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Learning to Use Evidence in Elementary School Over Time: A Study of the Discursive Construction of Ways of Answering Questions in Science Lessons

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The use of evidence in science lessons has been considered an important practice to be developed in science education. In this study, we investigate how 3rd graders constructed discursively the practice of using evidence. The theoretical and methodological framework of the study was grounded in Microethnography and Interactional Etnography. We characterize "ways of doing" related to evidence use based on the use of discursive resources: words/expressions that were emphasized by the participants in face-to-face interactions, through contextual cues of speech, such as intonation/volume shifts and pausing moments. We indicate how these ways of doing have changed over time and how participants negotiated a shared model in building answers using evidence. We also discuss methodological implications for research in Argumentation in science education and for classroom practice.

Keywords: Use of evidence; Elementary School Science; Ethnography in Education; Argumentation, Science Education.

Introduction

The goal of this study is to investigate how 3rd graders constructed discursively practices of using evidence in science lessons. There has been a growing interest in this aspect of argumentation in the field of science education (e.g., Manz & Renga, 2017; Monteira & Jiménez-Aleixandre, 2015; Osborne, Erduran & Simon, 2004; Ryu & Sandoval, 2012; Sasseron & Carvalho, 2014; Yun & Kim, 2015). Working with evidence in the classroom has the potential to help students to develop scientific thinking (Jiménez-Aleixandre & Erduran 2008; Kuhn, 1993), and children have opportunities to have contact with aspects of practices involved in the construction of scientific knowledge (Kelly, 2013).

Moreover, the use of evidence has the potential to provide alternative perspectives on science learning in contrast to traditional views that students usually hold. As Sandoval and Milwood (2008) point, this type of practices challenges the notion that teachers know all the "right answers" and students' role is to give these answers. Instead, they experience situation in which learning science involves not accepting ideas just because they are persuasive or because people with more power defend them. Thus,

another contribution of participating in these practices is that they emphasize aspects of education for citizenship in science teaching (Berland & Reiser, 2011; Jiménez-Aleixandre & Erduran, 2008).

As research in argumentation developed in the last years, it became evident that it is not a simple task to address evidence use in classroom contexts. Various authors have reported students' difficulties in establishing relationships between claim and evidence in an appropriate manner. Moreover, they do not expect/ask their peers to provide evidence to support their claim, nor to refute ideas that are proposed (Berland & Reiser, 2009; Ryu & Sandoval, 2012). Osborne et al. (2004) mention other challenges like students tendency to: i) select evidence ignoring data that contradict their claims; ii) oversimplify interpretation of evidence and reach conclusions without enough data; iii) use information that go beyond what is presented to evaluate evidence; and iv) ignore certain information for building their answers.

These studies indicate that some aspects may support teachers in promoting participation in practices of evidence use. However, we address this issue from a different perspective: instead of focusing on students'/teachers difficulties and on evaluating students performance, we consider essential to focus on the process of learning to use evidence. Previous research have highlighted that there is a gap in studies that investigate scientific practices at elementary school, considering that most of them focus on whether the children learn or not, instead of trying to better understand how they learn (Jaber & Hammer, 2016; Monteira & Jiménez-Aleixandre, 2015).

One way of making this process more "visible" is to emphasize the role of language in the construction of what happens in the classroom, like in our study. Munford, Souto and Coutinho (2014) note that an ethnographic approach has great potential for research in science education, since it focuses on participants' perspective situated not only in instructional context but also in cultural context. Thus, it can help researchers to develop new conceptions of what it means to learn and to teach science at school, that go beyond the emphasis on guidelines that can be applied in different settings. As some authors have pointed, these recommendations for practice often are based on notions of teacher/students' deficit or on process-product research approaches (e.g., Kelly, 2005).

In this study, we explore an ethnographic perspective based on constructs and tools from Microethnography and Interactional Ethnography (Bloome et al., 2008; Castanheira, Crawford, Dixon & Green, 2001; Green, Dixon & Zaharlic 2005). These frameworks make it possible to emphasize contextual aspects of interactions that are essential for the advancement of research in argumentation. Methodological tools that are most often used in studies about argumentation focus on the structure of the interactions, whereas characteristics of the context of production of argumentation receive little attention (Yun & Kim, 2015).

We analyze discursive interactions in a 3rd grade classroom during science lessons. We identified words/expressions that participants emphasized in these interactions, and that were related to constructing practices of evidence use. The following research

questions oriented our analysis:

What "ways of doing" related to evidence use are most significant to 3rd graders throughout a sequence of lessons involving argumentation?

How these "ways of doing" and their meanings change over time?

How discursive resources related to these "ways of doing" are used to negotiate a shared model of how to build responses to questions in science lessons using evidence?

Theoretical-Methodological Aspects

Considering the complexity of processes related to learning to use evidence in argumentation in science, this study is informed by theoretical frameworks from different fields. The notion of evidence that we adopted is based on Toulmin's pattern of argumentation (TAP) (Toulmin, 2006): evidence is data that supports a claim[1] . TAP is frequently used in research on argumentation in science education.

However, to give more visibility to the argumentative process, some methodological alternatives have been proposed in the literature, involving associating TAP to other tools (e.g, Ferraz & Sasseron, 2017; Knight-Bardsley & Mcneill, 2016; Monteira & Jiménez-Aleixandre, 2015; Sasseron & Carvalho, 2008; Scarpa & Trivelato, 2013), as well as the use of frameworks from Argumentation Theory (Franco & Munford, 2016; Ibraim & Justi, 2016; Martins, Ibraim & Mendonça, 2016; Munford & Teles, 2015).

In this study, we adopted the notion of evidence from TAP combined with frameworks informed by ethnographic perspective (Bloome et al., 2008; Green et al., 2005). Because our interest is to understand the construction of practices of evidence use during argumentation, these frameworks appear to be appropriate for various reasons. First, they help us to develop analyses that are historically situated, as we establish relationships between parts (e.g., specific events) and the whole (the history of the group of participants) (Green; et al., 2005). When describing certain events, analysis situated in time and in space (Bloome et al., 2013) oriented our investigation. This made it possible to give emphasis to changes over time based on continuities and changes in practices of evidence use. Thus, the process of argumentation received more attention than the products of argumentation.

Moreover, these frameworks were important to give visibility to participants' perspective, considering our interest in understanding what was most meaningful

1 We are aware that there are discussions around the notion of evidence in science education. For example, distinctions between genuine and non-genuine evidence (Kuhn, 1993); distinctions related to the origin of evidence (primary or secondary sources) (Hug & McNeill, 2008); distinctions between what is considered data and evidence (Sasseron & Carvalho, 2014). These different discussions have direct implications on working with evidence in the classroom. Moreover, they are essential for the advancement of our comprehension of this practice in science lessons. However, informed by an ethnographic perspective, we aim to develop analysis that avoid using a priori categorizations about our object of study. Moreover, we decided to refer to "evidence" in a broader manner, without defining beforehand "types" of evidence or making distinctions between evidence that different participants use in events.

for the group as they construct practices of evidence use. Ethnography in Education aims to describe "what is happening, what it means, what its significance to the social group from an emic (native, insider) perspective rather than an etic (external, outsider) perspective" (Bloome, 2012, p. 9). That is, it aims to value the point of view of members of the community being investigated. In the present study, we emphasize this aspect as we pay attention to contextual characteristics of events, emphasizing the form of the discourse (Gumperz, 1982), and not only its "content". This form reflects participants' meaning and not a priori meanings from researchers.

In this respect, it is worth noting that as we investigate evidence use, we consider it as a process in construction. Thus, our analysis do not start from the assumption that participants already had a shared model of what it would be to use evidence, but these "ways of doing" were constructed over time. Participants constructed practices of evidence use using semiotic resources through which "their individual and collective histories interacting with each other, with others in related pertinent situations, and including and within the material environments in which they live" (Bloome, Carter, Christian, Otto, & Shuart-Faris, 2005, p. 6).

These conceptions reflect the focus on events of the analyses we conducted. Based on a holistic perspective (Green et al., 2005), we build macroscopic representations. More specifically, representations that make it possible to visualize and analyze events with different levels of detail, as well as evidence relationships between whole and parts in group's history (Green et al., 2005).

