context units found in the materials analyzed, as well as the action verb, highlighted.

Table 6: Context units identified in 3 books analyzed.

LD	PAGE	PC3s	Context units
LD3_1	74	To describe	*"**In pairs**[2]**, describe** an object from the image to your colleague, then hear their description,"*
LD8_2	127	To describe To justify	*"Which object is more flexible? A glass cup or a rubber ball? **Describe** one characteristic that **justifies your answer**."*
LD8_2	127	To observe Why	*"(...) **Observe**[1] the images below and answer: can we say that the arch is flexible? **Why**?"*

In the first item of LD8_2, in addition to the action verb "to describe", the action verb "justify your answer" appeared, which is related to the evaluative capacity of the student facing a problem. In the second item of LD8_2, the use of the action verb "to observe pictures" appears, relative to PC1, and next it asks to answer "why" (related to PC3) an arch is flexible, referring to the study of material resistance. The use of two or more scientific practices in the same command increases the complexity of the activity. In this case, it is important to stress that, although it contemplates the activity EF01CI02 of BNCC, the activity is advanced for the year. In the item LD3_1, the action verb "to describe" refers to the scientific practice of elaboration of justifications (PC3) and the term "in pairs" is linked to the epistemic practice of evaluation of ideas (PE3), once the work is collective. This type of activity represents another efficient way to combine scientific and epistemic practices, which consists in a proposal for the promotion of scientific literacy (Jiménez-Aleixandre & Crujeiras, 2017). In general, the collection that showed PC3 the most was Ligamundo – Editora Saraiva, with 17 occurrences.

Regarding the scientific practices, we found a total of 385 occurrences in all of the books analyzed. Regarding the scientific practice of gathering, analysis of new information and development of representative models (PC1), we located 239 action verbs or terms, 51% of them related directly to the practice of observation. Regarding the scientific practice of systematic data gathering and hypotheses test (PC2), we found 73 occurrences, 26% of them being related to action verbs or terms that referred to the practice of investigation. At last, regarding the scientific practice of elaboration of justifications (PC3), we found 73 occurrences, 53.4% of them being linked to action verbs or terms that referred to the question of asking why. The collection Ligamundo – Editora Saraiva showed the biggest frequency of scientific practices among all analyzed. The significant presence of verbs and action terms related to the observation, the investigation and to being asked the reasons behind a certain phenomenon may be related to the demands for Teaching by Investigation, as BNCC recommends. However, it is important to highlight the need to pay attention to the excessive use of activities that strenghten the memoristic and reproductive teaching, in which there is no critical development of the student.

6 EPISTEMIC PRACTICES IN THE DISCURSIVE, EXPERIMENTAL AND INVESTIGATIVE ACTIVITIES PROPOSED IN SCIENCE TEXTBOOKS: FROM THE PROPOSITION TO THE LEGITIMATION OF IDEAS

We searched for verbs or terms of action throughout the text of the didactic unit and in the activities – be them discursive, experimental or investigative, that referred to the presence of epistemic practices. Next, we will describe the analysis units and the evaluation of the presence of the criteria, with PE1 – Proposition of ideas, PE2 – Communication of ideas, PE3 – Evaluation of ideas, and PE4 – Legitimation of ideas.

PE1 is related to the articulations between the knowledges and the configurations of meanings to the data patterns. The verbs and action terms searched allow to the activities of the didactic unit an opening to emit opinions, elaboration of projects, building and suggestion of proposal, the solving of problems and the monitoring of processes.

In total, we located 36 occurrences of action verbs or terms linked to the epistemic practice of proposition of ideas (PE1). Of those, 36.1% correspond to the action verb "to opine" and 27.7% to the action verb "to think". We did not find action verbs or terms related to data gathering, monitoring processes and problem solving, in an explicit way. Table 7 shows examples of the context unities found in the materials analyzed, as well as the action verb, highlighted.

Table 7: context units identified in 2 books analyzed.

LD	PAGE	PE1s	Context units
LD3_4	86	What would you say...	*"(...) Considering what Milena is saying,* ***what would you say*** *about the solvability of the powdered chocolate in the cold milk?" "b)* ***What would you say*** *to Milena to solve this problem?"*
LD9_2	49	To think	*"(...) Observe[1] the images (...). Knowing this characteristic of the plaster, why[1] do you* ***think*** *it is used in construction?"*

In the item presented by LD3_4, there is anactivity in which it is proposed to perform the preparation of chocolate milk. In the item a and item b, there is the use of the action term "what would you say", i.e., the proposition of ideas, which consists in one of the epistemic practices, which "are associated to metacognitive aspects of the construction of understanding and of ideas about phenomena and situations in investigation" (Sasseron, 2018, p. 1067).

