Investigating Discursive Interactions in Science Lessons: "contextual lenses" on Research in Science Education

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We present a critical discussion about context as a theoretical-methodological construct in research that investigates discursive interactions during science lessons. Based on the notion that context is historical, multiple and interactive, we understand that research can focus on different levels of context. We used a wide range of papers about elementary school, selecting eight examples considered illustrative to ground our discussion. Developing "contextual lenses" we characterize the diverse ways to consider context, from the more local level (instructional and classroom), to a broader level (institutional, community, social and cultural). We point the potential of a more descriptive focus in science education research to emphasize contexts that go beyond the instructional.

Key words: context; classroom discourse; research in science education.

Introduction

Our aim in this paper is to present a critical essay investigating "context" as a theoretical-methodological construct on research considering discursive interactions in the science education field. In recent decades, a range of researchers from human sciences have used notions of context, developing analyses that seek to go beyond their objects of study in isolation and to make connections with contextual dimensions in which these objects are embedded (Bloome et al., 2008; Goodwin, & Duranti, 1992).

In science education, it is also considered relevant to take contextual elements into account. A central concern in this sense is the development of contextualized teaching (see the discussion of Bennett, Lubben, & Hogarth, 2007). Authors like Lemke (2001) and Gilbert (2014) argue that, if science is an endeavor related to diverse contexts, then science teaching should reflect these relationships. Contextualized teaching would be an alternative to overcome fragmented notions of knowledge present in traditional teaching approaches, as well as it has the potential to raise students' interest because of connections with contexts that are familiar to learners (Gilbert, 2014).

In this regard, we have observed initiatives that encourage approaches to science teaching that establishes connections with contexts in which students are situated, for example, context-based science teaching programs (Ramsden, 1997; Gilbert, 2014) and the conceptual profile program (Mortimer, Scott, Amaral, & El-Hani, 2014). In these cases, the focus is on thinking about the emphasis of context as directly contributing to the improvement of science teaching in schools.

However, the discussion of our paper goes in another direction. Our focus is not on discussing context as a teaching strategy but rather as a theoretical-methodological construct in science education research, specifically in studies that investigate discursive interactions in the classroom. There is wide interest in studying classroom discursive in this field (Lin, Lin, & Tsai, 2014). Moreover, the relevance of relationships between these interactions and contexts in which they take place has been acknowledged (Lemke, 2001). We understand that contextual dimensions should receive great attention in these investigations, given that, what takes place in the science classroom is only possible because

> we all grow up and live within larger-scale social organizations, or institutions: family, school, church, community center, research lab, university, corporation, and (depending on your particular theory) perhaps also city, state, global economy, and even a potentially globe-spanning Internet chatroom or listserv group. Our lives within these institutions and their associated communities give us tools for making sense of and to those around us: languages, pictorial conventions, belief systems, value systems, and specialized discourses and practices (Lemke, 2001, p. 296).

Ignoring these contexts that inform human life when analyzing how students and teachers interact in the classroom means neglecting fundamental aspects of our understanding of how they negotiate, share and construct knowledge in science lessons (Kelly, 2005). In this sense, Lemke (2001) indicates that science education research has sought to use theoretical-methodological contributions from the human sciences to recognize the role of contextual elements in science teaching and learning.

Despite this recognition, science education as well as other fields of the human sciences, sometimes have experienced difficulties in emphasizing contextual elements of phenomena under study. A challenge that persists is to overcome historical influences that "ways of doing science" in natural sciences have in certain fields in human sciences (Milsher, 1979). The argument in favor of "context-free" investigations is considerably prevalent, that is, researchers often believe that to explain a phenomenon it is essential to minimize connections with local contextual dimensions, if one wants to generalize results.

Moreover, we indicate other challenging situations for the advancement of science education research, for instance, confusions about meanings of *context* and *setting*, as well as relationships between context and research results. Many researchers from science education, when addressing context in their studies, mention characteristics like physical space of the classroom and the participants. Some of them – in particular, international scholars – also describe demographic characteristics of participants, like gender, race and class (e.g., Manz, & Renga, 2017; Monteira & Jiménez-Aleixandre, 2015; Naylor et al., 2007; Oliveira et al., 2012; Ryu & Sandoval, 2012; Upadhyay, 2009).

However, these aspects of the classroom setting end up having a secondary role in analyses, like a background or scenario. Although authors take into consideration certain contextual elements, there are limitations in how these elements influence results and/or

in how they contribute to their interpretations. Therefore, it is important that research can reflect the complexity of notions of context, going beyond simply the setting in which the research takes place. With this goal in mind, we turned to contributions from Language Studies (Bloome et al., 2008; Blommaert, 2015; Erickson, 2008).

In the field of Language it is already a consensus that one must consider the context in which discursive interactions take place (see Goodwin, & Duranti, 1992; Rex et al., 1998). There are different ways to understand the construct "context", but it is widely acknowledged that analysis of discursive interactions involves a "fundamental juxtaposition of two entities: (1) a focal event; and (2) a field of action in which the event is embedded" (Goodwin, & Duranti, 1992, p. 3). However, there is still tension around methodological questions regarding the use of context in this field.

These tensions – and the discussions that emerge – can contribute to science education to the extent that they generate a deeper debate that helps us to critically reflect *if* and *how* science education has made use of "context". For example, Goodwin and Duranti, (1992) discuss the diverse ways how different traditions in Language Studies understood context. Similarly, we can ask ourselves how we, as science education researchers, understand this construct and how our definitions are connected with some theoretical-methodological traditions. Warriner and Anderson (2016), in their turn, ask what are methodological implications of different definitions of context. This can lead us to reflect on how science education uses distinct methodologies to analyze discursive interactions and what are implications for relationships with context. Erickson (2008, discusses what aspects should gain greater visibility when considering context: to use more local or more global aspects of the interactions? Similarly, we could ask ourselves about to what extent science education researchers generate methodological perspectives that emphasize immediate context of interactions or broader patterns, as we seek to explain what happens in science classrooms. Blommaert (2015) presents an interesting discussion about how relationships between discourse and context can be richer than a mere unidirectional juxtaposition. In other words, he addresses the issue of how to consider different factors that structure in a multidimensional way people's discursive interactions. We wonder if there is science education research that takes such articulations into consideration and how discursive interactions are analyzed in this research field analyzed.