Based on tenets of interactional ethnography, we experience analyses as an iterative-responsive process (Castanheira et al., 2001): we enter the field with a broad question and, then, new questions are generated considering the immersion in the classroom context. Once new questions are developed, we conduct analyses at the microscopic level (Green, et al., 2005). Thus, starting from a broader/general view derived from macroscopic analyses, we identify specific events, and then generate new questions, representations and analyses.

As we focus on the microanalyses of specific events, we understand "event" as a theoretical-methodological construct. The event is a heuristic for the production of analyses about what people do and their interactions with each other (Bloome et al., 2005) and the processes of selection/analyses of events reflect the ways the researcher conduct her/his investigations about certain practice[2].

The analyses of the events presented in this paper were informed by the notion of telling cases. This approach is still rarely used in science education research. A telling case is a situation when "particular circumstances surrounding a case, serve to make previously obscure theoretical relationships suddenly apparent" (Mitchel, 1984, p. 239). In our study, the telling cases were situations in which certain characteristics related

2 In this respect, it is possible to describe practices of evidence use in the classroom based on different perspectives analysis of events, for example, comparing a set of events before and after developing a sequence of lessons; measuring aspects of the practices of the group that are more frequent in a set of events; or emphasizing what happens in events that are considered "typical cases".

to participants' use of evidence were more visible in the oral discourse and made it possible make inferences about how this practice is constructed. These were revealing situations related to "some sequence of events from which the analyst seeks to make some theoretical inference" (Mitchel, 1984, p. 238). However, one should not think of a telling case as a "typical" case, nor as an isolated case, nor as a representative case of something that happens frequently in the classroom. The potential of telling cases lies on the analysis of moments when the flux of everyday life is disrupted, and certain aspects of the life of the group, that up to this moment were hidden, became evident to the researchers, and, possibly, to participants themselves (Agar, 1994).

To analyze telling cases, we were informed by what Bloome and colleagues (2013) call Analysis Situated over time and space, as represented in Figure 1, considering the appropriation of the notion of chronotopos in educational research (see Bloome et al., 2013). The events were situations in which children were constructing a practice of evidence use. They are related to each other historically, composing a set of processes that are evolving and changing over time.

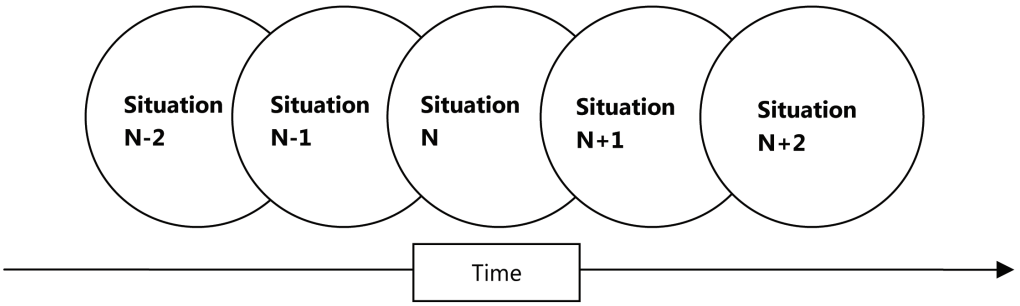

Figure 1. Representation of the Analysis Situated over time and space (adapted from Bloome et al., 2013, p. 626)

Our goal was to develop an integrated analysis of events. As emphasized in the connections between events represented in Figure 1, we aim to reconstruct the history of the group acknowledging that, if children use evidence in a certain way in a situation, this is related to the way this practice was constructed in situations in the past, and it will influence the construction of this practice in situations in the future. In other words, past events were a resource for constructing present events that will be a resource for constructing future events. This approach gives more visibility to the process of argumentation construction.

With the goal to move toward an ethnographic perspective, we adopted some assumptions and tools of Microethnography for analyses at the microscopic level (Bloome et al., 2005, 2008). This theoretical-methodological framework takes into account the centrality of discourse as representation of what the group constructs. Thus, Microethnography emphasizes the deep relationships between language and culture. That is why we consider evidence use as a cultural practice that is under construction in the classroom that we investigated.

It was through face-to-face interactions in the events that we searched for clues to understand how participants construct "ways of doing" evidence use. Gumperz (1982) proposed a notion of contextualization, involving the forms how people make sense of interactions through indexical meanings, using verbal, non-verbal and behavioral cues to express themselves. This construct highlights other elements of discourse beyond the structural content, making more visible meanings that participants were constructing in the conversation. Using this contextual information, we identified discursive resources that helped us to understand group's construction of evidence use.

Research Setting

The results presented in this paper refer to science lessons in an elementary school classroom in a public federal school in a big city in southeast Brazil. Our research team followed this class throughout three years, since they started elementary school. Here we present analyses of events that occurred in the 1st semester of 2014, when they were in 3rd grade.

During this period, there were 27 students in the classroom, and the same teacher –called "reference teacher" – taught Reading and Writing/Portuguese and Integrated Topics, a discipline in which history, geography and science contents were addressed. The teacher and members of our research team taught and planned collaboratively science lessons. A general view of topics addressed throughout the first three years at elementary school and a more detailed view of the 1st semester of 2014, when the situations that are analyzed occurred are represented in Figure 2.

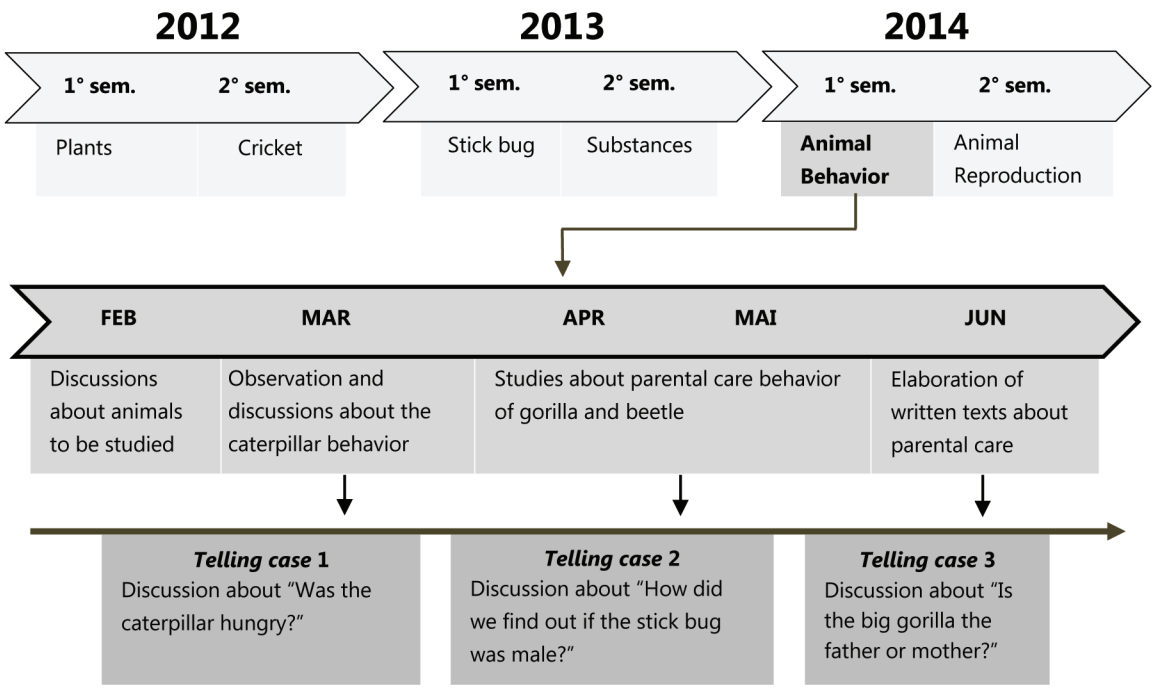

Figure 2. Sequence of science lessons

A scientific inquiry approach oriented planning of science lessons. It is possible to identify in the literature key aspects that characterize this approach (see Munford & Lima, 2007), although there is some heterogeneity in perspectives about inquiry. In the classroom that we investigated, the activities were designed to engage children with scientific oriented questions (Capecchi, 2013). Moreover, students had to use evidence to buid their answers and to share their conclusions (Carvalho, 2013; NRC, 2012; Zembaul-Saul, McNeill & Hershberger, 2013).

