



THE CHARACTERISTICS OF NATIONAL AND INTERNATIONAL RESEARCH ON THE PRODUCTION OF LEARNING EVALUATION IN DISCURSIVE INTERACTIONS

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Abstract

In this article, we analyze the national and international research characteristics on the production of learning evaluation in discursive interactions in science teaching based on a sociocultural perspective. We considered 89 researches, 66 of which were national and 23 were international, selected by consulting the ProQuest Education Resources Information Center and Web of Science virtual libraries, the CAPES Newspaper Portal and the ENPEC Annals. The researches were analyzed in the NVivo 12[®] software for four categories: (a) understandings and purposes of learning evaluation, (b) relationships between evaluation and discursive interactions, (c) learning evaluation assumptions and (d) analytical categories. The researches indicate the need to consider discursive dynamics in the evaluation conceptual understanding and in how it is structured according to interactional patterns so that students are able to develop meanings. The studies highlight multiple purposes and the need to expand spaces that value the expression of scientific ideas by students, above all, through dialogic discourse. Based on the research propositions, we emphasize the evaluation centrality in the articulation between scientific thought and language through a linguistic, epistemic and situated focus on science teaching.

Keywords: Learning evaluation; sociocultural theory; discursive interactions; science teaching; language.

Resumo

Nesse artigo analisamos as características das pesquisas nacionais e internacionais sobre a produção da avaliação da aprendizagem em interações discursivas no ensino de ciências fundamentadas na perspectiva sociocultural. Consideramos 89 pesquisas, sendo 66 nacionais e 23 internacionais, selecionadas por meio de consulta às bibliotecas virtuais ProQuest Education Resources Information Center e Web of Science, ao Portal de Periódicos CAPES e aos Anais do ENPEC. As pesquisas foram analisadas no software NVivo 12[®] para quatro categorias: (a) compreensões e propósitos da avaliação da aprendizagem, (b) relações entre a avaliação e as interações discursivas, (c) pressupostos da avaliação da aprendizagem e (d) categorias analíticas. As pesquisas indicam a necessidade de considerar as dinâmicas discursivas na compreensão conceitual da avaliação e em como ela é estruturada segundo padrões interacionais para que os alunos elaborem significados. Os estudos destacam múltiplos propósitos e a necessidade da ampliação de espaços que valorizem a expressão de ideias científicas dos alunos, sobretudo, pelo discurso dialógico. A partir das proposições das pesquisas, enfatizamos a centralidade da avaliação na articulação entre pensamento científico e linguagem por um enfoque linguístico, epistêmico e situado no ensino de ciências. Palavras-Chave: Avaliação da aprendizagem; teoria sociocultural; interações discursivas; ensino de ciências; linguagem.

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INTRODUCTION

Several national and international research studies have shown a growing interest in investigating how learning evaluation is produced in discursive interactions originating in science teaching situations, with a view to interpreting meaning making processes. According to Schnetzler (2002), Broietti, Santion Filho & Passos (2013) evaluation was discussed from a technological, propaedeutic, and instrumental viewpoint, especially for its relations with entrance exams, syllabuses, and textbooks, in addition to educational public policies aimed at the administration of education systems.

Starting in the 1970s, evaluation became increasingly linked to language phenomena, under the influence of social, economic, and technological movements and the so-called "linguistic turn", which transformed the notion of language (Duboc, 2012; Silva, 2008). According to Duboc (2012, p. 666-682), the transformation in the notion of language has brought implications for the evaluation of learning, such as considering its production by means of communication and information technologies, the transition from a typographical society, in which the elaboration of meanings was based primarily on the verbal language of printed materials, to a post-typographical society, in which meanings are based on complex uses of semiotic modes, in addition to the creation of a digital epistemological base and the redefinition of the concepts of language, text, reading, writing, authorship and genre due to the use of multimodalities. In turn, the concept of knowledge and subject has been transformed, so that evaluation centered on the attribution of meanings that were supposed to depend only on an exclusively individual plane has come to be perceived from the perspective of collaboration, in which knowledge is seen as a sociocultural construction and by meanings mediated by the school. In this sense, the logic of an evaluation based on linearity, objectivity, homogeneity, and the measurement of content by objectives considered to be stable and universal is overcome, to conceive the evaluation from the perspective of multiple semiosis by legitimizing the multiplicity of meanings, its collective, collaborative and distributed production (Duboc, 2012).

According to Kalantzis & Cope (2011), multimodality emerged from the identification of literacy difficulties in early childhood education in order to incorporate two aspects: the recognition of the multiplicity of communicative and representational forms by the use of new digital media and not only print media, and the multiplicity of meanings in social and cultural contexts. Considering multiple semiosis and multimodality means giving visibility to subjectivity, diversity, and meanings through the use of semiotic modes (Duboc, 2012), with profound changes in the conceptual notion of evaluation. In this sense, language includes new expressive resources and means to produce meanings and that expand the notion of text, of communication and representation by visual, sound, graphic, spatial, gestural linguistic modes (Duboc, 2012; Kalantzis, Cope & Havey, 2003; Maceno, 2020).

In analyzing national research, Schnetzler (2002) found that out of 152 theses and two dissertations published between 1971 and 2001 in Brazilian schools of education, only 28% investigated evaluation. With the same objective, Broietti *et al.* (2013) concluded that since 1986, there has been an increase in scientific production on teachers' conceptions and the evaluative instruments used. However, as Maceno (2020), Silva & Bego (2018) admonish, studies in Brazil that address evaluation in science education are rare, as they are often focused on syllabuses. Even though there are scientific productions about evaluation, the understanding that it is secondary or merely a consequence of teaching is common among national researchers. In these cases, the conceptualization of evaluation remains limited to psychometric sciences and the "formative and summative" dualistic categories, with no situated investigation on how it occurs in the classroom.

In the subsequent decades, research oriented by psychometric matrices was heavily criticized, while other investigative experiences in science teaching emerged, with theoretical and methodological improvements that influenced the understanding of evaluation as an activity. Consequently, evaluation has come to be seen also as a discursive and epistemic production, in which students, through the teacher's assistance, elaborate meanings and acquire scientific knowledge. Research has incorporated, in its investigative horizons, collective processes, negotiations, and contexts to understand the discursive and social organization that evaluation takes on among speakers. The mediation of material and symbolic tools has also become central in research to analyze how teachers and students act and speak when they evaluate.

Currently, several Brazilian researchers influence the interactional analysis of science teaching from a sociocultural perspective (Mortimer & Scott, 2002; Silva, 2008; Bozelli & Nardi, 2012; Giordan, 2013; Franco & Munford, 2017; Sasseron & Duschl, 2016; Silva *et al.*, 2017; Quadros & Mortimer, 2018), with impacts also on studies on evaluation (Giordan, 2013; Amaral, 2004; Quadros, 2014; Uhmman, 2017; Maceno & Giordan, 2017, 2019a, 2019b). Likewise, Sinclair & Coulthard (1975), Cazden (1972), Mehan

(1979), Lemke (1990), and Kelly (2005) make important contributions to the understanding of evaluation as part of a wide variety of discursive dynamics in science education, transforming its meanings for researchers. In addition, the evaluation produced in the interactions can qualify the expressive capacity of students when they exchange ideas about scientific knowledge, and is fundamental in the classroom (Cowie, Moreland & Otrell - Cass, 2013; Gómez & Jakobsson, 2014; Chetcuti & Cutajar, 2014; Silseth & Gilje, 2017; Iczl, Muslu, Burcks & Siegel, 2018).

Gipps (1994) argues that Vygotsky (2001) assisted in the understanding that evaluation should support learning by the use of tools and supports for the development of mental functions, which would "[...] reduce the emphasis on memorization skills and increase the emphasis on thinking and problem-solving" (Gipps, 1994, p. 27). The notion of cultural tools allows us to interpret how meanings are elaborated by interactions, which significantly influences the production of evaluation and the organization of evaluative activities. The actions in the classroom can be mediated by tools whose purposes are evaluative, which also allows us to analyze the process of meaning making by the student. Thus, tool-mediated action allows us to admit that there is an irreducible tension between internal and external action in the subject's use of and operations with these tools, so that semiotic and instrumental mediation are indistinguishable. Furthermore, refuting the separation between subject, tools, and environment means recognizing mediation in any action, including evaluative, and that the individual does not learn in isolation, but permanently acts with tools that allow the elaboration of meanings. Thus, mediated action maintains the dialectic between agent and instrument, because by considering agents-acting-with-cultural-tools (Wertsch, 1998; Giordan, 2013) evaluation is placed in a cultural and institutional context, and it is problematic to think of it as an exclusively individual production, despite the instruments used to measure memorization skills and the reproduction of book information. In this sense, research on evaluation has come to consider the individual's social and interactive processes as "[...] an integral part of the teaching process and embedded in the social and cultural life of the classroom" (Gipps, 1999, p.378). Problem-solving and memorization are like opposite poles, in Gipps' (1999) perspective, which should be mitigated when we observe the need to introduce scientific language that can be mistakenly confused with memorization situations by teachers and students. Much of scientific language has its origin in the characteristic rationality of each field of knowledge, which should be privileged in both teaching and evaluation proposals, which requires understanding how scientific language itself works in classroom interactions.

In order to characterize the central object of our research, we assume as evaluation of learning the activity of procedural, interactional and multimodal nature, produced in science teaching in social processes of use of interactional patterns, tools and semiosis by teacher and students, being constituted by references, evaluative appraisals, criteria, evidence, judgments and arguments in specific contexts to meet the multiple purposes and functions of language, and of performative and situated nature.

In the present work, we present a systematic study of the academic production in the virtual libraries ProQuest Education Resources Information Center (ERIC) and Web of Science, and, supplementarily, in the Annals of the National Meeting of Research in Science Education (ENPEC) and in the CAPES/MEC [Coordination for the Improvement of Higher Education Personnel/Ministry of Health] Journals Portal, considering the following questions: What understandings and relationships are emphasized for the evaluation of learning in relation to discursive interactions in science education? What are the main assumptions and themes explored by the researchers? What are the analytical categories used in the research?