In the research about epistemic practices found in the literature, authors such as Nascimento (2015), Ratz (2015), Silva and Trivelato (2016), and Azevedo, Del Corso and Trivelato (2017) found with high frequency the occurrence of practices related to the prodution of knowledge, in detriment of the other ones. However, it is important to stress that these authors developed their field researches with High School students and teachers. Regarding the researches of the final years of Elementary School, only Motta, Medeiras and Motakane (2018) related the presence of these practices, however, they highlighted the importance of the teachers' aid in raising hypotheses, for example. We did not find works aimed at the initial years of Elementary School.

In the activity described in the item LD9_2, there is the presentation of a text – in all caps, since the 2nd year students are still in the stage of learning to read and recognize letters – about houses built with unusual materials, with a children's literary aspect. The command proposes the observation and the analysis of pictures, which consists in a scientific practiced aimed toward the gathering and analysis of new information, and next, it wants the opinion about why the plaster is used in construction. All of these items allude to the epistemic practices of proposition, communication and evaluation of ideas, respectively. The activity previously analized shows an excelent way to articulate, simultaniously, the scientific and epistemic practices via the knowledge and literacy of the Portuguese language, which also makes way to the promotion of scientific literacy, which goes against the positions of Lorenzetti and Delizoicov (2001), who defend that:

> [...] scientific literacy can and must be developed since the beginning of the schooling process, even before the child knows how to read and write. In this perspective, science teaching can constitute a strong ally for the development of reading and writing, once it contributes to attaches feelings and meanings to the words and their discourses (Lorenzetti & Delizoicov, 2001, p. 57).

PE2 concerns the communication of ideas, and consists in an epistemic practice relative to the interpretation and construction of representations, as well as the production of relationships, mainly relative to explanations of a determined problem situations. BNCC lists the importance in the communication, where:

> To organize and/or extrapolate conclusions. Report information in oral, written or multimodal form. To present, in a systematic way, data and results of investigations. To participate in discussions of scientific character with colleagues, teachers, relatives and the community in general. To consider counter-arguments to review investigative processes and conclusions (Brasil, 2017, p. 323).

As Longino (2001) highlights, the communication of ideas is of extreme importance in the process of constructing the scientific knowledge, being characteristic of a community and not of the individual, i.e., they are social processes followed by the production of knowledge. This practice is part of the aspects related to the scientific investigation and are also backed by Teaching by Investigation. Thus, the action verbs or terms searched in the activities and the texts of the didactic units are related to the expression of ideas.

In total, we located 162 occurrences of action verbs or terms linked to the epistemic practice of communication of ideas (PE2). Of those, 29.01% correspond to the action verb "to write", 16.04% to the action verb "to explain", and 9.25% to the action verb "to cite". We did not find action verbs or terms related to the communication, propagation, information and the report of ideas.

Table 8 shows examples of the context units found in the materials analyzed, as well as the action verb, highlighted.

Table 8: Context units identified in 2 books analyzed.

LD	PAGE	PE2s	Context units

LD1_4	114	To explain	*"Read the text. Manuela was in a picknick with her family in a park. She spilled a little bit of watter (...). **Explain** to Manuela what must have happened."*
LD7_5	109	To annotate To explain	*"Can water dissolve any substance? **Annotate** your ideas. (...). **Observe and draw**[1] how each mixture turned out. (...) After doing the activity, were your ideas confirmed? **Explain**"*

In the item LD1_4, a base text is presented, which resorts to a problem situation, where the student will have to elaborate a plausible explanation, based on scientific criteria, in order to register what happened. It is noticeable that verbs associated to the action of reporting did not show up, although this verb and the action term "to present ideas" are equally important in this stage. Concerning this, BNCC highlights that:

> [...] when a determined verb is used in a skill, such as "to present" or "to report", it refers to common procedures in science, in this case related to the communication, which also involve other stages of the investigative process. The idea implicit is in reporting in a systematic way the result of a data collecction and/or to present the organization and extrapolation of conclusions, in a way to consider the counter-arguments presented, in case of a debate, for example (Brasil, 2017, p.331).

It is important to highlight that the work with the construction of explanations is defined and recommended by national and international curricular guidelines, like the North-American curriculum NGSS, one of the most relevant ones worldwide for Science teaching, which has as pedagogical didactic bias the Teaching by Investigation, and the work with epistemic practices also highlights the importance of the construction of explanations, mainly on fifth grade, identification of information about the natural world, with the explanation of complex phenomena in a progressive manner (NGSS, 2012).