The scientific concept addressed in science lessons during the first semester of 2014 was biological adaptation. As presented in Figure 2, teaching this concept involved developing activities related to the behavior of animal species like a caterpillar, the gorilla and a dung beetle.

Data Sources and Analysis

The main data sources for this study were participant observation (Spradley, 1980) with video and field notes recording (Green et al., 2005). We focused on 23 lessons that took place in the first semester of 2014.

The process of macroscopic analysis started with the construction of a Table of Lessons with general information about the 3rd grade science lessons. Based on this table, we identified activities that involved evidence use in the first semester, and we decided to develop analyses in this period. Then, another table with more detailed description was produced and we selected three lessons in which oral discussions around evidence use occurred. Finally, we produced descriptions even more detailed of each of these lessons, building Event Maps (Castanheira et al., 2001). These maps were used to identify situations that could be considered telling cases (Mitchel, 1984).

The microscopic analyses that followed macroscopic analyses involved transcribing word-by-word interactions from the telling cases. The transcription is divided in Interactional Units (IU), blocks of conversation that make it possible to establish boundaries within the events under analysis (Bloome et al., 2008). Each IU corresponds to a set of interactions around a certain focus. Moreover, transcripts are organized around Message Units, representing the smallest unit of meaning in the analysis of a conversation. Its production is related to the need of members of a group to construct shared boundaries in discursive interactions (Green & Wallat, 1981). These boundaries in discourse were established based on contextualization cues, like changes in intonation, rhythm, emphasis, speed, pause, posture, gesture, etc (Gumperz, 1982). In the transcript, symbols represent these signs, and the units are presented in charts with discursive interactions. Finally, we identified words/expressions that participants emphasized and that were related to the construction of a practice of evidence use.

The methodological procedures that we adopted, as well as the assumptions that guided our research are represented in Figure 3.

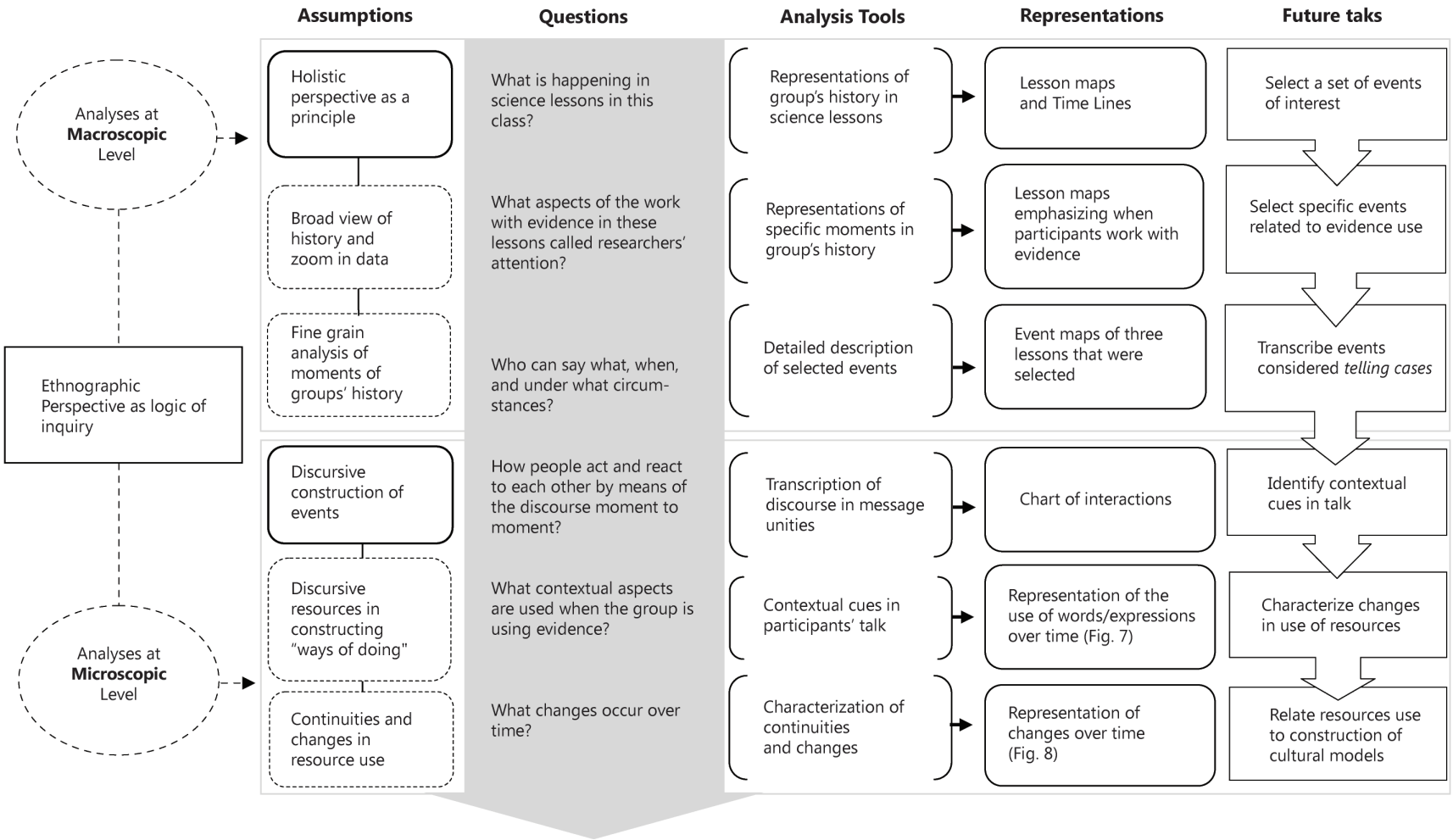

Figure 3. Representation of methodological procedures in this study. Based on assumptions of ethnographic perspective, our questions changed over time, The use of different methodological tools, representation, and tasks reflect that.

Results

We report our results presenting a broad description of the three telling cases (TC), organized in five interactional units (IU) based on the focus of the discussions[3]. TC1 corresponds to unities IU1, IU2, IU3, and TC2 and TC3 correspond to unities IU4 and IU5, respectively. In a second section of results we address research questions. Starting from examples of interactions in events, we identify "ways of doing" related to evidence use that were considered most significant to participants, and we describe changes in these "ways of doing" over time (Questions 1 and 2). Finally, we establish relationships between discursive resources participants used and a shared model of how to construct answers in science lessons (Question 3).

General Description of events

The telling case 1 (TC1), Discussion about the caterpillar behavior, occurred in the fourth science lesson in 3rd grade (Figure 2). At the beginning of the lesson, the teacher proposed that each child read the written texts they elaborated individually in the previous lesson, when they had observed the behavior of a caterpillar that some of the students had found at school.

As the class read their texts out loud, the teacher emphasized that in some descriptions students referred to: i) things that they "saw", like "the caterpillar is moving in circles" or "the caterpillar went up, and then, went down"; and ii) things that students "thought that" were happening, like "I think the caterpillar is not felling good" or "I think that the caterpillar is hungry". It is in this context that the TC1 took place. The event begun with a discussion around the question: "Is the caterpillar feeling good? (IU1). Afterwards, participants turned to the question: "Was the caterpillar hungry? (IU2), and they discussed evidence from caterpillar's behavior (i.e., "she kept going round and round"). However, students did not reach a consensus about the issue. Finally, they proposed and discussed possible ways to generate data to build an answer to the question "What could be done do find out if the caterpillar is hungry?" (IU3).

The second telling case (TC2), Is the stick insect/beetle male or female?, occurred fourteen days after the TC1(Figure 2). The class was studying parental care behavior in two animals: gorillas and dung beetles[4]. In this lesson, the goal was to work with a written text with information about parental care. However, before starting reading, some students came into the classroom with a beetle that they had found during recess. Vinícius, one of the students raised the question: "How can we know whether this beetle is male or female?". Some answered that it would be enough to observe the beetle's lower part to find out the answer. However, the teacher remembered an event that occurred in 2012, when the class discussed how to find out whether the sticky insects were male or

3 TC was used to designate telling case, IU for interactional unit, and L for lines in transcripts in the interaction charts.

4 A more detailed description of this sequence of lessons is provided in Franco, Cappelle, Munford & França (2014).

female. From this point, students engaged in a collective narrative about how the group built answers in that previous moment in their history.