In order to answer these questions, this paper contributes to the production of a prior art on the research published in virtual libraries and events on the evaluation of discursive interactions in Science Education. Furthermore, to investigate research on Science evaluation whose theoretical foundations are based on discursive interactions makes impractical the fundamentals and assumptions of psychometric Sciences, that is, to consider in the evaluation production only the measurement of the number of correct answers of memorized information, the depreciation of error, the over valuation of multiple choice tests and privileged use of the written semiosis, social exclusion by the classification of people, among other widely criticized problems. In terms of research, this study seeks to broaden the possibilities of analyzing evaluative situations in order to significantly expand understandings of evaluation by considering other investigative experiences that have analyzed discursive interactions, the use of language to respond to educational difficulties, and multimodality. Next we present the methodological path of the research.

a) The sociocultural perspective and evaluation in science teaching

Through his manuscripts, Vygotsky (2001) unquestionably contributed to the foundations of the social theory of mind, and can also be considered in understanding evaluation. His ideas about cultural development and higher mental functions are essential for the attention given to action and to material and symbolic tools, which present as an immediate application, the questioning of evaluation understood only as the ability to memorize information and reproduce it in tests.

By considering discursive interactions, it is possible to interpret the structures resulting from actions processed in environments that incorporate scientific concepts and knowledge by higher forms of thought and language. In other terms, thought and language constitute dialectical relations in the organization of human activities (Giordan, 2013), including evaluation as an interpretive activity about student levels of learning. Considering how discursive interactions produce evaluation allows us to understand how the teacher acts and supports students as they link thought and language. In this view, cognitive processes and the social dimension of consciousness are valued, without denying the biological aspects, with the transformation of innate capacities by mediational means and symbolic systems in the elaboration of meanings being central. The meaning arising from the domain of mediational media is broadened when the learner participates in social activities to become able to control his or her own mental activity and act independently of assistance from the more advanced peer.

According to Vygotsky (2001), cultural development occurs first on the social, interpsychological, and later on the intrapsychological plane. By the nature of mental functions, the social plane is linked to verbal thinking, that is, the interpersonal to intrapersonal dimension (Vygotsky, 2001). Specifically for evaluation, it is recurrent to use Vygotsky's (2001) ideas about the Zone of Proximal Development (ZPD), which refers to the difference between the actual level of development shown by the unassisted learner in relation to his or her performance and the potential level by adult guidance. The process of adults supporting the child at a higher level is known as scaffolding, that is, when the more advanced peer offers his or her support and gradually removes it when the learner reaches higher levels. In other terms, the adult reduces the child's dependence and the ZPD indicates the individual's learning potential and what he or she does independently of collaborators. Scaffolding is related to the teacher's development and support to help students master tools that enable them to judge, understand, discuss, and negotiate evaluation criteria about what they have produced in their work and to understand how they can achieve higher levels of learning. They are, therefore, processes of support and transfer from the teacher, who uses predetermined criteria and tools to teach students how to use them in learning evaluation and self-evaluation (Chetchuti & Cutajar, 2014).

The particularity of investigations that consider discursive interactions means analyzing the situations and experiences that give meaning to sign-mediated processes, transforming mental functions, which affects the learner's thinking about reality (Giordan, 2013). By this approach, we consider that if evaluation requires sign mediation processes to develop learners culturally at the social level, so that it inserts social forms of regulation for the interpretation of brain activity, conduct, and personality formation. The analysis of interactional patterns also allows us to understand language as a psychological tool and social semiotics in an environment with tools and signs. In this way, it is possible to interpret the genetic links between the relations of symbolic and material production and the social relations that are established in human activities (Giordan, 2013).

Not only does the production of evaluation occur daily at school, but also the signification of words by double mediation: semiotic (signs) and technical (instrumental) mediation. According to Vygotsky (2001), the word is a fundamental intellectual tool in cultural development, which is historical, social, and by concepts. Signification stems from the transformation from its indicative and normative function to the signified, which depends on social relations and thus interaction, which provide opportunities for the use of different signs externally and internally and for mental development (Giordan, 2013). The link between thought and language is increasingly refined in interactions with signs, symbols, and others, and this includes evaluation, which is fundamental in guiding students' cultural development. Therefore, evaluation is interactional by its very nature: being a public and collective activity that informs about education, is related to quality, and is guided by the social interests of schooling.

The meaning of evaluation produced in interaction is highlighted by Gipps (1994) based on three main arguments. As a first argument, the author points out new forms of evaluation that do not just consider the performance of an individual in a single one-off or "solo" task but of individuals as part of a group. According to the author, the process of evaluating and judging students' work or performance can be used to shape and improve their knowledge or understanding when they exchange ideas. A second argument from the author is the need for the use of another tool that plays a key role in evaluation: questioning, which

involves the use of questions in an interactive process of the students with the teacher. A third argument is to consider an interpretive approach, that is, that factors such as students' perceptions of how tests affect them, their confidence in the accuracy of the results, and their and teachers' perceptions of the goals of the evaluation may differ and need to be considered. According to Gipps (1994), to disregard interactions would be to disregard that the student-teacher relationship is traditionally hierarchical and that evaluation would merely be the surveillance of students. Taking into account interactions and how they interfere with the production of evaluation is to consider that the student has some ownership in the evaluation process and is therefore capable of self and peer evaluation, and that teachers also share power and control with the class with every questioning and opening they make for discussions of ideas (Gipps, 1994). Furthermore, interactions build and affect the relationships between teacher and students.

In putting it in these terms, one must remember the distinction between competence, the object of analysis of psychometricians, and performance, of interest to socioculturalists: competence refers to what a person can do in ideal circumstances, while performance refers to what he or she actually does in real circumstances. A student may not perform well in the classroom because of the influence of personal, emotional, or any other factors (Gipps, 1994), which may be different from what they would do in ideal situations. Considering performance requires the development of evaluations that unify cognitive, affective, and social dimensions by more interactive models in which a student is evaluated not only by artificial, individualized experiences, but by considering collaborative forms of cognition (Gipps, 1994). Performance evaluation aims to model learning activities in which students are engaged with others by skills and semiosis in which they seek to solve relevant problems rather than fragment them into multiple choice tests (Gipps, 1994). Thus, performances are produced in the classroom collectively, being situated (Smith, Teemant & Pinnegar, 2004) and multimodal, in which students are assisted by others to develop on intrapersonal, interpersonal and communal levels.

Smith, Teemant & Pinnegar (2004) advocate that evaluation from a sociocultural perspective is based on four principles: that knowledge is cultural understanding and competent participation, that teaching is a social phenomenon, that learning is assisted, and that performance is situated. Knowledge as cultural understanding includes language, symbols, tools, and meanings in students' participation to solve problems that affect a community (Smith *et al.*, 2004). Learning as internalization and stabilization of personal understandings and skills occurs in social activities, which requires the active elaboration of the individual in interactive processes to share meanings. Language and the other tools are responsible for mediation and structure the experiences for cultural development. Whereas multiple experiences relate meanings and serve as a paradigm for the participation of subjects in similar contexts (Smith *et al.*, 2004). To make all this possible, learning is assisted, that is, it includes goal-oriented activities that seek to support student performance in the process of meaning making and working. Teachers are best able to provide assistance within the learner's ZPD (Smith *et al.*, 2004). Thus, effective learning creates opportunities for knowledge to be guided by the teacher's interests and assistance for students to make generalizations to experiences, and teachers are best qualified to judge the quality of student performance by appropriate standards (Smith *et al.*, 2004).

RESEARCH PATHS AND METHODOLOGICAL PROCEDURES

To constitute the research corpus, we consulted the ProQuest ERIC and Web of Science virtual libraries, in addition to the CAPES Journals Portal and the ENPEC Annals. ProQuest ERIC and Web of Science are the primary means of access to digitized educational research information, and enable the training of researchers globally by including content, databases, academic journals, knowledge, and technologies. Likewise, the CAPES Journals Portal allows research on national and international scientific literature, and includes chapters, journals, theses, dissertations, and reference works to democratize access to information and develop graduate courses. In addition to these means of consultation, we considered the ENPEC Annals, an event organized every two years by the Brazilian Association for Research in Science Education, with digitized productions in the form of oral communication papers, which includes the disciplinary spheres of Physics, Biology, Chemistry and related areas, and is one of the country's main events on Science teaching. These four means of consulting scientific productions are justified by: (1) visibility and importance of research made available with rigor and scientific quality, (2) the unification of representative research production in national and international graduate programs, and (3) being the main means of access to digitized information on educational research.

For the selection of the national research, we employed the online query tool considering the following words and expressions, used simultaneously: (a) learning evaluation, (b) discursive interactions, and (c) science teaching. For each selected research, the title and abstract were read. The goal was to identify research that was related to evaluation in science teaching discursive interactions situations. In the

English language, we use the terms: (a) evaluation learning; (b) discursive interactions and (c) science teaching. The term "evaluation learning" was used for the selection specifically of texts that addressed the classroom, since many studies are focused on large-scale exams. In English, the term "evaluation learning" was used for the query instead of "assessment learning" due to the distinction between these terminologies, hidden in the Portuguese language. Broadfoot and Black (2004) clarify that the term "assessment" serves as a communication device to society or the media about public national school monitoring exams and reports, establishing publicly acceptable, legitimized, and generalizable quality benchmarks. In contrast, the term "evaluation" looks at evaluation shaped by specific educational conditions, by phenomena in social contexts, also produced by students and not only by teachers.

For the national research, texts were obtained from the ENPEC Annals (n = 21), and from the CAPES Journals Portal (n = 45) among oral communications from other events, articles, theses and dissertations. Articles were also selected (n = 29), covering the period from 2005 to 2019. The selected theses and dissertations (n = 9) cover the period from 2008 to 2018. The selected ENPEC papers span the period from 2003 to 2019, nine biennial editions of the event, and represent 2.3% of a total of 9,100 communications, panels, and oral sessions. It is noticeable that, throughout the editions of ENPEC, evaluation was among the least explored themes, being suppressed as a research line as of 2017. The selection also included other oral communications presented at other events (n = 7).

For international research, 22,158 studies were identified in ProQuest ERIC from 2001 to 2020 by simultaneous use of the three terminologies chosen in the online search tool. Subsequently, only the papers that were oriented by sociocultural theory were selected, which reduced the amount of research to 4,694. We then selected only those papers with the full text available on the ERIC platform and in the reviewed journals, reducing the sample to 592 research studies. For this last sampling, we read the titles and abstracts in order to make new clippings. Although the online keyword search was used, many studies referred to English language teaching, not science teaching, and the term "science teaching" was mentioned only among the references, not as part of the text.