In the item LD7_5, there is the simultaneous presence of action verbs related to the scientific ("to observe" and "to draw") and epistemic ("to annotate" and "to explain") practices, which makes the activity complete and adequate to the investigative process, consisting in a proposal for the promotion of scientific literacy (Jiménez-Aleixandre & Crujeiras, 2017).

PE3 is related to the evaluations of ideas, it is connected to the coordination between theory and evidence (argumentative processes), also providing the contrast between the conclusions and the ideas, evaluating the plausability of the problem situation. This epistemic practice has definitions very close to the ones taken by the scientific practice of Elaboration of Justifications. There is a thin line between the two actions, depending on the way the command or the base text are organized. Thus, we analyzed case by case, taking all of the context of the didactic unit. In general, this epistemic practice searched for activities that listed actions of distinction, analysis, evidence, justification and argumentation.

In total, we located 43 occurrences of action verbs or terms linked to the epistemic practice of evaluation (PE3). Of those, 39.53% correspond to the action verb "to choose", 25.58% to the action verb "to analyze" and 13.95% to the action verb "to justify". We did not find the action verbs or terms relative to the evaluation, the distinction, or the disclosure of ideas. Table 9 shows examples of the context units found in the materials analyzed, as well as the action verb, highlighted.

Table 9: Context units identified in 2 books analyzed.

LD	PAGE	PE3s	Context units
LD5_4	56	to discuss to argue to justify the choice	*"At the end of the Science class, two students are **discussing** about the evaporation of sea water. Marcos **argues** that the salt in this mixture evaporates with the water (…) b) Write an **argument** that **justifies** your choice."*
LD8_2	125	to analyse to notice	*"1. Handle and **analyze** three objects of your daily life (...)" "2. Did you **notice** any relation between the materials (…)"*

In the item LD5_4, a teaching situation is shown, where the student must make use of critical investigations in order to build an opinion. This type of activity shows to be well elaborated and deserves attention, once it works with the attribution of intellectual authority to the student, who must reason and make a judgment when facing the question. In the item b, it is asked for an argument, followed by a justification of choice, which are epistemic practices of evaluation of ideas (PE3). Sasseron (2018), backed by Bybee and DeBoer (1994), Hurd (1998) and Foures (1994), highlights that the work with critical investigation over day-to-day problems, mainly involving teaching situations, "substantiate the bases of scientific literacy, one this is understood as the possibility of the individuals to build an understanding about situations of their lives, that involve knowledge of sciences, by means of investigation processes and use of critical analysis" (Sasseron, 2018, p. 106). In general, the collection that showed PE3 the most was Quatro Cantos – Editora Dimensão, with 8 occurrences.

PE4 is related to the legitimation of ideas that suggest the confirmation of them by means of the collective, i.e., when the debate and discussion with the class and teacher are stimulated by the activities and the texts. Thus, we searched for action verbs or terms that referred to this practice. In total, we found 13 epistemic practices related to the legitimation of ideas in the analyzed books, with 84.6% of them making use of the action verb "to discuss" with colleagues about a certain idea. We did not find action verbs or terms about the building of consensus or collective decision about something. Table 10 shows examples of the context unit found in one of the materials analyzed, as well as the action term, highlighted.

Table 10: Context units identified in one book analyzed.

LD	PAGE	PE4	Context unit
LD1_4	89	To build a collective text	*"Review your annotations and, with the help of the techer and the classmates, **produce a collective text,** which whill be the experiment report (…)"*

This exercise is part of the didactic unit about the object of Chemistry knowledge "Homogenous and Heterogenous Mixtures", contemplating the skill (EF04CI01) to identify mixtures in daily life, based on their observable physical properties, recognizing its composition of BNCC. By means of an experiment, which proposes the preparation of mixtures, the activity suggests that the annotations be reviewed and the production of a collective text, which consist in practices of communication of ideas (PE2) and, at the same time, of legitimation of ideas (PE4), once it involves the work with establishing consensus in the group. According to BNCC, the competence 5 of Science for Elementary School, brings the importance of negotiation and the defense of points of view, i.e., it is important:

> To build arguments based on reliable data, evidence and information and to negotiate and defend ideas and points of view that promote socioenvironmental conscience and the respect to oneself and to others, welcoming and valuing the diversity of individuals and social groups, without prejudice of any nature (Brasil, 2017, p.324).

In gereral, the collection that showed PE4 the most was Ligamundo – Editora Saraiva, with 5 occurrences.