The third telling case (TC3), Is the gorilla male or female?, occurred four lessons after TC2, in July 2014 (Figure 2). The class was concluding their studies about parental care. In the previous lesson, the teacher had asked students to elaborate a written text, reporting on what they have learned during the semester, then, some children read aloud their texts and the class discussed them.

In her text, Nara posed the question: "Why the father of the baby gorilla was not in the video?". She recalled that in one of the first science lessons in April of that year, the class watched a video showing an adult gorilla taking care of a gorilla cub. Nara was intrigued with the presence of only one adult, supposedly the mother. Then, her peers started to discuss Nara's question and new questions were raised. Another student, Nina, for instance, stated that before answering Nara's question they would need to know whether the gorilla in the video was the father or the mother. TC3 took place in this context, involving debates around whether the gorilla in the video was male or female. Students watched the video again and tried to identify evidence that could help them to answer Nina's question.

What "ways of doing" are most significant in evidence use throughout a sequence of lessons involving argumentation? How these "ways of doing" change over time?

We identified certain words/expressions that participants emphasized in classroom interactions that appeared to be related to evidence use: to know, to think that, to look, to see, and to observe. The use of these discursive resources is understood as meaningful actions in the construction of "ways of doing" evidence use. However, when we discuss the use of "to know" or "to observe", for instance, we are not referring only to immediate/specific actions of knowing or observing per se. The analysis situated in time and in space gave emphasis to processes of negotiation of what is "to know" or what is "to observe" for participants, as well as, changes in these actions and in how they are intertwined to shape what we call "ways of doing".

In this section, we address relationships between to know, to be sure of and to think that, considering the dichotomic relationship that participants attributed to these expressions. After that, we will turn to the use of expressions to see, to look and to observe, that participants used in a similar way.

Throughout the units, to know, to be sure of, and to think that expressions were used in different ways. In IU2, the teacher emphasized expressions to think that (L4) and to know, when the class discussed the issue of whether the caterpillar (Figure 4 [5]).

Between lines 4 and 7, the teacher stated: "I think that this caterpillar is hungry." The teacher emphasized to think that, signaling with a pause after this expression before

5 Meanings of symbols: ↑ ↓ (raising/lowering intonation); XXXX (incomprehensible); emphasis; ▲▼ (higher or lower volume); higher speed; ┗ ┏ (overlaid speech); vowel+ (elongated vowel); non-verbal behavior in italics; I (pause); IIII (long pause); - (incomplete word).

finishing the sentence. Using this statement, the teacher brought a memory of how some students described the caterpillar's behavior in their texts. Thus, there is a movement of emphasizing differences between to think that and to know that. At the beginning of the discussion, some students thought something, but after this teacher intervention, to participate in the discussion required them to figure out a way to know the answer: to know and to think that appeared as distinct actions, and assumed a dichotomic relationship in this context of discussion.

Interaction Unit 2		
Line	Speaker	Discourse
1.	Teacher	Oh I
2.		Now I'll ask you one that I was in doubt I
3.		There were people who put so I
4.		I think I
5.		that cater I
6.		caterpillar I
7.		Was hungry I
8.		Is it possible I
9.		To know I
10.		If she was hungry ↑
11.	Nara and others	*Yes Nara is standing next to the teacher and raises her right hand*
12.	Teacher	*Now sit because I want to hear other people I she says looking at Nara*
13.	Vinícius	*Raises his right hand asking to be chosen to speak*
14.	Teacher	I want to hear one of the girls that are not participating I
15.		Tina and Lívia I
16.		There is a way to know I
17.		*for sure I as she says "for sure", her left hand raises to the forehead and goes down. Her index finger is close to her thumb.*
18.		*if the caterpillar was hungry I left hand goes up and down twice. Her index finger is close to her thumb.*

Figure 4 Discursive interactions in a section of Interaction Unit 2
Source: authors' elaboration

The word that was emphasized – to know – was found before and after IU2. In IU1, the teacher, Nara, and Júlio had used to think that and to know (Figure 5). The teacher started the discussion using the expression to think that when she asked Nara if the student thought that the caterpillar was felling well (L2). Nara answered stating that: "Because I think that she wanted more space" (L5). In this context, the teacher questioned Júlio: Can I be sure of that?", emphasizing the word "sure", through intonation and separating word's syllables. Júlio stated that it was not possible to be sure if the caterpillar was felling good (L13) because Nara did not know (L15). Thus, Júlio used "to know" to point that it was not enough to think that the caterpillar was felling

good (or not). It was necessary to know. If the student (Nara) did not know, she could not answer with certainty.

Interactional Unit 1		
Line	**Speaker**	**Discourse**
1	Teacher	When you looked at that table ǀ
2		Did you think that the caterpillar was not good there ↑
3	Nara	No ǀ ▼
4	Teacher	Why ↑
5	Nara	Because I think she wanted a bi+gger place ▼
6		For doing its things ǀ ▼
7		and the table is not very big ǀ ▼
8	Teacher	Can-
9		Júlio ǀ
10		Can I be su+re that ↑ *As she says the word sure her index finger follows the rhythm of the syllabic division of the word.*
11		She did not like that place ↑ ˪
12	Student	No ˩
13	Júlio	No ǀ ▼
14	Teacher	Why ↑
15	Júlio	Because if she does not know ǀ ▼
16	Teacher	Doesn't know ǀ
17		But we were looking ǀ
18		Weren't we ↑
19	Breno	We were ǀ
20	Teacher	How we are going to know whether she was liking it or not ↑
21	Breno and Júlio	*Raise their shoulders indicating that they do not know how to answer.*
22	Breno	If she was ǀ
23		If she was a+
24	Ramon	I know ǀ *levanta a mão*
25	Breno	That machine that I saw in a cartoon ǀ *he puts his hands on the top of his head*
26	Student	XXXX
27	Breno	No ǀ
28		A machine that I saw in a cartoon that was showing th+
29		the brain from one brain to the other ǀ *starts with the hands on his head, and then, he makes a movement with both hands to the left side*
30	Teacher	Ah+ ǀ
31		So that is what I need to know ↑
32		Is there something inside the brain Breno ↑
33	Students	XXXX

Figure 5. Discursive interactions in a section of Interactional Unit 1 (continue)

Interactional Unit 1		
Line	Speaker	Discourse
34	Teacher	Breno I
35		I nee- *she puts his left hand close to the desks that are in front of her*
36		To know that I have to know something that is going on inside the brain↑ *as she talks she user the left hand do point to the head*
37		Now I am going to ask I
38		I am sure that it moved in circles↑
39	Breno	Yes I
40	Teacher	How ↑
41	Breno	You saw it I
42	Teacher	Because we I
43		Sa+w it I

Figure 5. Discursive interactions in a section of Interactional Unit 1

Source: authors' elaboration

Later, already in IU4, to know appeared again in Vinícius talk in two instances: when the class discussed about whether the beetle that students' brought to the room was male or female (Figure 6).

Interactional Unity **4**		
Line	**Speaker**	**Discourse**
1	Vinícius	Teacher I
2		But is there a way for us to know I
3		Whether is it male or female ↑
4	Ricardo	Ye+s I
5	Paulo	It is just turning it upside down I *He makes a movement with his hands like he was turning a object and observing.*
6	Ricardo	Yes I
7		And if it has the+
8	Teacher	Then we have to make a decision on where we are going to put it I *Teacher is talking about the box with the beetle*
9		because I am travelling today I
10	Vinícius	Yes but we also want to know I
11		Whether it is a male or it is a female I
12	Mariana	Karina I
13		Where ↑ *Teacher makes a gesture asking the student to wait.*

Figure 6. Discursive interactions in a section of Interactional Unity 4 (continue)