The same procedures were performed in the Web of Science search portal. For this new sampling, we carried out a detailed reading of the texts to analyze their contents and promote new clippings by bibliometric criteria and parameters¹, namely: authorship, research institution, scientific journal, keywords, research trends, mapping of understandings, and relations of interest. By the bibliometric criteria, we carried out a documentary analysis of the pre-selected scientific production, creating a bibliometric evaluation system. Considering all these aspects, for the two international portals, 23 papers published from 1998 to 2017 were chosen that addressed the topic of the present research to relate science teaching, evaluation, and discursive interactions.

The publications were organized in NVivo 12[®] software into two projects, since they have different languages and require the use of different dictionaries. NVivo 12[®] is currently one of the leading categorical analysis software programs available for conducting qualitative research. Each text was identified according to the bibliographic reference and year of publication, and in alphabetical order, not chronological, although it could be done that way. Next, we interpreted the data by means of textual coding in NVivo 12[®] for the four categories elaborated from the triggering questions of this research (Table 1). Each textual segment was coded according to its corresponding category, generating reports of coded references that were later interpreted and grouped (Figure 1).

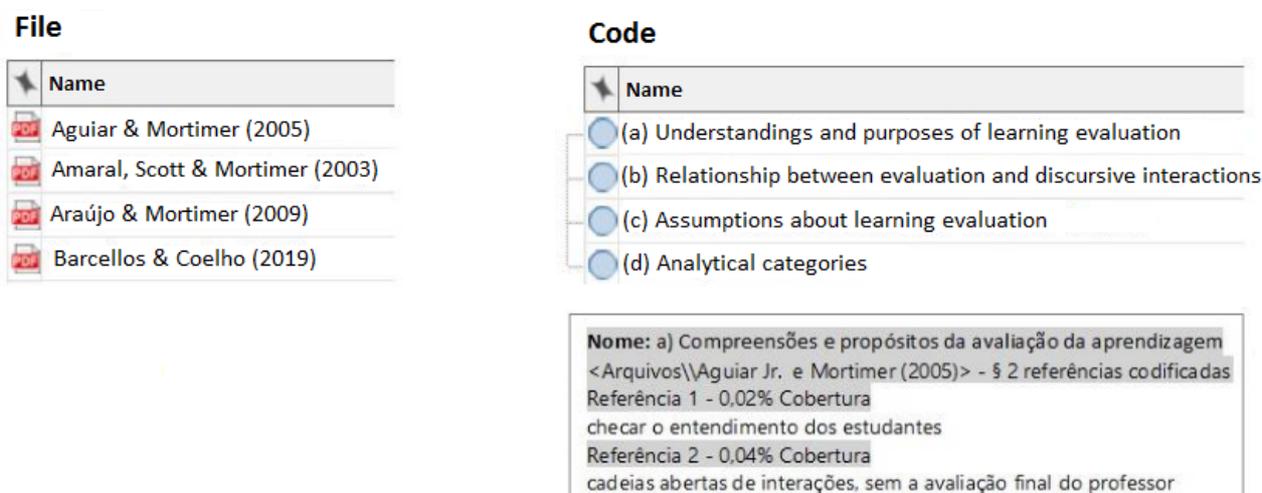
¹The successive reductions in the number of searches considered in this research (from 22,158 to 4,694, to 592 and, finally, to 23) result from the application of the following bibliometric criteria: a) translation and analysis of the text content; b) discussion in the text body of the evaluation linked to discursive interactions beyond the mention in the titles and abstracts; c) selection of research specific to science teaching; d) analysis of authorship, research institution, scientific journal, keywords, and research trends; e) mapping of understandings and relations of interest by document analysis of scientific production between 1998 and 2017; f) bibliographic counting and citation analysis; g) selection of recent texts with international relevance on the theme and use in the area of knowledge; h) presence of theoretical or empirical debate on evaluation in science teaching. Application of the bibliometric criteria and parameters indicates a considerable volume of international scientific production on evaluation linked to discursive interactions, but with a predominance of research publications on English language teaching, and to a lesser extent, on science teaching. Despite the apparent quantitative growth, the scientific production on evaluation in discursive interactions in science teaching internationally is still small.

Table 1 – Categories and descriptors.

| Categories | Descriptors |
|---|---|
| (a) Understandings and purposes of learning evaluation | Interpreting the motives, qualitative profile, and purposes of evaluation in discursive interactions in science teaching |
| (b) Relationship between evaluation and discursive interactions | Analysis of the bibliographical research linking evaluation and discursive interactions between teachers and students in science classrooms, whether through verbal or nonverbal language |
| (c) Assumptions about learning evaluation | Presentation of the assumptions that precede the production of the empirical data, by propositions and conjectures based on the bibliographical research, on previous studies, or analogies |
| (d) Analytical categories | Classification of data by similarities and differences in terms of meaning |

Source: The authors, 2022.

Figure 1 – Exemplification of manual coding of the Research Corpus in NVivo 12®.



Source: The authors, 2022.

For categories (a) and (c), not all research showed sufficient information for categorization. This is because in part of them, evaluation was approached in a peripheral way compared to the discussions about teaching, in these cases, considered as the main object of study. It should be remembered that, even with the increase in publications, in many cases evaluation does not represent the priorities of the researchers and is barely enunciated as a research problem. For category (d), part of the researches did not make explicit analytical categories, under the argument of conducting a "general" or "panoramic" discussion or analysis about the discursive interactions, or when they were bibliographical research. When the information was not identified, the research was not coded. In some cases, research was coded more than once for the same category due to complexity of the information presented. Through these methodological procedures, we highlight in the next sections the results for the categories considered.

RESULTS AND DISCUSSION

(a) Understandings and purposes of learning evaluation

1. National research

The understandings of evaluation should be observed as a way to analyze the theoretical foundations used by researchers, and that have a great influence on the planning and the evaluation practices of classroom teachers. It is equally relevant to interpret how researchers incorporate the educational, cultural, and social contingencies that permeate schools through the theoretical alignments and purposes for investigating evaluative situations.

Analyzing these aspects goes through the interpretation of what researchers are committed to do,

through understandings and motives about what is necessary to be developed in terms of knowledge about educational phenomena. The meanings and purposes for evaluating are not unique, but varied, due to the complexity, tensions, and situations that affect schools and Universities. Depending on how it is understood, evaluation can remain without substantial changes, which can cause tensions or keep entrenched what is seen as tradition (Vasconcellos, 2010).

By establishing what will be prioritized, evaluation is conformed in the classroom. Understandings and purposes guide action in the learning environment, aligning what is intended with what is practiced in curricular terms. Likewise, not only teachers in Elementary Education, but also the understandings and intentions of researchers regarding evaluation, should be observed.

In this sense, Table 2 summarizes the understandings and purposes of evaluation highlighted in the national literature. The understanding of evaluation as a necessary discussion for the support and analysis of the quality of the ideas expressed by the students about Science (15.1%) predominates, which presupposes that its production occurs, in part, in the discursive flow. In this view, students' ideas are used by the teacher as evidence of learning and analysis of the degree of adequacy or inadequacy of these collectively developed ideas in relation to school science.

Still in this discursive bias, other researches reiterate the understanding of evaluation as a linguistic structure (10.6%), which constitutes an interactional pattern subsequent to two others - opening and response - the former often being produced by the teacher and the latter by the students. From this point of view, the purpose of evaluation would be the finalization or synthesis of the ideas coming from a sequence of teaching in order for the teacher to obtain information about what the students were able to express and learn.

Another recurrent understanding in the studies is of evaluation through an epistemological bias, as the third epistemic practice (9.1%) to analyze the movements of knowledge production and communication by students. As Silva (2008), Sasseron & Duschl (2016), Maceno & Giordan (2017, 2019b) argue, evaluation, although less frequent than the other epistemic practices, plays an important role in the development of scientific knowledge because of the teacher's need to interpret students' explanations. In effect, the teacher needs to analyze the points of view of the class through explanatory models, and to do so, he or she must constantly evaluate the discursive interactions between the students, the teacher, and knowledge (Sasseron & Duschl, 2016).

Table 2 – National research findings for the category (a) Understandings and purposes of learning evaluation.

| National research | Understandings | Purposes | Frequency (%) |
|---|--|---|---------------|
| Franco & Munford (2015), Franco & Munford (2018), Freire & Motokane (2011), Maceno & Giordan (2017), Lobato & Quadros (2018), Sasseron (2018), Silva Júnior & Santos (2016), Souza & Marcondes (2013), Silveira (2016), Uhmman & Zanon (2016) | Discussion to support and analyze the quality of the ideas | Producing evidence for agreement or disagreement about what students argue and experience | 10 (15.1%) |
| Maceno & Giordan (2017), Maceno & Giordan (2019b), Sbardellati (2017), Sessa & Trivelato (2017), Silva (2008), Silva & Amaral (2017), Silva & Mortimer (2010) | Interactional pattern subsequent to initiation and response | Finalization or synthesis for information and evidence of learning | 7 (10.6%) |
| Araújo & Mortimer (2009), Camargo & Motokane (2018), Maceno & Giordan (2017), Sasseron (2018), Silva (2008), Silva (2015) | Epistemic practice | Validation of knowledge production and communication | 6 (9.1%) |
| Barros (2015), Bozelli & Nardi (2012), Dotta & Giordan (2008), Maceno & Giordan (2017), Sasseron (2018) | Formulation of questions | Formulation of feedbacks, reinforcements, and guidance on points of view | 5 (7.6%) |
| Franco & Munford (2018), Sasseron (2018), Valle & Motokane (2013) | Negotiating and engaging students through science-oriented questions | Production of answers to questions to formulate, communicate and justify explanations | 3 (4.5%) |
| Dotta & Giordan (2008), Maceno & Giordan (2019b), Sasseron (2018) | Guiding students in discursive interactions | Information during brainstorming to get around difficulties | 3 (4.5%) |
| Mendonça & Junior (2015), Maceno & Giordan (2017), Sasseron (2018) | Discursive participation through critical questions and comments | Research and development of social and scientific problems | 3 (4.5%) |
| Mendonça & Junior (2015), Sousa, Teixeira, Sales & Dias (2007), Zanon & Freitas (2005) | Teacher intervention | Conformation, selection, and sharing of meanings | 3 (4.5%) |