In this paper we are specifically interested in understanding how science education research that focus on discursive interactions gives greater or lesser visibility to different contexts present in science classrooms.

Extending prior discussions (Munford, Souto, & Coutinho, 2014), we propose "contextual lenses" to help us think about what has been valued in this research and what are its implications for the field. We intend to answer the following question: what different levels of context are emphasized in research that investigates discursive interactions in science lessons at elementary school?

Our methodological approach involved, initially, a discussion around how context

has been conceived as construct in Language Studies. We present a broad view of different definitions and uses of "context" in this field, and select one of them to develop what we call "contextual lenses" in terms of research from science education area. We rely on work form David Bloome and Judith Green (1982) about context. These authors argue that what takes place in classrooms is situated in broader context(s) and as researchers analyze interactions in this space, they make context visible in different ways, depending on their research goal(s) and on their analytical methodologies. These considerations are important because we can understand how science education research, through its different methodologies, emphasizes context in its analyses.

Bloome and Green (1982) propose a conception of context as having *multiple levels*. In this proposal, the researcher can take into account **different levels of context**: from the more local elements of interactions (e.g., features of the classroom, the orientations that the teacher uses to teach and the activities developed in a sequence of lessons) to more global aspects (e.g., education policies that guide the school and community in which the school is situated, culture, gender relations, social class, race and religious aspects). Based on this framework, we analyzed research papers published in Brazilian and international journal, and we selected cases that illustrate different levels of context emphasized in these studies to discuss our analyses.

Context in Language studies

Context has different meanings coming from diverse fields, like Sociology, Philosophy and Psychology. The seminal text by Goodwin and Duranti (1992) presents an overview of how these different conceptions influenced Language Studies, indicating the complexity of this construct and the impossibility of establishing a precise definition. Based on this discussion and on dialogue with more recent contributions (Bloome et al., 2008, Erickson, 2008, Warriner, & Anderson, 2016), we intend to make visible aspects that were valued in different traditions presenting context as: *action, situation, social interaction* and *power*.

Context as action refers to those studies that understand language as a form of action in the world. In Malinowski, one of the precursors of this notion of context, language is understood as **practical action**, that is, it goes beyond an abstraction and it would be an "indispensable element in the coordination of human action" (Malinowski, 1923, p. 316). In Philosophy of Language, we find indications that they share a meaning to language that is close to that Malinowski proposed, with roots in contributions from Wittgenstein.

In this case, the discussion is situated in different positions of philosophers of language in the mid-20th century about how to approach context. These studies are aligned, predominately, with two perspectives. The first one, under the influence of the Vienna Circle, constructed an understanding of language based on a rigorous formal program of analysis, valuing abstract systems that would reflect the reality of nature, as a universal entity, independent of context. The second derives from proposals

of Wittgenstein (1958) and Austin (1962), considering language as something that is accomplished in *action* and is organized based on the context in which it is employed (Goodwin, & Duranti, 1992).

The notion of context as situation originated in the concept of **situational context** coined by Malinowski. In his work "*The Problem of Meaning in Primitive Languages*", he makes a fundamental distinction: instead of dealing with dead languages", focusing on statements' structure, as ethnographers from his time did, he considered that research requires an understanding of language only through directly observing situations in which participants use it in interactions.

These two notions of context – *action* and *situation* – are not mutually exclusive, with each perspective emphasizing in a more certain aspects of linguistic analysis. These had a strong influence, especially for scholars interested in understanding language in face to face interactions (e. g. Goffman, 1967; Gumperz, 1982; Sacks, Schegloff, & Jefferson, 1974).

As we consider perspectives that see context as **social interaction,** we call attention to frameworks in which tensions between "individual" and "social" are at the core of the notion of context. We particularly highlight discussions of the Soviet traditions. Soviet research, originated from 1917 Revolution, generated two complementary and separate traditions that sought to relate language and context. The schools of Bakhtin and Vygotsky are rooted in assumptions of Marx's dialectical materialism, and they offer, each one in their own field of interest, fundamental contributions to linguistics, possessing some interesting approximations like a contraposition to 'individualizing' visions of language (Goodwin, & Duranti, 1992).

Bakhtin (1988) opposes to the thought of Saussure and of philologists who studied language as an immutable system and consequently, considering it as a product of individual consciousness, thereby neglecting context. At the same time, Vygotsky (2007) opposes to the perspective that the development of language is a process controlled by individual organic maturation and that does not acknowledge the social nature this process. Thus, the contextual content of language, in these traditions, resides in the articulation between the linguistic and the social.

Finally, a school of thought that has strongly influenced research in Language takes **power relations** as a starting point to understand "context". Foucault is the main scholar responsible for consistent and original contributions in this direction (Goodwin, & Duranti, 1992). For him, unconscious social conditions, rules, and practices govern what people do with their bodies, how they communicate, how they feel desire or fear and, essentially, how discourse permeates all these realities of human life (see Foucault, 1986). Based on Foucault's conception of discourse, Pêcheux constructs certain presuppositions considered central that help us to understand a conception of context from the perspective of power relations. Considering that discourse is related to the historical-social context in which it is produced, Pêcheux (1990) uses the notion of *Conditions of Production*. He calls attention to close relationships between discourse and

ideology that reflect how power relations are constructed in a society of classes.