Interactional Unity **4**		
Line	**Speaker**	**Discourse**
14	Teacher	Look here ǀ
15		Vinícius is asking a question ǀ
16		And I am getting curious ǀ
17		How do we kno+w ǀ
18		Sh+h ǀ
19	Ricardo	I know ǀ ▲ *raises the right hand*
20		It is easy teacher ǀ *standing up*
21		I+t's ǀ
22		It's just turn it upside down and+ ǀ
23	Vinícius	And if the leg has XXXX
24	Ricardo	It is just get a magnifier *making a gesture of observation with a magnifier*
25	Teacher	Look very well ǀ
26		First thing ǀ
27		Ho+w can we know ǀ
28		Pay attention to Ricardo's question ǀ
29		From Ricardo or from Vinícius ↑
30	Teacher Assistant	Vinícius ǀ *Vinícius raises his hand*
31	Teacher	How can we know ǀ
32		If these beetle is a male or a female ↑
33	Gláucio	Looking it at the bottom ǀ
34	Ricardo	Yes ⌊
35	Vinícius	Ah but XXXX ⌈
36	Teacher	But what are you going to see there ↑
37	Ricardo	It is easy it is easy ǀ *raising his right hand and standing up*
38		Take magnifier lenses and then if there is a pintinho[6] ǀ *Ricardo* makes a gesture of observing with magnifier lenses. *Vinícius disagrees shaking his head.*
39		Or a little thing like that ǀ *makes a movement with index finger of his right hand, moving it forward*
40	Teacher	But ǀ
41		Did we see pintinho in the stick bug ↑
42	Vinícius	No ǀ
43		We saw because we knew ǀ
44		We had a clue ǀ
45		The bigger was the fe+male ǀ

Figure 6. Discursive interactions in a section of Interactional Unity 4

Source: authors' elaboration

6 PINTINHO is a word that Brazilian children use for male genitalia

In this interaction, the initial question that Vinícius raised was framed as a more methodological doubt. The verb to know was part of a discussion that moved in direction of how to build an answer, instead of in direction of generating an answer to whether the beetle was a male or a female. In this case, to know was to have access to a piece of information that sustained a conclusion. As one student suggested that a certain piece of data could be useful to solve the problem, the teacher asked the class if they had faced a similar situation two years before when they were studying the stick bug. As an answer, Vinícius stated: "No! We saw it because we learned, we have a clue." (L42-44). To know, in this case, was related to the same context of the previous conversation: to have access to a piece of data (size of the animal) that make it possible to make a certain statement. In this case, to state whether the stick insect was female or male.

Other words emphasized throughout interactions were more directly related to observation: to look, to see, to observe. In lines 17 and 18 in interaction unit 1 (see Figure 5), the teacher questioned what Júlio had said: "But we were looking, weren't we?" In the context of the discussion around to think that - to know - to be sure that was taking place at this moment, the teacher introduced the verb to look. Since IU1, observation appeared in instructors' and in students' talk, sometimes in the form of to look, sometimes in the form of to observe, but mainly as the verb to see.

To see appeared in other moments in IU1 (see Figure 5): i) when the teacher questioned Nara in line 1 ("When did you look at that table"); and, ii) an emphasis in intonation when she spoke the verb to see as the teacher and Breno interacted. Breno suggested that to discover whether the caterpillar was felling good or not they could switch brains with it. Then the teacher questioned, in line 38: "Am I sure that it moved in circles?" Again, the emphasis is in the word sure. Breno answered yes and the teacher questioned why. In line 41, Breno answered: "You saw it!". The student emphasized the verb see, and the teacher repeated: Because we saw it!" (L42-43). In her statement she emphasized the word see and the vowel "e" was elongated.

In this interaction, contextual cues emphasized the dichotomy that was being constructed between to think that and to know: teacher's emphasis on being sure and to see/saw, and Bruno's intonation when using the verb to see. See was being associated to certainty of an answer in contrast to only think that. It is worth noting that the use of this verb occurred from the first interaction, and then throughout the events. In interactional unit 3, the researcher proposed that the class thought about situations to generate evidence to support an answer (Figure 7).

In the flux of interactions in IU1, the verb to see was associated to being sure of a statement (see Figure 5). Later, in the same telling case, the researcher used this word in IU3 (see Figure 7). The researcher questioned: "What can we do to see if it is really hungry?" (L1-2). In this case, see has a sense close to being sure. However, it is transitioning to a sense of having access to observable data, considering that the question engaged students in doing something that could help the class to build an answer, and not simply seeing the answer. This same use appeared again when the researcher talk in

line 68.

Vinícius and Ramon, who proposed answers to the researcher's question, also used the verb to see in these interactions. The meaning of this verb became to generate new evidence and to interpret evidence. In other words, to see did not mean to be sure anymore and started to mean to observe. Vinícius' proposal was to offer the caterpillar leafs from different plant species to see if she would eat (L37). Thus, if they did that, as a consequence, they would be able to see something that could be used to build an answer – they would not "see the answer" directly. Ramon used the verb to see as he introduced his proposal: "we can see the caterpillar. If its belly is moving in waves, then, it is because it is hungry" (L80-81). For him, the possibility to see the caterpillar was a starting point for the proposal. Since it was possible to see, it would be possible to have a signal to know if she was hungry. Vinícius and Ramon shared the same way of using to see: to observe a piece of data that could support a conclusion.

In IU4 (see Figure 6), the verb to see appeared in Ricardo's and in teacher's talk. Vinícius questioned if there would be a way to know whether the beetle that they found at school was a male or a female. Paulo stated that they should turn the beetle around, and Ricardo completed: "And see if it has the…"(L7). For them, it would be necessary to see a certain anatomic characteristic to give the answer. Using to see in a similar way, Glauco stated that they should look under the beetle (L33). The teacher questioned: "But what we are going to see down there?" (L36). The verb to see was used to ask directly for a piece of evidence. When she heard to Ricardo's suggestion that they would see a penis ("pintinho") of the beetle, the teacher asked: "But did we see the 'pintinho' in the stick bug?" (L40-41). In this case, to see was related not only to observe, but also to the experience of having access to data that helped the group to answer a similar question, in a past event, that is, in another moment of their history.

In IU4 (see Figure 6), the verb to see appeared in Ricardo's and in teacher's talk. Vinícius questioned if there would be a way to know whether the beetle that they found at school was a male or a female. Paulo stated that they should turn the beetle around, and Ricardo completed: "And see if it has the…"(L7). For them, it would be necessary to see a certain anatomic characteristic to give the answer. Using to see in a similar way, Glauco stated that they should look under the beetle (L33). The teacher questioned: "But what we are going to see down there?" (L36). The verb to see was used to ask directly for a piece of evidence. When she heard to Ricardo's suggestion that they would see a penis ("pintinho") of the beetle, the teacher asked: "But did we see the 'pintinho' in the stick bug?" (L40-41). In this case, to see was related not only to observe, but also to the experience of having access to data that helped the group to answer a similar question, in a past event, that is, in another moment of their history.

In IU5, participants used too see and to observe in a similar context of action in IU3 and IU4. The class watched again a video that was exhibited at the beginning of the year. This time, they were trying to find out whether the adult gorilla was the father or the mother (Figure 8).

Interacional Unit 3		
Line	Speaker	Discourse
1	Researcher	What can we do I
2		to see if she is realy hungry ↑ *Vinicius keeps the right hand raised*
3		Does anyone have any idea ↑ *Vinicius keeps the right hand raised*
4		Vinicius wants to talk ↑
[5-28] Discussions with other students		
29.	Vinícius	We can take a+ I
30.		Various types o+f I
31.		Leaves and put there I
32.		if she does not e+at I
33.		if she does not eat one there is the other I
34.		and if she did not eat any then you do not know what she eats I
35.	Researcher	This is a good idea I
36.	Maurício	You may know I
37.	Vinícius	We also can put leaves close to her to see if she eats I
[38-66] Discussions related to Vinícius' proposal		
67.	Researcher	What can we do to I *facing the student Ramon*
68.		To see I
69.		Whether it is hungry or not I
70.		There was a suggestion I
71.		that we already discarded it was to kill it I
72.		And Ra-
73.		Vinícius and Ricardo are telling us the idea of giving it different types of leafs I
74.		Different types of food to see if it would eat something I
75.		we would have a good piece of evidence I
76.	Maurício	XXXX *Ramon raising his hand*
77.	Researcher	Maurício Ramon still have to finish I
78.	Teacher	And Perseu I
79.	Researcher	And Camila I
80.	Ramon	We can see the caterpillar I
81.		so if its belly is moving in waves it is because it is hungry I

Figure 7. Discursive interactions in a section of Interactional Unity 3 [7].

Source: authors' elaboration

7 The interactional unit 3 is very long. Thus, because of space issues, we considered essential to present only a few sections of it, containing interactions in which participants use words/expressions that are discussed in this study.