| National research | Understandings | Purposes | Frequency (%) |
|--|---|--|---------------|
| Barcellos & Coelho (2019), Lobato & Quadros (2018) | Educational improvement | Adapting the teaching of concepts | 2 (3.0%) |
| Aguiar & Mortimer (2005), Sousa <i>et. ai.</i> (2007) | Checking students' understanding through teaching strategies | Generation of feedback for further activities | 2 (3.0%) |
| Barcellos & Coelho (2019), Silveira & Munford (2020) | Cultural practice of analyzing explanations and justifications | Investigation of activities and data | 2 (3.0%) |
| Barros (2015), Silva & Francisco (2019) | Use of the students' point of view in a dialogic interactive way | Argumentation about the level of understanding | 2 (3.0%) |
| Franco & Munford (2015), Silva, Gerolin & Trivelato (2017) | Scientific affirmation, evidence, or model | Interpretation of the merits of scientific reasoning and explanation | 2 (3.0%) |
| Sasseron (2018), Valle & Motokane (2013) | Construction and presentation of propositions | Justification and legitimization of knowledge | 2 (3.0%) |
| Bouças & Junior (2015) | Investigative phase subsequent to engagement, exploration, explanation and elaboration of ideas | Expansion of conceptual understanding and skills | 1 (1.5%) |
| Bozelli & Nardi (2012) | Communicative strategy and structuring | Observation and integration of joint discursive activities | 1 (1.5%) |
| Camargo & Motokane (2018) | Exercising authority | Negotiating the use of more reliable data for school science | 1 (1.5%) |
| Starling-Bosco (2015) | Defining rules of participation and coexistence | Collective discussion for the growth of a social group | 1 (1.5%) |
| Uhmann & Zanon (2016) | Continuous monitoring | Knowledge construction | 1 (1.5%) |

Source: The authors, 2022.

In addition to these, there are studies that understand evaluation as formulating questions for feedback and reinforcement to inform and guide students about their points of view (7.6%). Questions are seen as a means of negotiation and student engagement, either scientifically oriented (4.5%) or discursively oriented (4.5%). The questions, besides encouraging student participation in discursive production (4.5%), are understood as devices to institute actions based on the expression and socialization of students' ideas through interactions. In these researches, the questions have the purpose of producing answers for the students to justify their explanations, to exchange ideas, or to investigate social-scientific problems.

Many of these understandings and purposes highlighted by national researchers are multifaceted and multifunctional, justified in light of the attention primarily to social, linguistic, and cultural dimensions in research on classroom events. The information points to the significant incorporation of other national and international studies that analyze interactional patterns, communicative approaches, epistemic practices, types of elicitations, and debates around social-scientific problems. The information points to the significant incorporation of other national and international studies that analyze interactional patterns, communicative approaches, epistemic practices, types of elicitations, and debates over socio-scientific problems.

2. International research

In international research, Table 3 highlights among the highest percentages that evaluation is understood as the daily social, cultural, and historical practice for the elaboration and use of students' scientific ideas, which rely on the support and interpretation of the teacher for the necessary re-elaborations (13.0%). In this day to day of the classroom, judgments, negotiations, and perceptions of formative experiences are made based on the goals, criteria, and levels of references to reconfigure and qualify the responses and meanings accepted or rejected in the relationships constituted between the teacher and the students (13.0%). Thus, there is a predominant understanding of evaluation as a responsive, situated, and multimodal practice for directing students' ideas and responses to shape their learning trajectories. These transformations and appropriations of socially constructed knowledge include the participation of the students, who must collectively engage in investigations about Science and transfer them to other environments (8.7%) for monitoring by the teacher during instruction (8.7%) and meaning the symbolic representations in multimodal interactions (8.7%).

Table 3 – International research findings for the category (a) Understandings and purposes of

learning evaluation.

| International research | Understandings | Purposes | Frequency (%) |
|---|---|---|---------------|
| Gómez & Jakobsson (2014), Gotwals & Birmingham (2016), Mapplebeck & Dunlop (2019) | Socially, culturally and historically responsive everyday practices about students' science ideas used to support everyone in learning, informing and modifying teaching and learning activities | Demonstration and interpretation of students' understandings, responses, and ideas that respond to instructional decisions and support the situated nature of learning | 3 (13.0%) |
| Cowie (2005), Mislevy (2006), Silseth & Gilje (2017) | Process, judgment, and social negotiation involving everyday classroom perceptions, experiences, and multimodal compositions of the quality of student responses to shape, improve, and confer meanings and significance about science, self, relationships with peers, teachers, and the environment to accept or reject what is compatible | Participation by standards and the formulation of goals and criteria to reach a reference level, to give students initiative and responsibility for their learning, to develop and reconfigure learning trajectories, and to negotiate the syllabus | 3 (13.0%) |
| Hickey & Zuiker (2002), Hickey & Zuiker (2005) | Collective student participation in the use, practice, and transformation of socially defined knowledge, scientific inquiry, and engagement | Adaptation and appropriation of the knowledge rituals by ritualized participation and transfer to subsequent environments | 2 (8.7%) |
| Izci <i>et al.</i> (2018), Shabani, Khatib & Ebadi (2010) | Task, situation, and process used by teachers in a classroom to collect data about students at any point during instruction | Monitoring and supporting learning and instruction | 2 (8.7%) |
| Anastopoulou, Sharpies & Baber (2011), Silseth & Gilje (2017) | Specifically meaningful and scientifically rich activity for narrative, manipulation, and symbolic representations | Representation, engagement and reflection through multimodal interactions | 2 (8.7%) |
| Candela (1999) | Interactional pattern subsequent to initiation and response | Production of turns of speech that agree or disagree with the previous ones | 1 (4.3%) |
| Bearman, Dawson, Benett, Hall, Molloy, Boud & Joughin (2016) | Individual, departmental and institutional tensions, values and strategies of a complex social nature structurally shaped by environmental, professional influences and by factors incorporated by the educators themselves in the process | Promoting student learning | 1 (4.3%) |
| Allen, Gregoy, Mikami, Lun, Hambre & Pianta (2013) | Emotional support through a global and standardized approach | Observation of qualities linked to student learning gains | 1 (4.3%) |
| Chetcuti & Cutajar (2014) | Everyday, collaborative practice of students, teachers, and colleagues seeking, reflecting on, and responding to information from dialogue, demonstration, and observation in ways that enhance continuous learning through a shared, socially constructed, context-dependent social experience that assumes active and evolving student involvement with a key role in the teaching and learning process | Certification for selection, information for accountability, support and promotion of student learning, process of finding and interpreting evidence for use by students and their teachers for adaptation to learning needs | 1 (4.3%) |
| Chin (2006), Milne, Scantlebury & Otieno (2006) | Feedback for student encouragement and response to emerging needs | Externalization of ideas, hypothesis generation and testing | 1 (4.3%) |
| Evans (2013) | Passive or open exchanges, within and outside the immediate learning context, along with conceptual structures, through a variety of sources, roles, foci, meanings, and functions | Improving access, retention, conclusion, and student satisfaction | 1 (4.3%) |
| Hang & Bell (2015) | Purposeful, situated, contextualized, and intentional meaning making activity developed by a society's cultural norms and an integral part of teaching and learning | Interpreting and using language to communicate meaning by the partnership between teacher and students about what they are thinking | 1 (4.3%) |
| Pryor & Crossouard (2008) | Social discursive practice that involves dialectical, and sometimes conflictive, processes for critical consideration and reflection on tasks and learning | Building understanding of future situations for the application of new knowledge | 1 (4.3%) |
| Mansour (2001) | Culture of performance control | Use of evaluation and teaching methods in science education | 1 (4.3%) |
| Mapplebeck & Dunlop (2019) | Meaning to the syllabuses | Policy implementation | 1 (4.3%) |
| Windschitl, Thompson, Braaten & Stroupe (2012) | Evidence-based system of learning activities and tools adapted to the needs of teaching and supporting the continuous progress of effective and equitable instruction | Student participation, patterns, and instructional movement by discourse-based norms and roles for specific paired interactions | 1 (4.3%) |

Source: The authors, 2022.

Other research reiterates the understanding of evaluation as a linguistic structure (4.3%) that

establishes the third movement from the interactional pattern to agreement or disagreement about students' discursive contributions. Also emphasized are the complex social tensions involved in promoting and evaluating student learning (4.3%), with emotional repercussions that must be observed when analyzing the quality of what they learn (4.3%), which can generate conflicts for the critical considerations and reflections made (4.3%).

Research was also noted that emphasizes the importance of dialogue for shared social experiences about the information used by students (4.3%), through exchanges that include conceptual structures, roles, functions, meanings (4.3%), dialectical processes (4.3%), norms and tools (4.3%) incorporated into the evaluation produced in specific interactions.

(b) Relationships between learning evaluation and discursive interactions

1. National research

The relationships between evaluation and discursive interactions in science teaching have been increasingly advocated in the national and international literature to serve a variety of functions and through the influence of other areas of knowledge. Interaction is recognized as a means of evaluation development, a concept diametrically opposite to the behaviorist view, which prioritizes in tests the measurement of students' responses to the teacher's stimuli, and which result in some reward or punishment. In part, this link of evaluation to interactions emerges from the need for planning based on social-scientific problems, which presupposes greater student participation, the valuing of discursive production for the public display of ideas, and the support of the more advanced peer in the elaboration of meanings.

Instead of studies separated from the phenomena of language and social environments, research guided by the sociocultural view advocates that evaluation be seen as a process of interpreting the ideas expressed by students when they interact and use various semiotic modes in activities. By analyzing the interactional dynamics in the classroom, teachers can qualify students' expressive capacity for the ideas evaluated when incorporated into new learning and meaning-making processes.

From the analysis of the national research, we identified three relationships highlighted by the researchers: (a) the functions of evaluation in interactions, which can be single or multiple; (b) the interactional structuring, and (c) the communicative approaches in evaluative contexts.

Regarding function, Aguiar & Mortimer (2005), Mortimer, Massicane & Tiberghien (2005), Sepúlveda (2009), Nascimento & Amaral (2012), Silva Júnior & Santos (2017), Sbardellati (2017), Lorencini Júnior & Sbardellati (2020) point out that evaluation is seen as one of the interactional patterns identified in the classroom. According to the researchers, evaluation occurs only after the teacher's initiation, usually in the form of a question, which may prompt one or more answers from the students. For these researches, discursive sequences can occur in two ways: with or without the presence of evaluation. When students produce answers that are evaluated, the discursive sequences are closed. In such cases, a subcategory can occur when sequences are extended by the presence of intermediate feedbacks. The second possibility is the open-ended sequences, in which there is no final teacher evaluation, usually due to the absence of contributions from several students. These researches consider that the evaluation is developed in only one type of discursive sequence, the closed one, and that it has only one function in the discourse: the finalization or summarization of the diversified answers of the students to the teacher's questions.