Warriner and Anderson (2016) indicated that these discussions contributed in a significant manner to subsequent understandings of discourse relationships with elements of context. Habermas, (1984) for example, argues that in everyday life, communicative situations do not adhere to an egalitarian model. Power inequalities between interlocutors is the rule, resulting in asymmetry in society. Gee (1990), address language and power relations, referring to Discourse – with an upper case 'D' – to emphasize that people's everyday life discourse – with lower case d – is under influence of the Discourse of macro-social institutions. In this same direction, Critical Discourse Analysis offers relevant contributions about how *discourses* can constitute practices of reproduction or resistance of *Discourses* (Fairclough, 1992).

We consider that these four forms of perceiving context – *action, situation, social interaction* and *power* – despite their specificities, can be related to the same movement of researchers who sought, in different epochs and due to distinct debates, to valorize what Goodwin and Duranti (1992) called "the field of action in which the object of study is embedded" (p. 3).

To think how to value this "field of action" is a source of tension (Warriner, & Anderson, 2016). One of the emerging discussions refers to relationships between what happens in micro contexts of linguistic analysis (i.e., interactions between people); and in macro contexts in which people are situated (i.e., social institutional agendas, public policies, socioeconomic factors and cultural aspects etc.) (Bloome et al., 2008). It has been an arduous task for scholars of Language to think about these micro and macro levels, also called local and global (Erickson, 2008; Street, 2003)

A way of establishing these relationships is to understand what happens at the micro level as if it was embedded in the macro level. The emphasis in this case would be on how the macro processes influence local interactions (Bloome et al., 2008). As Erickson (2008) points out, the critique of this *top-down* approach is that the macro-context would be overestimated, which would lead to the ignore what is happening at the local level, generating distorted notions about how people construct practices of social change.

A second way to establish relationships would be to emphasize discourse analysis at the micro level and incorporate elements of discursive processes at the macro level in these analyses (Bloome et al., 2008). However, the main criticism of a *bottom-up* model is that it can concentrate "so intimately on specific characteristics of talk itself, that it ignores global aspects of the ecology of conversation" (Erickson, 2008, p. 108)

These ways of relating macro and micro contexts help us to understand, initially, how Language studies have given visibility to these elements. However, Bloome and colleagues (2008) indicate that these perspectives are insufficient to take into account the complex relationships between different levels of context. As presented in Figure 1, these authors share the assumption that contexts are considered

Historical (relating both to past and future events) multiple (including potential contradictions and contested contexts), at multiple levels, and as interactive (contexts affect each other) (Bloome et al., 2008, p. 37).
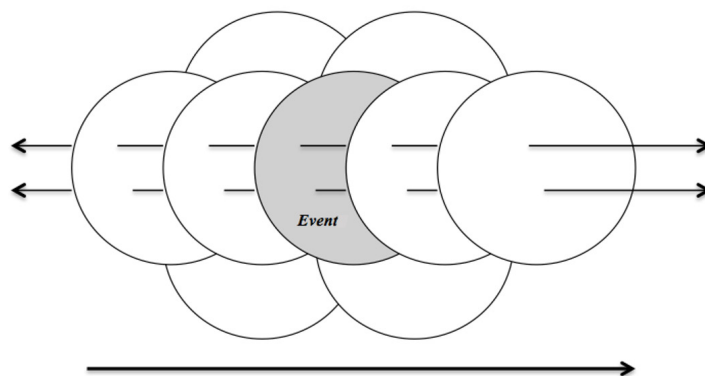

Figure 1. Representation of overlapping between multiple contexts proposed by Bloome et al. (2008, p. 38)

This conception of context(s) includes more elements than a mere unidirectional juxtaposition present in the top-down and bottom-up models. To say that contexts are historical, for example, means that moments people experience in the past have influence on what is happening in the present. Moreover, it is through interactions that people construct, reconstruct and figure new worlds by which they "move themselves into the future through time and space" (Bloome et al., 2008, p. 78).

To conceive contexts as multiple and as situated at multiple levels, means that contexts are created and negotiated at the level of a local event – *represented by the temporally connected spheres on the first plane of Figure 1*. Furthermore, it implies that they should be investigated considering their relationships with other events both within and outside the situation under analysis, in a way that contexts are connected to

State, other dominant social institutions, social and cultural ideologies including ideologies about language, race, gender, competition, individualism and what counts as knowledge within these social institutions (Bloome et al., 2008, p. 29) – *represented by larger spheres in second plane of Figure 1*.

Finally, considering contexts as *interactive,* that is, as affecting each other, is related to two fundamental aspects: i) the notion of being historical and of mutually influencing each other in time and space – that was discussed above; and ii) the perception that there are relations between local events and macro-contextual factors. These relationships can generate a diversity of situational consequences, for example: the difficulty of people to act in a situation, which generates local constructions of meaning based on the reproduction of elements from the macro level; the active stance of people in the circumstances in which they find themselves, transforming, adapting, resisting and avoiding macro level elements in their day-to-day lives; and, in some cases, explicitly undermining these elements (Bloome et al., 2008).

In summary, based on these discussions, it is possible to state that to take into account context(s) in our research involves emphasizing how every local event in a classroom has temporal relations with other events and with macro-contextual factors, like social institutions and power relations that permeate events.

The conceptions of context that we discussed offer a conceptual framework that underlines the theoretical methodological diversity with which Language Studies have constructed their analyses. Additionally, this diversity reflects the complexity of phenomena studied in Human and Social Sciences, in their interface with multiple spatial and temporal dimensions (Blommaert, 2015).

Specifically in the analyses that we propose in this paper, we share this notion of contexts from as historical and as multiple, that they occur at multiple levels and they are interactive (Bloome et al. 2008). Thus, we consider context as a complex set of intertwined aspects that a social group constructs in everyday life. This notion combine different perspectives from the field of Language, given that it includes both conceptions of context as situation and as action in the analysis of interactions at a local level, as well as notions of context as social interaction and power relations, giving visibility to broader dimensions.