Interacional Unit 5		
Line	Speaker	Discourse
1	P	The big gorilla I
2		Is it what ↑
3	Guilherme	Whether it is male or female I
4	P	Whether is it the father or the mother I
5		What means male or female I
6		You can go I
7	Students	XXXX
8	Teacher	Sh++h I
9		Nara I
10		Hey Jonas how do you watch the movie seating backwards?
11		IIII *pause for watching the video*
12	Students	XXXX *some make comments during the exhibition*
13	Glauco	We have to observe the big one I
14	Teacher	Sh++h I
15	Student	It is woman I
16	Teacher	Ricardo I
17		Observe I
18	Student	It is the mother I
19	Teacher	Observe I
20	Mariana	It is possible to see a woman there I
21	Teacher	Shh I
22		Observe I
23	Mariana	I saw a woman there behind with trousers I *talking to the researcher*
24		Shh IIII
25	Ricardo	This is a man I
26	Teacher	Ricardo I
27		Observe IIII

Figure 8. Discursive interactions in a section of Interactional Unit 5

Source: authors' elaboration

Just after watching the video, Glauco emphasized: "We have to observe the big one" (L13). The student indicated that the class should be attentive to see something in the big gorilla that could help them to answer the question being discussed. The teacher took up this comment many times, highlighting that the activity required observing (L19-22-27). In these cases, in a similar way of what occurred in the past, to observe was part of the context of using a piece of data to support a conclusion.

In sum, the group constructed discursively "ways of doing" based on the use of these words/expressions over time. The different forms of using words/expressions

throughout interactions indicated how language sustained a process of change in how children constructed the practice of evidence use in the classroom.

To know, for example, was initially associated to being sure of something, in contrast to think that. That happened in a discussion related to establishing distinctions between "know something" and "to think that". Later, to know started to be used as a reference to accessing data that could support conclusions. In a similar way, to see, initially, was associated to being sure of something. Throughout interactions, there was a change. Verbs related to observing, like to see, to look and to observe were used to indicate data observation that could help the class to build answers.

Thus, in participants' perspective, these "ways of doing" became closer to what is understood in the field of science education as using a piece of data to support a claim. This is a key aspect of evidence use in the classroom. The process that took place in this case is represented in Figure 9.

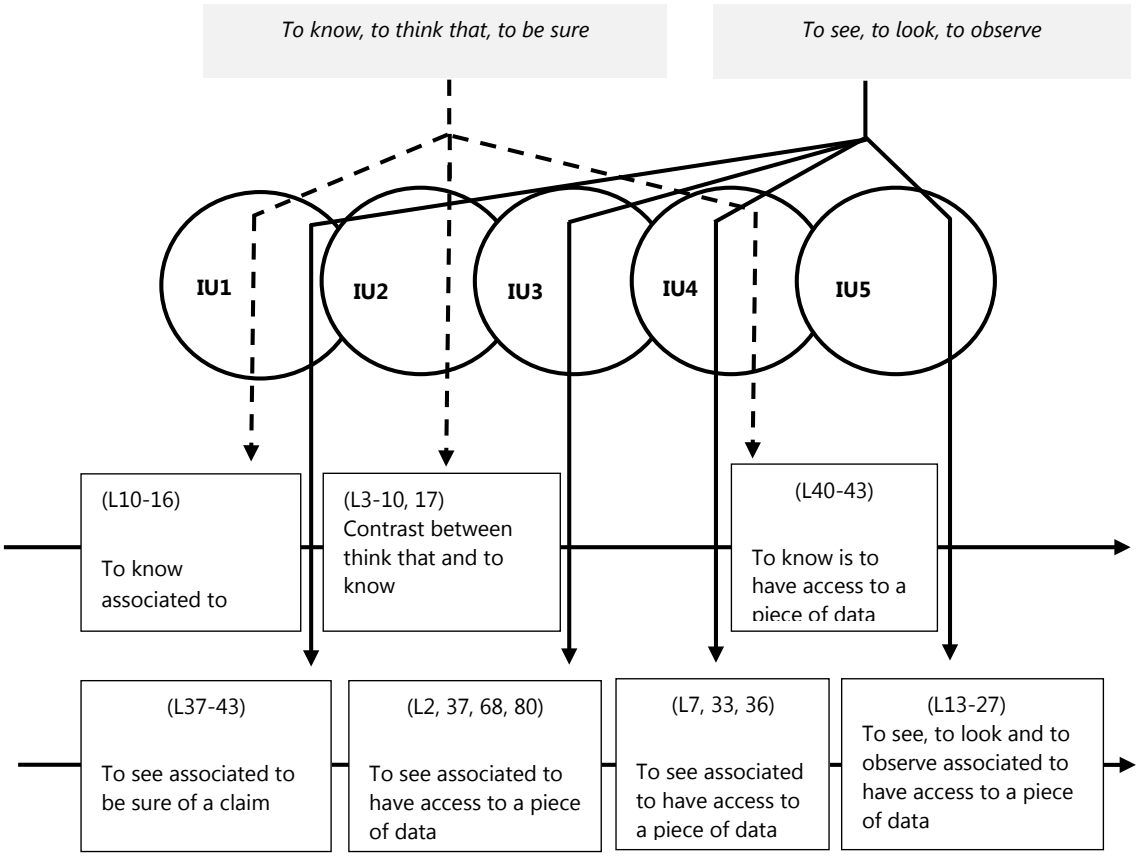

Figure 9. Representation of the use of words/expressions related to actions in the construction of practice of evidence use.

How participants used discursive resources related to these "ways of doing" to negotiate a shared model of how to construct answers to questions in science lessons using evidence?

The discussions that we highlighted did not involve only "providing the right answer" to questions. The interactions indicate the occurrence of negotiation processes around building answers in science lessons. We do not intend to point out that there was a consensus among all the members of the class about how they provide answers in science lessons. Children and teacher were not interviewed about it directly. On the contrary, our inferences were based on discursive resources that participants used/highlighted during discussions.

We described the use of these resources indicating an initial movement of the participants away from building answers based on personal opinions (to think that), in direction to an appeal to the need to be more sure about one's own claims (to know, to see, to be sure).

The use of these resources suffered transformations over time, as to know, to look and to see were not associated anymore to absolute certainty of an answer, and started to indicate access to data that could help in building answers (Figure 10).

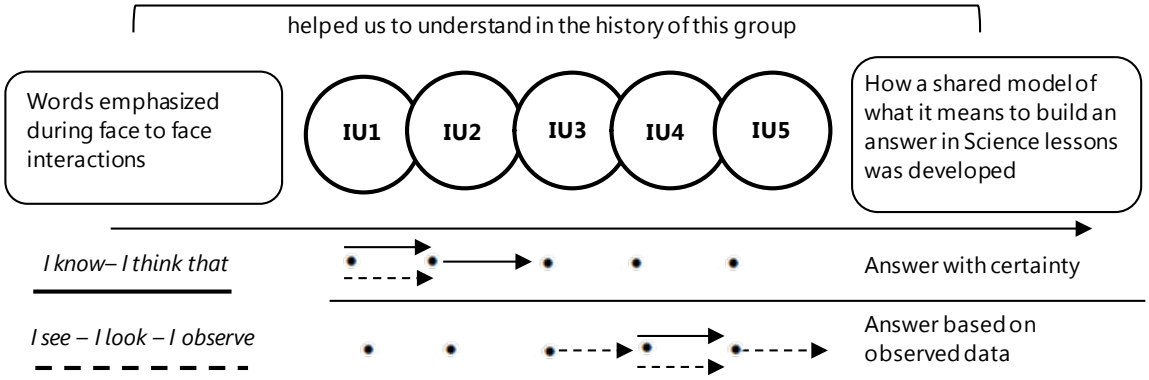

Figure 10. Representation of changes in the process of negotiating a shared model of building answers in science lessons'

Discussion and Implications

In this article, we presented a study based on an ethnographic perspective in education. Based on contextual aspects of face to face interactions, we identified discursive resources related to the construction of practices of evidence use in a 3rd grade classroom, and we discussed participants' negotiations around a shared model for building answers.

In our analyses we emphasized the ways in which participants mobilized discursive resources. Thus, we aimed to learn more about what ethnographers call "talk into being", that is, the ways in which humans, using discursive resources, share,

negotiate and reconstruct practices of everyday life in educational settings/contexts (Green & Dixon, 1993).