Differently, for other authors, evaluation does not have a single function in discourse, but is seen as multifaceted and multifunctional, depending on the context of production. According to Maceno and Giordan (2017), certain epistemic movements, which belong to the interactional categorical unit of evaluation, can have various functions, such as confirmation, reorientation, correction, appreciation, or summarization of what has been said by students. Evaluation can also have the function of repeating, rephrasing questions, justifying, or interpreting the quality of what is said about a socio-scientific problematization. There are other possibilities of functions also linked to the continuity of interaction by structures generated by authoritative or dialogic discourses, or even, when evaluation is withheld, that is, when the teacher ignores or is silent in the presence of students' responses for an educational purpose (Maceno & Giordan, 2017, 2019) and by implicit judgments about what they say. In the same view, Silva (2008), Fortini (2012), Melo, Teixeira, Martins and Santos (2017) and Pereira da Silva (2015) recall that more recently, evaluation can have the function of instigating the student to extend the answer, to expose his or her ideas or connect with the ideas of other classmates. Fortini (2012) and Melo *et al.* (2017) add that evaluation can have the function of partly repeating students' ideas or providing feedback for them to move forward.

About the interactional structuring of evaluation, Amaral *et al.* (2003), Silva *et al.* (2017) link this

pattern to contexts in which scientific explanations and generalizations need to be constructed to engage students in learning science. Explanations are necessary due to teachers' concern with inserting students into scientific culture (Barcellos & Coelho, 2019), and therefore, the importance of evaluating the ongoing production of ideas. In this same view, Bouças & Junior (2015) complement that it is through this interactional pattern that the teacher can conform the students' ideas and direct them towards the appropriation of scientific knowledge. According to Capecchi & Carvalho (2019), in addition to the evaluation driving the discussion by a predominantly elicitive discursive pattern, it encourages the exchange of ideas and the elaboration of collective explanations for the formation of a view of Science. According to Bezerra & Amaral (2017), the evaluated discourse is reconstructed by demarcating students' appropriations of that discourse. Starling-Bosco (2015), Francisco & Silva (2019) stress that only evaluation develops epistemic criteria of knowledge, which depends on analysis of the discursive flow. Ribeiro (2008), Bozelli & Nardi (2012), Camargo & Motokane (2018) claim that assessment ensures an interactional structure not only for the teacher to seek information, but to also control the content under discussion and to direct thoughts and actions through discourse. These are, therefore, researches that stress evaluation as an interactional pattern that enables the structuring of discourse and the continuity of interactions that encourage student contributions.

Another noticeable relationship in national research is about the communicative approach in which the evaluation is produced. According to Barros (2015), interactive dialogic approaches, although fundamental to giving students feedback on their ideas, do not produce an assessment capable of finalizing a discourse sequence. The author generalizes that only authoritative approaches generate interactive patterns capable of producing an evaluation. In both cases, the teacher's mediation is done in a way that does not readily anticipate the answer to the students, in order to listen to everyone in the discussion about what they think to answer (Barros, 2015). The author states that both dialogic as well as authority interactive approaches are necessary, with the former allowing for diversified responses, while the latter, induces students toward the correct response according to the situation under discussion (Barros, 2015).

In another view, Paixão & Silva (2017) consider that although the dialogic interactive approach is more common, authority interactive approaches are less frequent in classroom evaluation. The authors generalize that students' discursive production is not supported by the discourse of authority to the extent that they improve their ideas and expose their views. According to the authors, when several evaluative feedbacks from the teacher appear, the discourse of authority is presumed, because there is an analysis of what the students say, even if the teacher does not specify what. Zanon & Freitas (2005) argue that any evaluation contains dialogic and authority phases, which can be combined to generate the four classes of communicative approach proposed by Mortimer & Scott (2002).

These researches exemplify that, depending on the context, evaluation can be generated by only one or up to four types of communicative approaches. Still, national researchers differ on which communicative approaches are more frequent in the classroom, whether any of them are more conducive to evaluation or whether they should be combined, which are more conducive to learning or are more accepted by students.

2. International research

By interpretation of the international literature, the researchers' discussions are centered on four relationships: (a) dependence on context, (b) social role of evaluation; (c) the interactional structure and (d) cooperation.

The dependence on context evaluation is the relationship most stressed by international researchers in terms of discursive interactions. According to Bearman *et al.* (2016), thinking about the context of interactions allows one to understand the local circumstances that influence the production of evaluation. Gotwals and Birmingham (2016) argue that context not only makes explicit what influences, but how evaluation is produced in the instructional and interpretive course over ideas in the classroom. According to Hang and Bell (2015), the context of evaluation explains how meanings are shared and culturally situated, and how evaluative practices take on meaning through mental processes and action. Hickey & Zuiker (2002) point out that evaluation depends on the production context in terms of its quality, which may or may not have the participation of everyone in learning. According to Mansour (2001), sociocultural contexts shape evaluative experiences and transform these practices. Silseth & Gilje (2017) stress that contexts indicate how subjects act when evaluating through the use of available cultural tools, which serve to engage students in specific activities and guide them in interactive and dynamic ways. Thus, evaluation, as a continuous activity in which meanings are negotiated, depends on contexts to understand how it is conformed, produced, signified, qualified, and influenced in classroom actions.

The social role of evaluation related to discursive interactions is admitted by Candela (1999), Chetcuti & Cutajar (2014), Cowie (2005), Gómez & Jakobsson (2014), Pryor & Crossouard (2008). According to these researchers, interactions incorporate roles, conflicts, power struggles, negotiations, and discursive control of the speakers. Since evaluative contexts can be symmetrical or asymmetrical, the interventions and roles students play in evaluations can vary depending on whether what they express is altered individually or collectively (Candela, 1999). These interventions show the dependence of social role evaluation on ongoing interactions.

In the same view, Chetcuti & Cutajar (2014) warn that evaluation has several social facets, and can be reciprocal or not, depending on the imbricated levels, values, and qualities. Cowie (2005) emphasizes that evaluation shapes identity and what it means to be a teacher and a student, and is marked by more or less social participation, with consequences for science learning over time. In the same vein, Gómez & Jakobsson (2014) stress that identifying the social roles occupied by teachers and students during interactions involves alternating verbal and nonverbal behaviors, so that evaluation is socially and culturally acquired. Pryor & Crossouard (2008) argue that evaluation brings into play issues of power between students and teachers in institutional discourses regarding what knowledge is considered legitimate about school science.

Like the national research, the international research also underscores the interactional structure of evaluation. Chin (2006) considers that evaluation creates a structure so that incorrect information can be replaced by the correct information. It is through it that the teacher analyzes the meanings explored by interactional structures to judge the merit of students' knowledge and production in the activities. Because there is no single possibility for interactional structure, the teacher can engage students around ideas and thoughts in a variety of ways, so that evaluation can be reflective, muted, critical, corrective, affirmative, negative, complementary, challenging, or neutral. In the same view, Windschitl *et al.* (2012) argue that evaluation includes structures for directing students in terms of scientific thinking, information, and ideas.

Other researchers relate evaluation to interactions marked by cooperation. Izci *et al.* (2018) point out that in order to evaluate, the teacher must have the cooperative help of others to elicit, support, and revise the knowledge of the disciplinary content. Similarly, Shabani *et al.* (2010) consider that in the interaction there must be collaboration of the students to identify what is or is not appropriate and so that the teacher can intervene while evaluating.

(c) Assumptions about learning evaluation

1. National research

When analyzing national research, a common assumption is to consider that meaning making occurs first on the social plane of the classroom, at an interpsychological level, and then on an internal plane, at an intrapsychological level, in line with Vygotsky (2001). Because of the importance of the social plane in cultural development, interactions take on importance in the evaluative appreciation of scientific ideas, even though information produced orally and by other semioses is often ignored as ways of evaluating. In addition to this, we identified five assumptions about evaluation, linked to knowledge, meaning, questions, argumentation, and teaching.

According to the first assumption, Araújo & Mortimer (2009), Silva *et al.* (2017) consider that evaluation is a specific form of legitimization of knowledge among members of a community concerning a disciplinary sphere. For Starling-Bosco (2015), the process of knowledge appropriation stems not only from conceptual or procedural understanding, but from the criteria that sustain legitimate knowledge about Science. Starling-Bosco (2015) propose that evaluation is an integral part of spoken discourse, whose face-to-face interaction conveys evaluative actions by verbal and nonverbal indicators, by socially constructed meanings and understandings internalized by contexts of a materially mediated activity.

Regarding the second assumption, according to Maceno & Giordan (2017, 2019b), evaluation delineates educational priorities by its inseparable relationship to the elaboration of meanings. Complementing this, Maceno and Giordan (2017, 2019b) assume that evaluation is produced in interactions because they ensure action to the extent that the teacher intervenes in meanings, whether with greater or lesser student participation.

Regarding the third assumption, Maganha, Lopes, Versuti-Stoque & Santos (2017) propose that the variety in the teacher's questioning when evaluating expands the possibilities for the construction of scientific knowledge. Sbardellati (2017) assume that interactional patterns that include questions are most often used with evaluative intent. According to Silva and Francisco (2019), the question allows the teacher to evaluate

the students' point of view for agreement or disagreement on the explored subject.

Regarding the fourth assumption, Sasseron (2018) considers that argumentation can be included in evaluation, this being fundamental in understanding scientific language as one of the three epistemic practices. Sasseron & Duschl (2016) assert that in order to understand the Sciences and the production of knowledge, rules and practices must be enhanced by constant evaluation, and argumentation is a means of incorporating rules and processes of critical analysis that substantiate the public criteria that support the judgment that is being made. Likewise, Silva *et al.* (2018) assume that evaluation incorporates rules and forms of control, with argumentation being an alternative for discursive dynamics with greater student contribution.

Regarding the last assumption, Silva & Amaral (2017) state that evaluation analyzes the quality of teaching strategies and interactions, in addition to the attainment of goals with the teaching of science. According to Uhmman & Zanon (2016), evaluation is an investigative practice by the teacher to intervene in the results, being a starting point for new activities and new directions for teaching.