Thus, Bloome and Green´s (1982) discussions were relevant for identifying different contexts and to propose "contextual lenses" regarding the papers that we analyzed. As we argue, these authors propose that *different levels of context in the classroom*, from more local to broader, emerge in different ways, depending on the manner in which researchers "look" at interactions in science lessons. Therefore, their theoretical-methodological decisions emphasize the role of certain levels of context, some more than others, depending on what are research goals.

Methodological Procedures

This study involved the analysis of a set of papers published in Brazilian and international journals. However, it is not a report on *state of the art* research because it does not adopt an "inventory and descriptive stance [on the analysis of] academic and scientific production" regarding the theme that we intend to discuss (Ferreira, 2002, p. 258). We use a wide range of papers as a data source. The review resulted from the following phases: i) initially, we searched for international and Brazilian research papers ii) we organized general information about papers; iii) we read the papers; iv) we elaborated extended abstracts following a format that included more detailed information than conventional abstracts.

The search involving international research papers was conducted in the ERIC data bank[1] (Education Resources Information Center). The Brazilian papers, in their

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[1] This data base from the Institute of Education Sciences of the Ministry of Education of the United States, created in 1964, has ample recognition from the international scientific community from the education area and presenting clear and integrated criteria for the selection of material. It provides an extensive bibliographical data base, around 1.5 million archives, available in a platform with search tools for use by educators, researchers and the general public. Accessed at: https://eric.ed.gov/

turn, were collected based on a search for publications in the last 12 years in the four main Brazilian science education journals[2]. We used the following key-words: *elementary school, early years, science education, discourse* and *discursive interactions*. We selected papers that addressed elementary school and that investigated discursive interactions.

We obtained a set of 56 international papers and 55 Brazilian papers that investigate discursive interactions in the classroom in elementary school. In a second phase, preliminary data was entered into tables with the following information: title of article, authors, year of publication, journal, abstract, nature of the study (empirical or theoretical), thematic area of the science education field (Physics, Chemistry, Biology, Sciences or other) and the observations of the reader.

Subsequently, we read 34 international and 22 national papers. As a third step, after reading the 56 papers, we elaborated extended abstracts in the format of table for each article. The construction of abstracts used categories similar to those typically used in the review studies as indicated by Pinhão and Martins (2009): academic context of the study (e.g., theoretical-methodological approach), aims, information regarding the participants and the instructional context, information regarding the research design and methods, main results, conclusions and educational implications.

All the studies were developed with classes from elementary school. However, it was not our goal to focus on specificities of this level of formal education in this paper. We address the understanding of context that oriented these studies to "research lenses" more sensitive to context. Therefore, we use research on elementary school as an example to discuss our proposal. The results that we present regarding the selection of papers and their subsequent analysis only refer to the studies of the early years and it is not our intention to generalize these findings. However, our intention is that this "contextual lenses" can be adopted to be useful for any study interested in investigating discursive interactions in sciences classes, independent of level.

Then, we identified what level(s) of context (in accordance with Bloome and Green, 1982) that were focused on in each study. Our assumption is that in science classrooms, there is a diversity of contexts that overlap, and researchers can give greater of lesser visibility to one or another contextual level.

In our initial review of literature, we made a first attempt to categorize the papers into the different levels of context Bloome and Green (1982) proposed. Therefore, we added to the extended abstracts a column with observations regarding the different levels of context that were more emphasized in each study. However, this approach proved unfruitful as analyses progressed. First, often, due to the complexity of studies, they would not fit neatly in a single category. Some studies focused on one context level more than others. In other cases, they presented aspects of the same context level with greater details than others. Second, this categorization with a more quantitative potential resulted in blurring particularities of each study. This made it difficult to develop a more consistent discussion about how context was constructed.

2 *Ciência & Educação, Investigações em Ensino de Ciências, Ensaio Pesquisa em Educação em Ciências e Revista Brasileira de Pesquisa em Educação em Ciências.*

Thus, instead presenting results of analyses based on the frequencies of each type of context identified in the 56 papers, we chose to present analyses with a smaller number of studies. We argue that an in-depth analysis of how the context 'appears' in each study would contribute more to the field of science education, considering that researchers could learn more about the process of constructing context when conducting and when reporting an investigation. The criteria for selecting papers was that of including the greatest *diversity* of forms of constructing context, depending on how researchers gave more or less emphasis to certain contexts during their investigations. This criterion is commonly used to select participants in qualitative research (Creswell, 2007). Therefore, we do not intend to provide information on quantitative representativity of ways of focusing on levels of contexts. We are aware that certain levels of, contexts are emphasized in most papers, whereas others are rarely explored. What we did was to identify the levels of contexts emphasized in the 56 papers and, then, we choose one example to illustrate how each different context level was constructed. This resulted in a set of 8 papers, used in our discussion regarding how to construct "contextual lenses" when considering studies of discursive interaction.

Context Levels in analyses of discursive interactions at elementary school

Bloome and Green (1992) presented a way of analyzing studies of reading practices in classroom that can orient readers in identifying different levels of context that researchers emphasized in their methodologies and analyses. These levels are characterized based on their relationships with more local elements – that is, elements that focus on what specifically happens in the classroom space (i.e., like context at the instructional, structural, thematic and intrapersonal levels) – as well as based on more global elements (or non-local) – that is, elements that go beyond classroom walls (i.e., context at an institutional, community, social and cultural level).

Instructional Context

A first level of context Bloome and Green (1982) discussed is the *instructional context level*. These authors illustrated this level of context based on a study that investigated approaches to better promote student learning, analyzing the discourse of 11 different teachers during the same narrative reading task.

The results suggest that, given that all the teachers used similar interaction patterns, the variation in how children shared information from the narrative could not be associated with these patterns in themselves, but rather with the sequence in which these patterns occurred. When teachers introduced questions during the explanation of the text, students were able to remember more elements of the story and of the class discussions. When the teacher explained the text and left all the questions to the end, students had greater difficulty in sharing what they had understood of the narrative.