Regarding the epistemic practices, we found a total of 282 occurrences in all of the analyzed books. Regarding the epistemic practice of proposition of ideas (PE1), we located 36 action verbs or terms, 36% of them being related to the practice of emitting opinions. Regarding the epistemic practice of communication of ideas (PE2), we found 190 occurrences, 29% of them relating to the practice of writing. Regarding the epistemic practice of evaluation of ideas (PE3), we located 43 action verbs or terms, with 39.5% of them alluding to the practice of choice. At last, regarding the epistemic practice of legitimation of ideas (PE4), we found 13 verbs, 84% of those were connected to the practice of discussions. Under the analysis of the epistemic practices, Coleção Encontros – Editora FTD showed the highest frequency of PEs among all of the analyzed materials.

7 FINAL CONSIDERATIONS

The collections analyzed were approved by PNLD 2019, with one of the criteria being the adequacy to BNCC. Thus, the editorial project and the choice of contents present in the books were created, possibly, by reading from the specialists and technicians of the publishers, thus it is noticeable a wide range of variation in the approach of the contents related to Chemistry. Thus, each collection showed a way to develop and evaluate the knowledge of Chemistry. We can verify the efficacy in the transition stage from Preschool Education to the initial years of Elementary School – for the 1st and 2nd year – with the approach aimed towards literacy in Portuguese, at the same time that the contents connected to the Natural Sciences were worked. For the 3rd, 4th and 5th year, there was a complexification of the activities. Furthermore, there was a greater support to the appropriation of the alphabetical writing system, working with texts and questions that demanded discursive answers.

The high frequency of scientific practices, in detriment of the epistemic practices, can be justified by the historical manner in which Science teaching has been developed throughout the years, where traditional approaches that tended toward technicality were valued, which tend to decrease with the implementation of the proposal of Teaching by Investigation recommended by BNCC or other active or constructivist methodologies, which are linked to the use and development of epistemic practices. Thus, we hope that the formulation of the curricula contemplates both practices, in order to aid the process of teaching and learning Science in the initial years.

Therefore, the general objective of this research, which was to investigate and reflect on the knowledge of Chemistry present in the Science textbooks approved by the National Program for Textbooks, PNLD 2019, and aimed towards the 1st through 5th years of Elementary School, making use of the scientific and epistemic practices as parameters were not only contemplated, but also surpassed, once we observed a rather important point for Science teaching: as it has been pointed by national and international researchers in the field, the association of these practices is a pathway for the promotion of scientific literacy.

The presence of scientific and epistemic practices in the textbooks is made necessary, but the implementation of them in the daily routine of the teacher in the classroom, will depend on the initial and continued training that they are receiving. Qualitative research in courses that graduate teachers have been building, with support of the national research groups, ways to articulate the practices with proposals of didactic sequences and studies about the theme.

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HOLOS
ISSN 1807 - 1600

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COMO CITAR ESTE ARTIGO

Matos, C. F. de ., & Lorenzetti, L. (2023). A PRESENÇA DAS PRÁTICAS CIENTÍFICAS E EPISTÊMICAS NOS LIVROS DIDÁTICOS DE CIÊNCIAS DA NATUREZA: UM OLHAR PARA O CONHECIMENTO QUÍMICO NOS ANOS INICIAIS. HOLOS, 1(39). Recuperado de https://www2.ifrn.edu.br/ojs/index.php/HOLOS/article/view/14447

SOBRE OS AUTORES

C.F.MATOS

Licenciada em Química (2017) e Mestre em Educação em Ciências e em Matemática (2020) pela Universidade Federal do Paraná (UFPR). Editora de livros didáticos de Química para o Ensino Médio, participando também do desenvolvimento de projetos educacionais no Núcleo de Conteúdo Editorial (NEC) do grupo Arco Educação. Membro da Associação Brasileira de Pesquisa em Educação em Ciências (ABRAPEC) e da Sociedade Brasileira de Ensino de Química (SBENQ). E-mail: m.clarianna@gmail.com
ORCID-ID: https://orcid.org/0000-0002-8848-7495

L.LORENZETTI

Graduação em Ciências. Mestre em Educação. Doutorado em Educação Científica e Tecnológica.
Professor da Universidade Federal do Paraná. E-mail: leonirlorenzetti22@gmail.com
ORCID-ID: https://orcid.org/0000-0002-0208-2965

Editora Responsável: Francinaide de Lima Silva Nascimento

Recebido: 11 de novembro de 2022

Aceito: 8 de fevereiro de 2023

Publicado: 1 de março de 2023