2. International research

In looking at international research, we identify three assumptions underlined by researchers, associated with: the functions, the nature, and the evaluative context.

As observed in part of the national research, the international research considers that evaluation serves several functions in interactions. According to Chetcuti & Cutajar (2014), evaluation has the function of highlighting the student as the focal point in a shared practice community. Izci *et al.* (2018) considers that evaluation has two functions: to capture and to aid learning. Pryor & Crossouard (2008) also propose two functions of evaluation: to answer about the student's work and to judge what good learning is. Researchers Mansour (2001), Mapplebeck and Dunlop (2019) argue that evaluation has three functions: to motivate students, to analyze how teachers teach with a view to learning, and to indicate on a daily basis what is scientifically acceptable. According to Milne *et al.* (2006) and Mislevy (2006), evaluation has a dual function: criticism and argumentation about theoretical development.

Regarding the second assumption, Silseth & Gilje (2017) consider that evaluation is enacted and negotiated in school by a multimodal composition and mediation by cultural tools. Bearman *et al.* (2016) stresses the complex and critical nature of evaluation for student progression in learning environments. In the same vein, Hickey and Zuiker (2005) point out as an assumption that evaluation has a conventional nature, characterized by a participating community. Mercer (2004) also proposes that communicative events are shaped by cultural and historical factors, so that learning and development cannot be understood without taking into account the intrinsically social and communicative nature of evaluation in human life.

Even though the three assumptions are related, the third one is the most emphasized among international researchers. In the view of Allen *et al.* (2013), the quality of teacher-student interactions depends on a solid understanding of the nature of the teaching, content, and emotional relationships that take place in evaluative contexts. According to Cowie (2005), Chin (2006), Gómez & Jakobsson (2014), Hang and Bell (2015), knowledge is constructed in a context permeated by language and other semiotic media, which first occurs on an interpsychological plane and then on an intrapsychological plane. Therefore, students' responses and reactions to the teacher's questions create a specific evaluative context that involves mental processes, marked by social relations, through authentic teaching situations. When they interact, negotiation processes, norms, values, culture, and agency in everyday activities also shape evaluative contexts.

(d) Analytical categories

1. National research

Observing the categories used in the researches allows us to understand the meanings attributed by the researchers about a certain educational event based on the theoretical contribution used, classifying them in terms of methodological similarities and differences. Equally relevant, it is possible to identify the studies most used by others, and to identify those that are most influential in a particular area of knowledge.

Table 4 summarizes the main categories identified in national literature, as well as the researchers who originated them. It also highlights the frequency and percentage of searches that used a certain category. For this classification, part of the studies use more than one, generating categorical combinations to constitute new analytical frameworks. In other studies, only part of other researchers' categories were

used. There were also cases where the categories were emergent or not explicitly mentioned.

Table 4 – Results of national research for category (d) Analytical categories.

| National research | Categories used | Author(s) of the category(ies) | Frequency (%) |
|--|--|--|---------------|
| Aguiar & Mortimer (2005), Amaral, Scott & Mortimer (2003), Barros (2015), Starling-Bosco (2015), Cavalcanti Neto & Amaral (2017), Figueiredo & Sepulveda (2018). Fortini (2012), Francisco & Silva (2019), Lobato & Quadros (2018), Lorencini Júnior & Sbardellati (2020), Mafra, Karnopp & Belluco (2017), Mortimer & Scott (2002), Paixão & Silva (2017), Pereira da Silva (2015), Sbardellati (2017), Sepulveda (2009), Silva (2008), Vilela-Ribeiro & Benite (2009). Zanon & Freitas (2005), Zanon & Freitas (2007), Valle & Motokane (2013), Souza, Amauro, Gouveia & Fernandes-Sobrinho (2017), Sousa <i>et al.</i> (2007), Silva & Francisco (2019), Silva & Amaral (2017), Ribeiro (2008), Nascimento & Amaral (2012), Mortimer <i>et al.</i> (2005), Mendonça & Júnior (2015) | Interactional patterns | Mortimer & Scott (2002) | 30 (45.4%) |
| Aguiar & Mortimer (2005), Amaral <i>et al.</i> (2003), Barros (2015). Bezerra & Amaral (2017). Carvalho & Giordan (2017), Cavalcanti Neto & Amaral (2017), Figueiredo & Sepulveda (2018), Fortini (2012), Francisco & Silva (2019), Lobato & Quadros (2018), Lorencini Júnior & Sbardellati (2020), Maceno & Giordan (2017), Mafra <i>et al.</i> (2017), Mortimer & Scott (2002), Pereira da Silva (2015), Sbardellati (2017), Sepúlveda (2009), Silva (2008), Silva (2015), Silva & Amaral (2017), Silva & Mortimer (2017), Vilela-Ribeiro & Benite (2009), Zanon & Freitas (2005). Zanon & Freitas (2007), Vilela-Ribeiro & Benite (2009), Valle & Motokane (2013), Souza <i>et al.</i> (2017), Sousa <i>et al.</i> (2007), Silva & Francisco (2019) | Communicative approaches | | 29 (43.9%) |
| Barros (2015), Cavalcanti Neto & Amaral (2017), Figueiredo & Sepulveda (2018), Fortini (2012). Francisco & Silva (2019), Lobato & Quadros (2018), Lorencini Júnior & Sbardellati (2020), Maceno & Giordan (2019b), Mafra <i>et al.</i> (2017), Mortimer & Scott (2002), Pereira da Silva (2015), Sbardellati (2017), Sepúlveda (2009), Silva (2008), Silva (2015), Silva & Mortimer (2010), Zanon & Freitas (2005). Zanon & Freitas (2007), Valle & Motokane (2013), Souza <i>et al.</i> (2017), Sousa <i>et al.</i> (2007). Silva & Francisco (2019) | Teacher's intentions and interventions and discourse content | | 22 (33.3%) |
| Carvalho & Giordan (2017), Silva & Amaral (2017), Silva & Mortimer (2010), Silva Júnior & Santos (2016), Silva, Souza & Santos (2018), Silveira (2016), Sousa <i>et al.</i> (2007), Sousa <i>et al.</i> (2017), Melo <i>et al.</i> (2017) | Interactional pattern IRA | Mehan (1979) | 9 (13.6%) |
| Lobato & Quadros (2018). Maceno & Giordan (2017), Silva, Souza & Santos (2018) | Types of elicitations | | 3 (4.5%) |
| Starling-Bosco (2015), Franco & Munford (2015), Franco & Munford (2017), Franco & Munford (2018), Silveira (2016) | Argumentation | Van Eemeren, Grootendorst & Henkemans (2002) | 5 (7.6%) |
| Starling-Bosco (2015), Franco & Munford (2015), Franco & Munford (2018) Silveira (2016), Silveira & Munford (2020) | Discourse analysis | Bloome, Carter, Christian, Otto & Shuart-Fris (2008) | 5 (7.6%) |
| Camargo & Motokane (2018), Silva <i>et al.</i> (2017), Sasseron & Duschl (2016), Silva (2008) | Epistemic practices | Kelly (2005) | 4 (6.1%) |
| Araújo & Mortimer (2009), Silva (2008), Silva (2015) | Epistemic practices | Jiménez-Aleixandre, Mortimer, Silva & Diaz (2008) | 3 (4.5%) |
| Santos <i>et al.</i> (2014), Silva, Souza & Santos (2018), Silva Júnior & Santos (2016) | Pedagogic discourse | Bernstein (2001) | 3 (4.5%) |
| Duarte & Rezende (2008). Sepulveda <i>et al.</i> (2011), Silva Netto, Cavalcanti & Ostermann (2017) | Thematic pattern | Lemke (1997) | 3 (4.5%) |
| Bozelli & Nardi (2012). Carvalho & Giordan (2017), Silva & Mortimer (2010) | Interactional pattern IRF | Sinclair & Coulthard (1975) | 3 (4.5%) |
| Maceno & Giordan (2017). Silva (2008) | Epistemic movements | Lidar, Lundqvist & Ostmann (2005) | 2 (3.0%) |
| Barcellos & Coelho (2019), Sasseron & Duschl (2016) | Types of engagement | Engle & Conant (2002) | 2 (3.0%) |
| Souza & Marcondes (2013) | Cognitive and verbal dimension | Souza & Marcondes (2013) | 1 (1.5%) |
| Starling-Bosco (2015) | Classroom discourse and argumentation | Jiménez-Aleixandre & Bustamante (2003) | 1 (1.5%) |

| National research | Categories used | Author(s) of the category(ies) | Frequency (%) |
|--|---|--------------------------------|---------------|
| Bezerra & Amaral (2017) | Discursive activity | Martin & White (2005) | 1 (1.5%) |
| Dias & Sessa (2017) | Content analysis | Bardin (2011) | 1 (1.5%) |
| Versuti-Stoque, Freire & Motokane (2013) | Prediction, observation and explanation | Erduran (2006) | 1 (1.5%) |
| Versuti-Stoque <i>et al.</i> (2013) | Functional interpretation | Versuti-Stoque (2011) | 1 (1.5%) |
| Maganha <i>et al.</i> (2017) | Types of questions | Machado & Sasseron (2012) | 1 (1.5%) |
| Bozelli & Nardi (2012) | Discourse analysis | Edwards & Mercer (1988) | 1 (1.5%) |
| Dotta & Giordan (2008) | Dialogism and polyphony | Bakhtin (1978) | 1 (1.5%) |
| Sasseron (2018) | Didactic, pedagogical practices, student actions, schematic diagram | Sasseron (2018) | 1 (1.5%) |
| Sessa & Trivelato (2017) | Gestures | Kendon (2004) | 1 (1.5%) |
| Mendonça & Júnior (2015) | Gestures | Pimentel & McNeill (2013) | 1 (1.5%) |
| Uhmann & Zanon (2016) | Triadic modules | Zanon (2003) | 1 (1.5%) |
| Silveira & Munford (2020) | Practices from conceptual, epistemic, and social domains | Duschl (2008) | 1 (1.5%) |

Source: The authors, 2022.

The most widely used categories in science teaching to address evaluation in discursive interactions were proposed by Mortimer & Scott (2002), Mehan (1979), van Eemeren *et al.* (2002), Bloome *et al.* (2008), Kelly (2005), Mortimer *et al.* (2007). There is a predominance of classroom research on interactional patterns, communicative approaches, teacher intentions and interventions, discourse content, argumentation, discourse analysis, epistemic practices, and types of elicitations, albeit by different authors. In smaller percentages, other studies focus on the categories linked to pedagogical discourse, the thematic pattern, types of student engagement, cognitive and verbal dimensions, and gestures.