The results made visible characteristics of everyday life of a specific group during science lessons. Thus, the changes in the use of discursive resources that we described are situationally defined, and they are immersed in a series of experiences and contexts that are intertwined with participants' lives. Therefore, it is essential to sustain a dialogue with other studies about evidence use among children.

A first important aspect in this dialogue is the movement of distinguishing between personal opinions and evidence use in the process of building answers. Other researchers have also investigated particularities of this process. Berland e McNeill (2010), for example, highlight the role of the teacher. These authors indicated that the teacher had an important role in helping students to characterize arguments in an explicit manner to make distinctions between an opinion and evidence. In the events reported in our study, we observed another way of acting. In the first events, the teacher did not refer to evidence or arguments in an explicit way. However, she tried to engage students in a different way of thinking about answers, something that required observing to formulate claims. Explicit references to evidence occurred only later on.

The study of Monteira and Jiménez-Aleixandre (2015) brings important aspects for discussing our results. These authors studied a group of children throughout a year, and the interactions that they presented have parallels with our analyses. There are students that also refer to "seeing" to warrant certainty of an answer. Moreover, the teacher tried to make a distinction between what students "thought/imagined" and tests that the group would conduct. Therefore, we indicate that these aspects were significant in this study too. In that case, the authors' analysis focused on the relevant role of observation as a long-term practice that was important in the process of revising answers that the group built.

In this direction, we understand that in the context of elementary school, children are introduced to a series of school practices very different from prior experiences (Neves et al., 2011). This also applies to practices of school science that will follow them throughout their schooling trajectory. This requires that we pay special attention to introducing these practices. Thus, we point out that something particularly relevant in this context refers to the construction of distinctions between different ways of building answers. Children can be introduced to evidence use – an aspect essential to the way people build answers in school science – even before the teacher talks explicitly about evidence. That is, using evidence in elementary school also involves developing an understanding of what is and how to build a 'good' answer in school science.

Another aspect that caught our attention refers to the paths that participants followed in building answers. Since the first interactional unit that we analyzed, there were questions that teacher, students and researchers posed that generated conflicting answers. Throughout the events, these disagreements led participants to work with data that was related to a shared model (Bloome et al., 2005) of how to build answers using

evidence.

Sasseron e Carvalho (2014), in a study about children's use of evidence, note that there are other ways to build answers. As the authors studied actions in science lessons that contributed to argument construction, they identified a counterintuitive path: the starting point for working with evidence was discussions around a claim. In this case, participants' claims/answers were constructed based on the occurrence of various situations in which children analyzed data that the teacher had provided. In our study, discussions around the interpretation and use of evidence also appear to be significant. However, these discussions occurred in situations in which children made claims and they posed questions that led them to search for evidence and to analyze them.

Therefore, these studies combined to results of our research help us to learn about the diversity of ways to construct practices of evidence use. This requires that researchers in science education develop deeper understandings of the meaning of these practices for children, as well as explore new possibilities for introducing them in school science.

This implication is related to another relevant aspect of this study: the feasibility and importance of developing studies that value argumentation as process in science lessons. This gap in science education literature may derive from what McDonald and Kelly (2012) have called a crystalized view about what is arguing, and it has motivated researchers to develop alternative tools for analyses.

The methodological approach that we present has a significant contribution in this research context. As we address evidence use over time, we developed analyses that focus more on changes in students' argumentation, instead of focusing on products of argumentation. To do so, we contrasted different moments of group's history in science lessons to give more visibility to continuities and changes in what is was "to use evidence" for participants.

Moreover, contextual characteristics of participants' talk oriented our inferences. Thus, we valued another challenging aspect of research on argumentation: moving from analyses of the content of discourse to its form (Gumperz, 1982; Hymes, 1974). As we used signals like emphasis, intonation, pauses and volume in talk, we highlighted the way teacher and students constructed argumentation (form) and not only what was said (content).

Finally, we emphasize that these elements of an ethnographic perspective can be associated to constructs from the field of science education in a fruitful manner. In the present study, for example, we associated notions that are used often in studies about argumentation like the notion of evidence based in Toulmin (2006), with analyses with elements of Interactional Ethnography and Microethnography. Thus, we pointed the importance of combining different frameworks, aiming to develop analyses that are closer to what participants experience as arguing and as using evidence in the classroom.

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References

Agar, M. (1994). *Language shock*: *Understanding the culture of conversation*. New York: William Morrow and Company.

Andrews, P. (2016). Is the 'telling case' a methodological myth? *International Journal of Social Research Methodology*, *19*(2), 1–13. doi: 10.1080/13645579.2016.1198165

Berland, L. K., & McNeill, K. L. (2010). A learning progression for scientific argumentation: Understanding student work and designing supportive instructional contexts. *Science Education*, *94*(5), 765–793. doi: 10.1002/sce.20402

Berland, L., & Reiser, B. J. (2009). Making sense of argumentation and explanation. *Science Education*, *93*(1), 26–55. doi: 10.1002/sce.20286

Berland, L., & Reiser, B. J. (2011). Classroom Communities' Adaptations of the Practice of Scientific Argumentation. *Science Education*, *95*(2), 191–216. doi: 10.1002/sce.20420

Bloome, D. (2012). Classroom Etnography. In M. Grenfell, D. Bloome, C. Hardy, K. Pahl, J. Powsell, & B. V. Street. *Language, Ethnography, and Education: Bridging New Literacy Studies and Bourdieu* (pp. 7–26). New York: Taylor & Francis.

Bloome, D., Carter, S. P., Christian, B. M., Madrid, S., Otto, S., Shuart-Faris, N., & Smith, M. (2008). *Discourse Analysis in Classrooms: Approaches to Language and Literacy Research.* Nova York: Teachers College Press.

Bloome, D., Carter, S. P., Christian, B. M., Otto, S., & Shuart-Faris, N. (2005). *Discourse Analysis and the Study of Classroom Language and Literacy Events*: *A Microethnographic Perspective*. Mahwah: Lawrence Erlbaum.

Bloome, D., Katz, L., Hong, H., May-Woods, P., & Wilson, M. (2013). Methodologies in Research on Young Children and Literacy. In J. Larson, & J. Marsh, (Orgs.), *Handbook of Early Childhood Literacy* (pp. 605–632). 2nd Ed., London: SAGE Publications.

Capecchi, M. C. V. de M. (2013). Problematização no Ensino de Ciências. In A. M. P. Carvalho (org.). *Ensino de Ciências por Investigação*. São Paulo: Cengage Llearning.

Carvalho, A. M. P. (2013) *Ensino de Ciências por Investigação*. São Paulo: Cengage Llearning.

Castanheira, M. L. (2004). *Aprendizagem contextualizada*: discurso e inclusão na sala de aula. Belo Horizonte: Ceale, Autêntica.

Castanheira, M. L., Crawford, T., Dixon, C., & Green, J. (2001). Interactional Ethnography: an Approach to Studying the Social Construction of Literate Practices. *Linguistics an Education*, *11*(4), 353–400. doi: 10.1016/S0898-5898(00)00032-2

Ferraz, A. T., & Sasseron, L. H. Propósitos epistêmicos para a promoção da argumentação em aulas investigativas. *Investigações em Ensino de Ciências*, *22*(1), 42–60. Retrieved from https://www.if.ufrgs.br/cref/ojs/index.php/ienci/article/view/312

Franco, L. G. S., Cappelle, V., Munford, D. & França, E. S. (2014). Estudando o besouro rola-bosta: Uma sequência de aulas investigativas nos Anos Iniciais do Ensino Fundamental. Revista da SBEnBio, *7*, 5143–5154. Recuperado de http://www.sbenbio.org.br/wordpress/wp-content/uploads/2014/11/R0135-1.pdf

Franco, L. G. S., & Munford, D. (2016). Raising questions and trying to answer them: a study of students' use of second hand data. In J. Lavonen, K. Juuti, J. Lampiselka, A. Uitto, & K. Hahl (eds). *Eletronic Proceedings of the ESERA 2015 Conference. Science Education Research: Engaging Learners for a sustainable future* (pp. 979–990). Part 7/Strand 7, Ed. M. Andrée, & A. P. Jiménez-Aleixandre, A. P. Helsinki, Finlândia: University of Helsinki.