In this case, the research gave visibility to the instructional context level related to

reading, considering the emphasis on the role of a reading task. Therefore, the analysis established a direct relationship between a certain instructional task and its effects on learning certain practices in the classroom. There was no concern, for example, with the reading routine that each class adopted throughout the year, or if the way teachers conducted this specific reading activity was frequently adopted.

A significant part of the studies in science education that we analyzed emphasize this context level. A fairly illustrative example is the study by Colombo Junior, Lourenço, Sasseron and Carvalho (2012). In this study, the authors analyzed discursive interactions to understand how 7 and 8-year old students reasoned during a practical activity about physical knowledge (Atividade de Conhecimento Físico). More specifically, the authors investigated how the children solved the "little basket problem". In this activity students have to place a little ball on tracks in a way that it falls into a basket. It is expected that students conclude that this only happens if the ball is placed in a certain position on the tracks. This conclusion provides elements for the construction of the concept of energy transformation. The authors used as data interactions between children during the activity, and were able to analyze how they constructed arguments. They state that "when students start to interact with the material, they became familiar with the experiment and began to test their hypotheses and to observe evidence" (p. 498). This excerpt is illustrative of the way in which the analysis was developed: they establish a direct relationship between what was done in the activity that was proposed (acting on materials) and the consequences for learning science (testing hypotheses, observing evidence). Colombo Junior et al. (2012) used data from children's discourse to support their conclusions.

Therefore, the study focus on the instructional context level, given that it establishes parallels between the variations in the way how participants constructed their discussions and the task that was proposed at that moment: the little basket problem. Additionally, further evidence of the emphasis of instructional context level is that the information that authors used was related to what was observed at that moment in time and in space. Therefore, the reader does not know if this type of approach was often present in the class or if it was new to participants; if the teacher usually encouraged group discussions or not, etc. The analysis was based on what the specific activity, at the level of an event, could inform researchers/readers. Evidently, this does not mean that this type of study does not acknowledge the presence of other dimensions of the classroom context. We understand that diverse contexts are inter-related and when a researcher focuses a context level, they chose to emphasize a specific way of looking at data. In Colombo Junior and colleagues' (2012) study, for example, the way that teachers conducted the activity, and not only the activity in itself was emphasized. This corresponds to another broader level of context. This emphasis was identified in the following statement:

> […] it is important to note that teachers present the problem and take care to not give the answers […] In this way, they already offer the possibility to the students so that

they can construct hypotheses" (p. 498)

In other words, the way of conducting the activity also influences analysis, but it is not the main focus. As we observe, the greater emphasis is on characteristics of the activity and on its impacts on students' reasoning. Thus, we concluded that the study focuses on the instructional context level.

Classroom context: structural, thematic and intrapersonal levels

Bloome and Green (1982) also discuss the classroom context level, referring to what happens in a class over time. As we described earlier, the instructional context level seeks to capture a specific moment of school practice – *a task* – and its developments in the learning process. Thus, the classroom context level, is broader.

The classroom context can be understood from three points of view: *structural, thematic* and *intrapersonal* (Bloome, & Green, 1982) Studies that focus on understanding the *structural* context focus on the relationships between tasks that were developed in classroom and their effects on the classroom. An example the authors presented is a study that indicated how the way reading tasks were structured influenced interactions in the classroom. Some activities were organized to give greater opportunities for student-student interactions, what had a positive impact on engaging in reading practices. In this case, we emphasize that the analysis corresponds to a distinct perspective on the context at the instructional level, considering that it was not restricted to consequences of a single task, but included a set of activities and how they unfold.

To illustrate how this level of context is emphasized in science education research, we selected Naylor, Keogh and Downing's (2007) study. They examined the influence that using cards and working in groups had on children's participation and their conversations during science lessons. The study was conducted with ten-year old children from seven different classes. In some classes, throughout the year, students engaged in activities using cartoons with questions about scientific concepts. For example, students read a cartoon with the question of whether two overlapping shadows would be darker than just one, and, then, discussed the issue. Additionally, the activities were organized in different ways: in some classes, the cartoons were discussed in small groups, and in others, with the whole class.

The results indicated that there are relationships between the use of cartoons and frequency and complexity of discussions during lessons. In the classes in which these activities were introduced, children spent more time discussing and their reasoning was gradually more complex in interactions. Moreover, when establishing comparisons between the forms of organizing lessons, analyses indicated that in small group discussions students tended to seek common understanding more often, instead of trying to prove that their colleague was wrong – what frequently occurred in whole class discussions.

In other words, valuing the structural context is related to investigating how using a specific activity influences science learning over time. In the case of Naylor and

colleagues' (2007) study, introducing cartoons and organizing lessons into small groups had an impact on children's participation and argumentation over the time. Although this is not the aim of this article, it is worth noting that this context level was present in most of the papers that we analyzed.

Bloome and Greeen (1982) also indicate that some studies emphasize the classroom context level focusing on teacher's orientation about how to develop reading with children, what they called *thematic context.* They present as an example a study that addressed how children approach reading errors differently, depending on teacher's pedagogical orientation. Two forms of teaching reading were compared: *meaning emphasis* and *word-by-word decoding emphasis.* In the first approach, the teacher tends to expect that students themselves perceive and correct their errors. Students in these teachers' lessons tend to develop reading practices that follow this orientation, acting with greater easiness when errors occur.

This type of study, that gives greater visibility to ways in which teachers conduct lessons, was also clearly identified in papers that we analyzed. Monteiro and Teixeira's research (2004), for example, emphasized contextual elements at the thematic level. These authors analyzed three teachers' practice in different classes of nine years old students, focusing on how they developed experimental activities and subsequent discussions. Two of these teachers adopted similar approaches: conducting more directed, less dialogical discussions, as if they were following a script for students to construct the "right answer". The other teacher presented a more hybrid orientation when conducting oral discussions. Sometimes she was more direct, and sometimes she was more dialogical, using information that children presented to lead discussions without offering strict directions.