In general, research prioritizes the analysis of evaluation in terms of verbal language, even though other semiotic modes are identified as complementary to evaluative production in discourse. It is also noticeable that much of the research prioritizes categories by national authors, even with a variety of international studies that make up the analytical frameworks. Analysis of the four categories indicates an openness in national research to the integration of discursive interactions as part of the concept of evaluation. Research cites interactions as a means of producing evaluation, whether for meaning making, the interpretation of scientific ideas, the exercise of authority, and social norms and rules.

The researches presents various aspects detailed in their investigations, some more focused on how evaluation in discursive interactions assists in the formation of identities (Dotta & Giordan, 2008; Maceno & Giordan, 2019b), in the analysis of student performance (Zanon & Freitas, 2007; Giordan, 2013; Lorencini Júnior & Sbardellati, 2020), as epistemic practice (Sasseron & Duschl, 2016; Silva *et al.*, 2017; Maceno & Giordan, 2017), or how it benefits from argumentation (Sasseron & Duschl, 2016), through scientific engagement, through technologies (Giordan, 2013) or through multimodality (Mendonça & Júnior, 2015; Sessa & Trivelato, 2017). Other studies are focused on planning and cultural development through the relationship between evaluation and syllabus (Silva *et al.*, 2017; Franco & Munford, 2017; Uhmann, 2017), and on how it affects social relations among speakers (Giordan, 2013; Bezerra & Amaral, 2017). The intensification of interactions as an investigative horizon of evaluation indicates new understandings about it by virtue of conceptual preferences in scientific production.

2. International research

Table 5 shows the categories most commonly used to address evaluation in discursive interactions in the national literature for teaching science. The use of thematic analysis prevails, even if from varied researchers (Strauss & Corbin, 1990; Braun & Clarke, 2006; Gotwals & Birmingham, 2016). Some of the researchers explain the methodologies and theories that gave rise to their analyses without emphasizing

analytical categories, as is the case of Mansour (2001), Mercer (2004), Cowie (2005), Milne *et al.* (2006).

Table 5 – Results of international research for category (d) Analytical categories.

| International research | Categories, methodologies and theories used | Author(s) of the category(ies) | Frequency (%) |
|---|---|--|---------------|
| Bearman <i>et al.</i> (2016), Gotwals & Birmingham (2016) | Thematic analysis of open coding | Strauss & Corbin (1990) | 2 (8.7%) |
| Evans (2013), Silseth & Gilje (2017) | Thematic analysis | Braun & Clarke (2006) | 2 (8.7%) |
| Allen <i>et al.</i> (2013) | Classroom learning evaluation scoring system (emotional support, class organization, instructional support, student achievement, teacher, student, and classroom characteristics) | Pianta, Belsky, Vandergrift, Houts & Morrison (2008) | 1 (4.3%) |
| Gotwals & Birmingham (2016) | Thematic analysis (teacher positioning/interaction patterns with students; eliciting, interpreting and responding; timing) | Gotwals & Birmingham (2016) | 1 (4.3%) |
| Chetcuti & Cutajar (2014) | Preparation, implementation and evaluation, modeling, scaffolding and engagement | Falchikov (2003) | 1 (4.3%) |
| Gómez & Jakobsson (2014) | Interactional pattern IRF | Mehan (1979) | 1 (4.3%) |
| Chin (2006) | Interactional pattern IRE | Wells (1993) | 1 (4.3%) |
| Cowie (2005) | Interpretive research methodology | Erickson (1998) | 1 (4.3%) |
| Hang & Bell (2015) | Cultural factors | Hang (2011) | 1 (4.3%) |
| Hickey and Zuiker (2005) | GenScope secondary genetics syllabus (modeling and simulation) | Horwitz & Christie (2000) | 1 (4.3%) |
| Izci <i>et al.</i> (2018) | Five principles of evaluation | Siegel (2007) | 1 (4.3%) |
| Mapplebeck & Dunlop (2019) | Understanding feedback, conceptualizations of convergent and divergent feedback, purpose, feedback practices, teaching experiences | Tunstall & Gipps (1996) | 1 (4.3%) |
| Mislevy (2006) | Argument structure | Toulmin (1958) | 1 (4.3%) |
| Anastopoulou <i>et al.</i> (2011) | Multimodal interaction | Papert (1980) | 1 (4.3%) |
| Candeia (1999) | Discourse analysis | Edwards & Potter (1992) | 1 (4.3%) |
| Pryor & Crossouard (2009) | Convergent and divergent evaluation | Torrance & Pryor (1998) | 1 (4.3%) |
| Mansour (2001) | Multi-founded theory | Ezzy (2002) | 1 (4.3%) |
| Mercer (2004) | Systematic observation | Mercer (1994) | 1 (4.3%) |
| Milne <i>et al.</i> (2006) | Hermeneutic phenomenology | Ricoeur (1981) | 1 (4.3%) |

Source: The authors, 2022.

Also noted is research on the interactional patterns proposed by Mehan (1979) and Wells (1993), Toulmin's (1958) argument structure, Edwards & Potter's (1992) discourse analysis, and Hang's (2011) sixteen cultural factors. Other analytical frameworks are also used to evaluate through scoring, modeling and simulation tools (Horwitz & Christie, 2000; Pianta *et al.*, 2008). Other studies analyze categories on feedback by Tunstall & Gipps (1996), the principles and stages of evaluation by Falchikov (2003) and Siegel (2007), Papert's (1980) multimodal interaction by categories, discourse analysis based on Edwards and Potter (1992), and the convergent and divergent evaluation proposed by Torrance & Pryor (1998).

Broadly speaking, the research presents a variety of sources and categories that support the interpretation of evaluation in interactions. As observed for the national ones, verbal language is prioritized, even though they incorporate other semiotic modes. International researchers consider works from other fields of knowledge in the composition of their analytical frameworks. Due to the frequent use of interviews as a complement to the analysis of teaching episodes, the preference for thematic analysis is observed for the open coding of the research corpus, in addition to the proposition of emergent categories. Not only the interactional patterns and multimodality are investigated, but also the curricular, cultural and argumentative characteristics of the evaluation thus produced.

Approximations and distances between researches

Analysis of the four categories indicates the incorporation of discursive interactions as part of the concept of evaluation and the investigative horizon in research guided by the sociocultural and ethnographic perspective, both in national and international literature. Research considers interactions as a means of producing evaluation, whether for the elaboration of meanings, the interpretation of scientific ideas, the exercise of authority, as well as the analysis of social norms and conventions, even though not every interaction includes the evaluation of learning, or that evaluation is limited to discursive interactions.

One can see how evaluation is related to a plurality of understandings and purposes, being guided by various assumptions and analytical categories. It is noticeable that, among national researchers, there is greater consensus for categories (a) and (d) than for (b) and (c), that is, greater convergence between the understandings, purposes, and analytical categories used than for the evaluation relationships and interactions, and for the guiding assumptions of this research. In contrast, among international researchers, there is more agreement for categories (b) and (c) than for (a) and (d), that is, greater convergence among them in dealing with evaluation relations and interactions, and the guiding assumptions of this research, and greater divergence in the understandings, purposes, and analytical categories used.

In general, national research exhibits a predominantly discursive and epistemic interpretive stance on evaluation, identified by the analysis of discussions, interactional structure, knowledge construction, and the movements and acts subsequent to questions asked by the teacher for the purpose of producing evidence of learning. One must emphasize the multifunctionality that evaluation can assume in teaching situations, even though some researches advocate the existence of a single function. Even if the assumptions are aligned with the sociocultural perspective, they also exhibit a variety of approaches. The assumptions reiterate the importance of the social plane and tools for cultural development, which would justify investigating the production of evaluation through interactions. Among the analytical categories, interactional patterns and communicative approaches are often adopted, with other, preferably national studies being included for the categorical composition, even though part of them also considers a variety of interactional references.

International research, on the other hand, adopts a predominantly functional, thematic, and contextual interpretation of evaluation, which is understood as an investigative means of thematic analysis when incorporated into discourse production. In these researches, data production is central, in order to aid the teacher's guidance and student support, through actions, activities, and movements whose purposes are to shape meaning making and to understand how evaluation is produced everyday by social, historical, and cultural marks. In international research, evaluation plays a central role in everyday classroom life to analyze the use of students' scientific ideas, which should be shaped by the teacher's support and interpretation of learning for the necessary reworkings, considering mainly the notions of Zone of Proximal Development (ZPD) and scaffolding (Vygotsky, 2001). It is necessary to recognize that the multiplicity of functions of evaluation is recognized by most researchers, in order to also observe how it contributes to students' scientific engagement and symbolic representations in multimodal interactions. The assumptions reaffirm the importance of the multifunctionality of evaluation, in addition to its social nature for multimodal composition and mediation using cultural tools. Among the analytical categories, thematic analysis is often used in international research, which preferentially chooses to identify emerging themes linked to evaluation by participants through videos and interviews in courses, in the classroom, or through continuous education.

When we analyze the characteristics of research on the production of learning evaluation in discursive interactions in science teaching, based on the sociocultural perspective, it is observable that for national research, there is greater convergence in the understandings and purposes considered than for international research. The use of material and symbolic tools, mediation, the elaboration of meaning, the appreciation of the social plane, and cultural development are notions emphasized in both types of research, through the influence of Vygotsky's (2001) studies. Additionally, the use of the notion of ZPD and scaffolding is prevalent in international literature, and is rarely emphasized at the national level. The same goes for the notion of feedback, which is central in much of the international research, forming part of the analytical categories used, while it is less mentioned in national literature.

For the national literature, the understanding of evaluation as discursive production is predominant. However, in the international literature, not only is the discursive flow considered as part of the conceptualization of assessment, but also how it collaborates, directs, supports, adapts and shapes meaning making, that is, what unfoldings it presents in terms of learning and meaning.

Another observable aspect is that while for the national literature there is disagreement about multifunctionality and which communicative approach (Mortimer & Scott, 2002) is most suitable to create an appropriate evaluative context in the classroom; in the international literature, there is greater concern about how the evaluative context is produced and which social roles are played by teachers and students, with the multifunctionality of evaluation being a consensus. Furthermore, for international research, there is a greater concern to recognize that there are various evaluative structures that are discursively produced and dependent on social and linguistic organization, and on the circumstances in which they were generated (Sinclair & Coulthard, 1975), and not just on the type of communicative approach used or the content of the discourse.