Green, J., & Dixon, C. (1993). Talking knowledge into being: Discursive and social practices in classrooms. *Linguistics and Education***,** 5(3), 231–239. Retrieved from https://www.researchgate.net/publication/234654077_Talking_Knowledge_into_Being_Discursive_and_Social_Practices_in_Classrooms

Green, J., Dixon, C., & Zaharlic, A. (2005). A etnografia como uma lógica de investigação. *Educação em Revista*, Belo Horizonte, *42*, 13–79.

Green, J., & Wallat, C. (1981). *Ethnography and language in educational settings*. Norwood, NJ: Ablex.

Green, J., & Baker, W. D. (2017). Interactional Ethnography as a Non-Linear Logic-in-Use: A Guidebook for Developing a Conceptually Driven Logic-of-Inquiry. In *Midwinter Conference of NCTEAR* – National Council of Teachers of English Assembly for Research, San Francisco State University, SF.

Gumperz, J. J. (1982). *Discourse Strategies*. 1st edition. Cambrige University Press.

Hymes, D. (1974). *The foundations of sociolinguistics: Sociolinguistic ethnography*. 1st edition. Philadelphia: University of Pennsylvania Press.

Hug, G. B., & McNeill, K. L. (2008). Use of First-hand and Second-hand Data in Science: Does data type influence classroom conversations? *International Journal of Science Education*, *30*(13), 1725–1751. doi: 10.1080/09500690701506945

Ibraim, S. S., & Justi, R. (2016). Teachers' Knowledge in Argumentation: Contributions from an Explicit Teaching in an Initial Teacher Preparation Programme. *International Journal of Science Education*, *38*(12), 1996–2025. doi 10.1080/09500693.2016.1221546

Jaber, L. Z. & Hammer, D. (2016). Learning to Feel Like a Scientist. *Science Education, 100*(2), 189-220. doi: 10.1002/sce.21202

Jiménez-Aleixandre, M. P. & Erduran, S. (2008). Argumentation in Science Education: An Overview. In M. P. Jiménez-Aleixandre, & S. Erduran, S. *Argumentation in Science Education*: *perspectives from classroom based research* (pp. 03–25). Dordrecht: Springer.

Kelly, G. J. (2005). Discourse, description, and science education. In R. Yerrick & W. M. Roth (eds.). *Establishing Scientific Classroom Discourse Communities: Multiple Voices of Research on Teaching and Learning* (pp. 79–108). Mahwah, NJ: Lawrence Erlbaum.

Kelly, G. J. (2014). Inquiry teaching and learning: Philosophical considerations. In M. R. Matthews (ed.) *Handbook of Historical and Philosophical Studies in Science Education* (pp. 1363–1380). Dordrecht: Springer.

Knight-Bardsley, A. M., & McNeill, K. L. (2016). Teacher's pedagogical design capacity for scientific argumentation. *Science Education*, *100*(4), 645–672, 2016. doi: 10.1002/sce.21222

Kuhn, D. (1993). Science as argument: implications for teaching and learning scientific thinking. *Science Education*, 77(3), 319–337. doi: 10.1002/sce.3730770306

Manz, E., & Renga I. P. (2017). Understanding how teachers guide evidence construction conversations. *Science Education*, *101*(4), 584–615. doi: 10.1002/sce.21282

Martins, M., Ibraim, S. de S., & Mendonça, P. C. C. Esquemas argumentativos de Walton na análise de argumentos de professores de química em formação inicial. (2016). *Ensaio Pesquisa em Educação em Ciências*, *18*(2), 49–71. Retrieved from http://www.scielo.br/pdf/epec/2016nahead/1983-2117-epec-2016180203.pdf

McDonald, S. P., & Kelly, G. J. (2012). Beyond Argumentation: Sense-Making Discourse in the Science Classroom. In M. S. Khine (ed.) *Perspectives on Scientific Argumentation*: *Theory, Practice and Research* (pp. 265–281). Dordrecht: Springer.

Mitchell, C. J. (1984). Typicality and the case study. In: Ellens, R. F. (ed.), *Ethnographic research*: A guide to general conduct. New York: Academic Press.

Monteira, S. F., & Jiménez-Aleixandre, M. P. (2015). The Practice of Using Evidence in Kindergarten: The Role of Purposeful Observation. *Journal of Research in Science Teaching*, *52*(6), 1–27. doi: 10.1002/tea.21259

Munford, D., & Lima, M. E. C. C. (2007). Ensinar ciências por investigação: em que estamos de acordo? *Ensaio Pesquisa em Educação em Ciências, 9*(1). Retrieved from http://www.portal.fae.ufmg.br/revistas/index.php/ensaio/article/view/122/172.

Munford, D., Souto, K. C. N., & Coutinho, F. A. (2014). A etnografia de sala de aula e estudos na educação em ciências: contribuições e desafios para investigações sobre o ensino e a aprendizagem na educação básica. *Investigações em Ensino de Ciências*, *19*(2), 263–288. Retrieved from https://www.if.ufrgs.br/cref/ojs/index.php/ienci/article/viewFile/80/55.

Munford, D., & Teles, A. P. S. S. (2015). Argumentação e a construção de oportunidades de aprendizagem em aulas de ciências. *Ensaio Pesquisa em Educação em Ciências*, 17, 161–185. Retrieved from http://www.scielo.br/pdf/epec/v17nspe/1983-2117-epec-17-0s-00161.pdf.

National Research Council. (2012). *A Framework for k12 Science Education*: Practices, Crosscutting Concepts and Core Ideas. New York, National Academy Press.

Neves, V. F. A., Gouvêa, M. C. S., & Castanheira, M. L. (2011). A passagem da educação infantil para o ensino fundamental: tensões contemporâneas. *Educação e Pesquisa*, São Paulo, *37*(1), 121–140. Retrieved from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1517-97022011000100008.

Osborne, J., Erduran, S., & Simon, S. (2004). TAPing into argumentation: developments in the application of Toulmin's argument pattern for study science discourse. *Science Education, 88*(6), 915–933. doi: 10.1002/sce.20012

Ryu, S., & Sandoval, W. A. (2012). Improvements to Elementary Children's Epistemic Understanding from sustained Argumentation. *Science Education, 86*(3), 488–526. doi: 10.1002/sce.21006

Sandoval, W. A., & Millwood, K. A. (2008). What can argumentation tell us about epistemology? In M. P. Jiménez-Aleixandre, & S. Erduran (eds.). *Argumentation in Science Education*: *Perspectives from classroom-based research* (pp. 68–85). Dordrecht: Springer.

Sasseron, L. H., & Carvalho, A. M. P. (2008). Almejando a alfabetização científica no ensino fundamental: a proposição e a procura de indicadores do processo. *Investigações em Ensino de Ciências*, *13*(3), 333–352. Retrieved from https://www.if.ufrgs.br/cref/ojs/index.php/ienci/article/view/445/263.

Sasseron, L., H. & Carvalho, A. M. P. (2014). A construção de argumentos em aulas de ciências: o papel dos dados, evidências, e variáveis no estabelecimento de justificativas. *Ciência & Educação, 20*(2), 393–410. Retrieved from http://www.scielo.br/pdf/ciedu/v20n2/1516-7313-ciedu-20-02-0393.pdf.

Scarpa, D. L., & Trivelato, S. L. F. Movimentos entre a cultura escolar e cultura científica: análise de argumentos em diferentes contextos. *Revista Internacional de Investigación en Educación*, *6*(12), 69–85. Retrieved from http://revistas.javeriana.edu.co/index.php/MAGIS/article/view/7202

Spradley, J. P. (1980). *Participant Observation*. Harcourt Brace Jovanovich College Publishers. Orlando, Florida.

Toulmin, S. E. (2006). *Os usos do argumento*. 2ª ed. São Paulo: Martins Fontes.

Wolcott, H. F. (1994). *Transforming qualitative data*. Thousand Oaks, CA: Sage.

Yun, S. M., & Kim, H. (2015) Changes in Students' Participation and Small Group Norms in Scientific Argumentation. *Research in Science Education*, *45*(3), 465–484. Retrieved from https://link.springer.com/article/10.1007/s11165-014-9432-z

Zembaul-Saul, C., McNeill, K. L., & Hershberger, K. (2013). *What's your evidence?* Engaging k-5 in constructing explanations in science. New York, Pearson Allyn & Bacon.

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