These two different ways of conducting science lessons had implications in terms of children's engagement. On one hand, in the first two classes, the authors understood that the existence of this mental script to be followed in a rigid manner hampered freer students discussion. This, hinder greater refinement in their discussions and led to a less evident participation. On the other hand, the third class was more participative and able to develop more consistent discussions. In this case, the difference between thematic context and instructional/structural context was clear: the focus of analysis was not on activities themselves or on how they are related/organized, but on how the *teacher* conducted such activities and their influence on learning processes.

The studies discussed so far offer a vision of what happens at the interpersonal level in classroom. However, Bloome and Green (1982) indicated that in the classroom context some studies focused on *intrapersonal* level. These studies focus on personal orientations that students give to the reading activities, which can influence their performance in this task. An example the authors offered is a study that described two students reading in the same class. Some characteristics described were: what these two students choose to read; what they did after the reading; reading abilities that they possessed; and how these abilities changed depending on the audience, etc. These

characteristics were analyzed and related to the way in which each one of these students individually constructed different forms of engagement in their reading practice.

In our review, the studies with this type of focus were rare. Bricker and Bell's (2014) research seemed relevant to us to illustrate the intrapersonal context level. The objective of these authors was to investigate how experiences of a student across different environments, activities, social groups and times resulted in science learning, development of expertise and identity.

The authors followed the same child during the 3rd, 4th and 5th grades. The discursive interactions in science lessons were related to experiences that child had in other spaces. For instance, visits to her grandmother's house, where she played with her cousin, making mixtures; her interest in a perfumery kit that she got from her mother; visits to the dentist, visits to the paleontology and archaeology museums; and discussions with her mother about how to feed their pet dog. All these experiences were specific to that student and generated impacts on her science learning in the classroom, indicating that intrapersonal context was emphasized in this study. These analyses indicated that the student used these experiences for positioning herself in two distinct ways when participating in the science lessons: as a learner and as a collaborator with her classmates. The latter emerged especially in moments when she was working directly with her classmates.

In sum, in this study there was a focus on intrapersonal context level, given that the analyses made visible that what student used their personal experiences during science lessons.

Preliminary considerations...

The levels of context discussed so far were characterized separately, but they are part of the same classroom context and they are deeply intertwined. We identified various studies that give visibility to more than one level of context in their analyses. For example, often researchers conduct analyses that make visible both the role activities in promoting science learning (structural level), as well as influences the ways in which the teacher develops activities (thematic level) have on science learning.

Actually, this is not the goal of the present study, but it is worth noting that the majority of studies that we analyzed focuses on instructional and classroom context levels. However, Bloome and Green (1982) also pointed out that there are studies that brought to light other contextual aspects that go beyond classroom environment, and that established relationships with institutions, communities, society and culture in which students were situated. We found fewer studies in science education that focused on these broader contextual levels.

This does not mean that we see this major focus on classroom contexts as useless or limited per se. Rather, this contextual level is fundamental, given the common goal of science education research to contribute to better understand science teaching and learning processes and to improve practice, even in face of diverse objectives and

methods that guide particular studies. Therefore, what happens in science lessons and its influences on these processes deserves our attention, which is extremely positive.

Nevertheless there is some reason for concern if we consider the need to develop analyses that makes it possible to focus on broader contextual dimensions. The examples that we present in the following sections help to understand how science education researchers made this movement, and how this analytic perspective makes it possible to generate new and interesting perceptions regarding what happens in science lessons.

Curricular/Institutional Context

The curricular/Institutional context level refers to relations between reading processes in the classroom and influences of institutional factors (Bloome, & Green, 1982). Institutional factors can be understood as practices institutionalized in school or elements related to the curriculum. The authors cited a study that adopted this perspective to analyze data related to difficulties that different classes had in reading. As part of the results, researchers highlighted that a significant factor was the time that each institution dedicated to reading activities. The group that spent less time with the teacher on reading presented greatest difficulties. In other words, reading was related to institutional and curricular factors: the time spent on reading activities.

Enfiled, Smith and Grueber (2008) represent an interesting example of this type of approach in science education. They investigated the introduction of epistemic practices[3] in science lessons based on a comparative analysis of two distinct curricular proposals. The same class of eight years old children were investigated at different times. The authors followed children for one year as they learnt about relations between force and motion during the first semester, and about plant growth during the second. The same teacher developed all the lessons, however, in each semester, a different curriculum materials was adopted[4].

On one hand, the curriculum adopted in the first semester used clear indications regarding the role of each epistemic practice to be developed in an explicit way throughout the lessons. On the other hand, during the second semester, there was a greater focus on procedures related to data collection and observation, using hands on activities, however, there were not guiding questions for each investigation.

The results indicated that the first curricular materials offered more opportunities for students to engage in construction of scientific reasoning and to develop more consistent notions regarding making questions in science lessons. The second proposal, in its turn, seemed to produce greater results in terms of challenging students' prior

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3 In accordance with the authors epistemic practices by are: asking questions, collecting data, elaborating descriptions of observations, seeking patterns in data, and developing scientific reasoning.

4 The unit about movement was part of the curricular proposal from CCMS (*Center for Curriculum Materials in Science*). This center produced materials based on partnerships between institutions like AAAS (The American Association for the Advancement of Science) and some universities (for example, Michigan State University and Northwestern University). The unit about plants was part of a curricular proposal that a private institution from the state of Michigan in the United States, the BCAMSC (*The Battle Creek Area Mathematics and Science Center*) developed.

knowledge. Therefore, the curricular guidelines were directly related to how students constructed knowledge in the classroom. This gave visibility to a level of context that is broader than the instructional and classroom contexts level: the implications of using a certain curricular orientation in science lessons.