It is also notable that while for national literature, the assumptions of evaluation are centered on knowledge and meaning making, for international literature, they are centered on functions and their nature. Whereas the national analytical categories are mainly centered on the identification of interactional patterns and the communicative approach, while for the international literature, thematic analysis predominates, with a lower incidence of research on interactional patterns.

In general, the literature, both national and international, recognizes discursive interactions as a means of developing evaluation by covering themes, contents, ideas, meanings, and knowledge about science. For these studies, evaluation, besides being structured by teaching planning, is also produced by the scientific ideas embodied by ordinary activities in the use of language. Through these classroom activities, the teacher can value the students' contributions to the discourse and promote the public display of scientific ideas, which allows redirecting them in the meaning-making process. It is accepted that discourse emerges from the social space of the classroom, in which the teacher and students compose interactional structures that configure and signify ideas about school science, which become the object of evaluation. From this approach, the evaluation is not only an activity of verification or exploration of students' ideas, but it is distributed in the processes of re-elaborations of scientific ideas, and expansion by the support of the more advanced peer in diversified activities, and not only in tests, exams or quizzes. The semiotic and activity variation help to a great extent in the production of learning evaluation, more than that, it is essential to create opportunities for students to express their ideas about physical phenomena for the production of evidence and inferences from the teacher about what they understand about science and at the same time, aid the teaching action to lead them in the development and expansion of meanings.

In the classroom, interaction between the teacher and the students may or may not occur. What differentiates a discursive interaction that has an evaluative purpose from others is that in this case it aims not only to instruct, ask, answer, order, direct or verify, but also to include decision making through value judgments, evaluative appraisal about the quality of what is said or how the student acts using scientific ideas. Consequently, evaluation is instituted in discursive interactions through teacher inferences about learning, teacher action through judgment about the quality of ideas, and new activities that support the student in the process of internalizing concepts.

Discursive interaction is therefore a means of developing evaluation. As a result, thinking about evaluation in this way poses dilemmas for teachers, ranging from planning to types of interactions, accepted practices, cultural aspects, division of labor, supporting student identity development and interactional skills. Evaluation is not always understandable and familiar to the student depending on the degree of collaboration and the interactional patterns used, which can make evaluation easier or more difficult, especially when there are rare opportunities for them to express their ideas.

Considering the various possibilities, Table 6 shows a synthesis of the main relationships inferred from the studies analyzed. By including interactions as a significant part in the evaluative constitution, the teacher broadens his or her understandings, valuing the conditioning and unfolding of the discursive flow in meaning making and science education beyond written tests focused only on the frequency of students' right and wrong answers.

To complement this, Table 7 highlights aspects of sociocultural perspectives on learning evaluation, identified by the research corpus.

Table 6 – Summarizing studies on evaluation in discursive interactions in science teaching.

| | | |
|---------------------------------------|-------------------|---|
| Evaluation in discursive interactions | concerns | oral analysis, teaching, observation, contextualization, negotiation, signification, specification, dynamization, production |
| | serves to | engage, clarify, manage, contribute, act, respond, change, qualify, transform, conform |
| | explore | quality, observation, quantity, measurement, specification, criticism, organization, identification, criteria, characterization, and domain |
| | is conditioned by | practices, situations, outcomes, rituals, identities, rules, values, tools, people, globality, episodes, social conditions |
| | it occurs | between teacher-school, teacher-students, community, between students, students and tools, teachers and tools |
| | it occurs through | interpretations, questioning, review, discourses, dynamics, responses, action, instruction, narrative, and discussion |
| | it aims at | meaning making, teacher assistance through scaffolding, performance analysis, and learning |

Source: The authors, 2022.

Table 7 – Evaluation of learning in studies from the sociocultural perspective on science teaching.

| Aspect | Sociocultural perspective |
|-------------------|---|
| Distribution | At any point in time and space in daily classroom practice |
| Contextualization | By discursive interaction, through material and symbolic tools and people, valuing the learning processes and products |
| Interests | Demonstration and evidence of what has been learned; evidence and observations of student performance over time, subjectivity, diversity, and the experiences developed in varied activities that explore different skills and semiosis |
| Production | In multifunctional and multimodal activities |
| Information | Real events in the student's context |
| Involvement | Varied responses through meaning making and performance in tasks that address real-life situations |
| Culture | Multicultural and dynamic approach as a sociocultural activity |
| Use | Through practices that allow exploration of diverse aspects and disciplinary spheres of socio-scientific problems and contexts that result in solutions and social action in a classroom community for collaboration and support systems, focusing on the potential for learning and higher levels of learning; through questions for the production of answers, the elaboration of meaning and argumentation by encouraging the expression of ideas by the student |
| Concerns | Elaboration of meanings and tensions generated by evaluation in students |
| Values | Openness to creativity and originality |
| Language | Interpretation of verbal and nonverbal language in use |
| Criteria | Explicit and negotiated |
| Division of labor | Between teacher and student that encourages collaboration between them in teaching and engagement for science education and values discursive interactions |

Source: The authors, 2022.

In place of the limitations arising from the point instruments used to evaluate science education in psychometric perspectives, we conclude that studies guided by the sociocultural view advocate for the daily analysis of what is expressed, argued, and produced by students in interactive activities, which can raise inferences and appreciation of the students' work. Evaluation as a teacher support activity is produced and contextualized by interaction, by values that have social unfoldings, by thinking about scientific phenomena, feedback about learning, culture, and the creation of linguistic structures in action.

CONCLUDING REMARKS

From the research propositions, we emphasize evaluation as a fundamental activity for the necessary articulation between language and thought in science learning, through understandings, assumptions, and analyses focused on linguistic, situational, and epistemic dimensions, which can contribute to the composition of new theoretical and analytical frameworks in the national and international scientific production in science teaching. The understandings of evaluation as discussion, as the analysis of collectively produced scientific ideas, and as movement subsequent to the questions reiterate the need for dialogic discourses and the mediating role of the teacher and tools to investigate, guide, assist, and accompany students. At the same time, these understandings also advocate for the fundamental communicative function that discourses of authority offer, that is, whereby the teacher must explicitly agree or disagree with students, select which information is reliable, and judge and attribute merit to the scientific explanations they enunciate in observance of school science.

In addition to the discursive and epistemic link, there is this relationship established between evaluation and knowledge within discursive interactions, which significantly breaks with the view of evaluation only as measurement, as testing and verification of memorized information, of its supposed exemption from the contexts of production and of the focus, above all, only on the conceptual dimension, a perspective harshly criticized by Maceno (2020), Broietti *et al.* (2013), Quadros (2014), Gómez and Jakobsson (2014). Gradually, social and cultural issues are also being considered at the microstructure level of the classroom, incorporating what is said and done by teachers and students as a concern of researchers, and not only by analysis at the macrostructure level of education systems or by written national examination results. These data support Gipps' (1999) affirmations about production being both a social and individual process of evaluation, which becomes discursively dynamic and influenced by cultural values and value judgments, the social skills of producing and using knowledge in action, and in performance on cognitive tasks inseparable from these values and social relations for problem solving according to the cultural setting.

For the observed theoretical and analytical alignments, the importance of the discourses, of the conventions, of the social and linguistic organization of the evaluative production through a variety of dynamics and situations, by oral, gestural, graphic or other practices is well known, even though there are nuances among the authors about the conceptual perspective of evaluation and how it takes shape in the classroom in the contexts of its production. However, in part of the national research, although the understandings of evaluation incorporate attention to knowledge, learning, and student information and, above all, to the conceptual and meaning-making dimensions, they emphasize, to a lesser extent, the procedural and attitudinal dimensions, with implications for these understandings.

Many problems indicated in the analyzed researches concern the fact that they give priority to teaching rather than to evaluation itself, and in many cases it is treated as a peripheral or complementary activity both in the classroom and for the investigative course. These are aspects that have also been found by Gipps (1999) and Crossouard (2009) on the social and cultural influences on evaluation investigated in science teaching. Through the research issues, the value of interaction is identified in interpreting students' points of view and ideas, negotiating and participating in activities, establishing classroom norms, and self-evaluation, as advocated by Gipps (1999) as a way of understanding the relationships between evaluation, syllabus, and teaching.

Analyzing the characteristics of the research in terms of assumptions, understandings, and priority aspects indicates the relevance that evaluation takes on in the permanent monitoring of the teacher in order to shape the learning and scientific education processes. In recent decades, there has been a recurring argument that not only does the production of information about discursive interactions contribute to understanding the characteristics of science teaching, but also how to incorporate evaluation as a daily practice of interpretation, redirection, and support for meaning making. It is also imperative not only to investigate how evaluation is structured in the classroom, but also how teachers and students constitute the spaces of production and communication of knowledge, and how it is developed by actions that assume evaluative purposes.

As we could conclude, the meanings and purposes of evaluation are multiple, and depending on how it is understood, it can cause tensions and conflicts in the classroom, difficulties in proposing new syllabuses, or even cause teaching and learning problems to remain. Since evaluation in discursive interactions shapes the dynamics in the classroom, the action in the teaching environment may or may not be aligned to what is intended and practiced by teachers regarding the syllabus. In the same way, the understandings and intentions of researchers regarding learning evaluation, its foundations and precepts should be analyzed considering its possible implications for Basic Education, always in a specific sociocultural and historically situated context.

Furthermore, through this study, we identified convergences and divergences between national and international research, which indicates varied interpretations, fundamentals, and assumptions. The results indicate needs in terms of deepening the perspectives and understandings about evaluation, so that the findings relate to the theoretical contribution, the delimitation of research issues, the types of analysis, and primary sources of data on the production of evaluation in science teaching. We cannot ignore that such research, by virtue of how it is appropriated, has social and formative implications for science teachers and how they can understand students' cultural development. In this sense, based on this study, it is possible to design programs and research that investigate the evaluation arising from the interaction considering the formative needs of school institutions and new understandings about it. For science teaching, the results obtained in the research raise reflections on the conceptions of evaluation considered by teachers, in order to consider it more and more as a daily practice of discourse production in which the production of meanings should be analyzed beyond instruments focused on the written semiosis and the student's ability to retain information, but in classroom dynamics whose meanings articulate scientific thinking and language.

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Received: 03.07.2021

Accepted: 06.12.2021