Community Context

Bloome and Green (1982) proposed that there is a *community* context level, that is the focus of studies that establish relationships between reading and the community in which school is situated. This is the case of an investigation in Alaska with a community that associated literacy practices with foreign culture, in a way that people that read and wrote were considered "outsiders" who did not share the group's values. This stigmatized vision of reading and writing generated an impact on how students from this school dealt with these practices in the classroom, as well as tensions between community context and institutional context – in this case, the curricular guidelines from the government.

In science education, Reinhart and colleagues' (2016) research illustrates how this level of context can gain visibility. These authors followed students' families from six classes in the same city. There, a Harvard University[5] project had already taken place, involving developing science activities in the family setting. Considering their observations that not all families engaged satisfactorily in the project, the authors created two categories of family: families that had strong participation and those that had little participation. The criteria for defining categories of family were their participation in school events throughout the year, and the number of visits to the city's science center.

The analyses suggested that greater engagement in the activities with the family was an important aspect to raise children's interest in science discussions and to promote greater participation during lessons. Additionally, the analysis of interactions showed a greater degree of investigative behavior among children from participatory families. These analyses highlighted how members of the community in which a school was situated valued science differently in their day-to-day lives, and in the school life of their children, what affected the science learning processes of these students. Thus, the level of community context was more prominent in this type of investigation.

As we already indicated, we identified studies that gave visibility to more than one contextual level. Bricker and Bell's article (2014), that focused on intrapersonal context level, also offers elements that made visible the community context level. Their analyses, despite being about a single student, used different community elements in which she was situated, like the scientist play with classmates and her cousin, the visits to the dentist and visits to science museums. All these experiences revealed how elements from her community influenced her participation in sciences lessons and in her learning.

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5 Project "*What is complementary learning?*" accessible at http://www.hrfp.org

Social Context

Other studies that Bloome and Green (1982) analyzed sought to focus on relationships between reading practices and social structure, giving less emphasis to instruction or to individual development of reading. In these cases, studies establish relationships between the development of reading and broader aspects that go beyond classroom setting like: social class, race, gender, religion and political/economic power. One of these studies, for example, analyzed reading practices among children who lived in the outskirts of Chicago. Some of these students, black and Latino children, developed alternative strategies to achieve levels of proficiency in reading and they gained respect from the rest of the class. In other words, in this case, there was a focus on how learning to read was related to questions of economic power and racial segregation.

Oliveira and colleagues (2012) study illustrate this type of perspective in science education. In this research, the analyses focused on discussing environmental dilemmas. One of the dilemmas was about what to do with a deer found alone in the woods.

The analysis of the interactions revealed a discussion between students who adopted homophobic attitudes in relation to a classmate and others who sought to defend him. In Brazil the Portuguese word for deer (i.e. "*veado*") is an expression that refers to homosexuals in a pejorative way. The authors indicated that the situation created an environment of social insecurity that influenced children's discussion. Therefore, instead of focusing on a scientific rationality to construct a response to the dilemma, as had happened in the discussion of previous dilemmas, children quickly agreed on a simpler answer, attempting to protect their classmates who had become a target of bullying.

In summary, the authors used a macro social factor, related to sexism and homophobia, to understand the way how a group of children formulated answers during the science lesson. It is worth noting that in our review of papers, few studies made this movement of relating social factors to what happened in science lessons.

Cultural context

Finally, Bloome and Green (1982) discussed studies that emphasized the cultural context. These studies seek to understand how certain aspects of the culture of a group influences the development of reading. An example that they offered is an investigation of reading processes in a school of a city in Alaska with indigenous students (Athabaskan tribe).

In the Athabaskan culture, there are some particularities in their practice of storytelling. In contrast to takes place in western culture, among Athabaskan there is a process of negotiation between audience and narrator. The storyteller only presents an introduction (framework) of the narrative, and the audience has an active role in its ongoing construction.

When they arrived at school, Athabaskan children faced diverse problems, including difficulties in reading. This study analyzed how five indigenous children changed their reading practices over time, given that their classmates and teachers

considered their practice of conducting narrative as inferior. Therefore, reading was related to cultural elements that were in conflict with the classroom.

In science education field, we find many studies that focus on cultural aspects, especially when dealing with themes of diversity and minorities. However, in this context, those who sought to analyze discursive interactions in the classroom were rare. The research by Upadhyay (2009) offers an interesting example.

The author investigated science lessons in a class of ten-year old white, black and Hmong[6] students in the United States. The analyses show how the teacher, who was of Hmong descent, sought strategies to value the culture of this group – for instance, when they were studying plants. The Hmong children frequently made use of gardening examples, an important practice in their culture that carries resonances of a spiritual nature. The teacher used this interest and involvement of Hmong students with gardening to engage them in their investigation. This was, according to the author, a consequence of the fact that the teacher was able to perceive the importance of gardening due to her own connection with Hmong culture. Considering students' inclusion/exclusion, this study offers an interesting contrast to the study Bloome and Green (1982) mentioned. That study evidenced how characteristics of a minority culture were subjugated at school, what led to strategies of adaptation of children from this culture. On the other hand, the study by Upadhyay (2009) highlighted how a minority group engaged in a more effective way in science lessons, what was related to teacher's use of elements of their culture.

Proposing a descriptive perspective

In this paper, we discussed context as a theoretical-methodological construct using examples from science education research that investigate discursive interactions at elementary school. Our analysis indicates that researchers give visibility to different contexts when studying science lessons, depending on their objectives and methodologies.

Even with this diversity, there is evidence of predominance of studies that focused on contexts at the instructional and classroom levels. Although it is not the goal of this article, we would like to point out that, only five of the 56 papers that we initially analyzed, were categorized as studies that established relations with broader context levels (i.e., institutional, community, social and cultural levels). Four of these studies were presented in this paper.

The prevalence of studies with an instructional focus could be related to the goal of improving quality in education. Currently, there is a demand to provide evidence of the impact that certain innovative activities, approaches or teaching practices on students, and this type of investigation is necessary to formulate recommendations regarding what *should* or *should not* happen in a 'good' science lesson (Kelly, 2005, Munford et al., 2014). Kelly (2005) refers to research with this type of design as normative, considering that it is oriented by arguments "based on a moral point of view and focused on ideas or norms that guide social practice" (p. 80) We agree with Kelly (2005) regarding the relevance

6　The Hmong are a group from Vietnam. They had to leave their native land after the Vietnam War. Prior to arriving in the United States, they lived as refugees in Thailand and in Laos.

of studies of this character. However, he also argues that studies with a descriptive character are relevant because they offer other perspectives that can also contribute to the advancement of science education. Moreover, a descriptive stance has the potential to broaden our views of other contexts that are present in the classroom, besides the instructional.

Thus, we align ourselves with the idea Kelly (2005) proposed that: to understand science in the classroom, it is necessary to take into consideration the ways in which scientific knowledge is formulated, communicated, criticized, appropriated and evaluated in the school by particular social groups, considering that these groups possess a specific history and language use situated in a determined context. These types of studies have been significantly influenced by the fields of Sociology/Anthropology and have as their focus "the actual practices of a social group, regardless of whether this accounts conform to stated norm or rules for behavior" (Kelly, 2005, p. 80).

In the studies that we analyzed in the present paper, we noted that investigations with a more normative focus gave greater visibility to instructional and classroom context levels, while more descriptive research were precisely those that established relations with broader contexts levels, like social and cultural.

We propose that research that investigate discursive interactions in science lessons should explore the potential of studies with a more descriptive character. Kelly (2005) argues that the development of this type of research for three main reasons. First, the descriptive focus makes visible meanings that members of groups share, based on the study of their social practices. Through the analysis of day-to-day practices of the group, associated with constructs from science education research – like *nature of science, inquiry teaching, constructivism, hands on activities* – it is possible to understand meanings the group constructed during science lessons – for example, what counts as inquiry practices for a group. In this case, the focus on day-to-day activities of that group and not on the instructional content of the lessons makes it possible generating insights about how the group experiences and how they signify instruction, leading to a reflection about the meaning that scientific community attributes to some constructs (Kelly, 2015, p. 80).

Second, descriptive studies can help us to understand situations that escape what is expected from the instructional point of view, but that are directly related to science learning. This can happen for example, when, due to questions a student poses, the teacher changes her/his initial plan and he/she generates an "anomalous" situation, possibly, stimulated by interests and interventions of students (Kelly, 2015, p. 90–93).

Kelly (2005) indicates that an interesting way of generating insights is to analyze events in which "anomalous" situations take place. That is, to seek situations in which there is a break in researchers' or participants' expectations regarding what should happen in science lessons. In these moments, there is a significant chance of describing how members of the group themselves are negotiating and constructing certain norms and practices. This can be fundamental for the researcher to understand what *counts*

as science or science learning for the group. For students as individuals who are being introduced to science knowledge and practices, anomalous situations can be indicative of how they are learning to participate in the social event "science lesson", and to engage in science learning opportunities. There is less chance to perceive or value these aspects in studies guided by a purely normative research framework.

Kelly's third argument is that the descriptive studies focus on day-to-day lives of people in concrete situations. When investigations of science classrooms are oriented by the search for adequate instruction, we may ignore limits of these proposals, as well as how science learning occurs in varied ways within a group.

Using as example a student talk during a science lesson, Kelly illustrates how the descriptive perspective includes new elements. An analysis restricted to structural content of speech would indicate that the student did not fully understand the concepts discussed. However, considering the context of the situation, as well as the day-to-day context of his class, a descriptive analysis made it possible to identify diverse elements regarding how he understood important scientific ideas and how he had constructed a coherent understanding in terms of what was scientifically acceptable.

What made these elements visible was an understanding of student talk in light of the classroom history in science lessons, and contextual features of talk (e.g., intonation and body movements). In this case, a descriptive study made it possible to investigate how learning occurs in different ways. This would receive little attention in more normative studies. Therefore, descriptive studies can contribute to constructing more inclusive approaches that reflects the diversity that is present in our classrooms.

Like Kelly (2005) points, as we adopt this perspective, we do not intend to propose a descriptive *versus* normative dualism in research in science education. Studies that consider more descriptive arguments also establish moral judgments to some extent regarding what happens in the classroom. The same happens with studies with a more normative focus that make use of descriptive elements. The difference consists in the emphasis researchers give in their analyses.

Monteiro and Teixeira's (2004) study, for example, had a greater focus on normative arguments, but authors used descriptive elements to characterize performances of three teachers. Even so, a greater normative focus occurred because what oriented research design was precisely a judgment about what teachers had the best practices, and who was more capable of promote interactions that are significant to science learning.

Therefore, we conclude this discussion arguing that a way to face the challenge of investigating science lessons with contextual lenses would be developing more descriptive studies in science education research, according to the notions presented by Kelly (2005). We understand that a normative dimension reflects a fundamental role of research in promoting the improvement of quality in education, as well as, in the development of pedagogical innovations. However, a more descriptive dimension offers possibilities to researchers to understand what happens in science lessons from other perspectives, and, consequently, they are able to conceive teaching and learning processes

in a way that is directly related to perceptions of those who experience these processes, that is, students and their teachers., Furthermore, the more descriptive perspective has the potential to give visibility to other contexts that go beyond the "classroom walls" and that also have a strong influence on what is students construct when learning science. Therefore, acknowledging the point of contact between descriptive and normative, we can amplify the horizons of a scientific education of excellence.

Acknowledgements

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