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Argumentation in Science Teacher Education: The simulated jury as a resource for teaching and learning

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In this article, we focus on the contributions that a simulated jury-based activity might have for pre-service teachers, especially for their active participation and learning in teacher education. We observed a teacher educator using a series of simulated juries as teaching resources to help pre-service teachers develop their pedagogical knowledge and their argumentation abilities in a physics teacher methods course. For the purposes of this article, we have selected one simulated jury-based activity, comprising two opposed groups of pre-service teachers that presented aspects that hinder the teachers' development of professional knowledge (against group) and aspects that allow this development (favor group). After the groups' presentations, a group of judges was formed to evaluate the discussion. We applied a multi-level method for discourse analysis and the results showed that (1) the simulated jury afforded the pre-service teachers to position themselves as active knowledge producers; (2) the teacher acted as 'animator' of the pre-service teachers' actions, showing responsiveness to the emergence of circumstantial teaching and learning opportunities and (3) the simulated jury culminated in the judges' identification of the pattern 'concrete/obstacles–ideological/possibilities' in the groups' responses, which was elaborated by the teacher for the whole class. Implications from this study include using simulated juries for teaching and learning and for the development of the pre-service teachers' argumentative abilities. The potential of simulated juries to improve teaching and learning needs to be further explored in order to inform the uses and reflections of this resource in science education.

Keywords: *Simulated Jury; Discourse; Argumentation; Physics Education*

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Introduction

Discourse analysis of classroom interactions is spreading worldwide (Kelly, 2007) as a way to understand and rethink instructional discourse. Following this trend, in recent years researchers and national reports have called for more argumentation practices in science education (Commission, EACEA, Eurydice, 2012; National Research Council [NRC], 2012; Newton, Driver, & Osborne, 1999). In this new approach to teach science, argumentation is conceived not only as a mode of teaching that offers contributions for the development of content knowledge (Van Aufschnaiter, Erduran, Osborne, & Simon, 2008), but also as a means to understand and engage in scientific practices (Osborne, 2014). Despite the contributions brought to the field from the emphasis on argumentation, relatively few studies have focused on teacher education, with most of them placing an emphasis on elementary science education (Evagorou & Dillon, 2011; Friedrichsen, Driel, & Abell, 2010; McNeill & Krajcik, 2012; Zembal-Saul, 2009), and less emphasis on physics education (Kelly, 2007; Osborne, Simon, Christodoulou, Howell-Richardson, & Richardson, 2013).

In this perspective and in face of the need to promote more argumentative practices in science education (Bybee, 2011; Driver, Newton, & Osborne, 2000; Duschl & Osborne, 2002; Jiménez-Aleixandre & Erduran 2008; NRC, 2012), we are interested in understanding how teacher educators introduce argumentation in their courses as a mode of teaching, as well as in how they encourage the development of the students' (future teachers) argumentative abilities through a variety of experiences.

As studies have shown (Abd-El-Khalick, 2003; Dawson & Venville, 2010; Knight & McNeill, 2011; Osborne et al., 2013; Simon, Erduran, & Osborne, 2006; Zembal-Saul, Munford, Crawford, Friedrichsen, & Land 2002), the promotion of argumentative activities in teacher education is an important step to introduce argumentation in basic education. Some studies attempted to explore how argumentation can be used as a mode and goal of teaching through explicitly instruction (Sadler, 2006; Simon et al., 2006), through the uses of role-play (McSharry & Jones, 2000; Simonneaux, 2001) and through scaffolding computer oriented activities (Cho & Jonassen, 2002; Zembal-Saul, Munford, Crawford, Friedrichsen, & Land, 2002). However, the uses of simulated juries as a resource and mode of teaching for promoting argumentation in these contexts remain still unexplored.

We acknowledge the simulated jury as a particular type of role-play activity (McSharry & Jones, 2000). In simulated jury activities, future science teachers (hereinafter referred also as 'pre-service teachers') can assume different roles, such as defender, opponent and judge of the posed arguments (for a theoretical account of these argumentative roles, see Plantin, 2005). Also, they can interchange their roles, exerting all the role possibilities and, of course, can experience roles that they do not necessarily assume as yours in one given situation (Vieira, Melo, & Bernardo, 2014). Finally, in these juries pre-service teachers are expected to have active roles in knowledge production, which may have positive impact on their learning.

We consider that such opportunities afforded by simulated juries contribute for future teachers in exercising and gain competence of the 'decentralization process,'

a process that is strongly related to their scaffolding postures in teaching science. The scaffolding implies giving support to students' arguments, which initially may be naïve and lacking coherence. Therefore, scaffolding processes are important in forwarding classroom discourse and in affording opportunities to the evolution of contrapositions between everyday and scientific arguments (McNeil, Lizotte, & Krajcik, 2006). From this point of view, the teacher may defend and offer justifications for arguments he or she does not necessarily agree in favor of the discussion development, as we showed elsewhere (Vieira, Kelly, & Nascimento, 2012).

In simulated juries, the future teachers can put themselves into the other's perspective (decentralization process), which contributes for developing their scaffolding postures and to widening their understanding of the counter-positions and counter-arguments of the topic that has been discussed. Furthermore, the understanding and development of the rebuttals and counter-positions by participants engaged in argumentation are strongly recommended by the literature (Cho & Jonassen, 2002; Simon et al., 2006; Simonneaux, 2001; Zembal-Saul et al., 2002).

There are a number of studies that document efforts in helping future teachers to introduce argumentation in the teaching of science (Sadler, 2006; Simon et al., 2006; Simonneaux, 2001; Zembal-Saul et al., 2002). However, we did not find studies in the literature that explore the uses of simulated juries as a teaching resource in the teacher education, especially in the physics teacher education. As we have suggested before, such simulated juries offer opportunities for future teachers to exercise the decentralization process and situate themselves in the other's perspective. And this is, in our view, a very important experience that helps teachers become more confident with argumentation processes in their science classrooms.

At this point, it is worth noting that the simulated juries would afford different teaching and learning opportunities than more traditional class-activities. It is still to be explored in detail which is the contribution that the simulated jury activities bring into science teaching and to teacher education. We address this problem in this article by analyzing the discourse features of one simulated jury activity, such as the teacher's and the pre-service teachers' actions and roles, and their relations to learning and discourse production. Through this analysis, we show how the jury-based activity constituted a way of affording argumentation in a physics teacher methods class. The importance of this approach lies in the fact that:

- physics teachers and pre-service physics teachers do not have much opportunities to engage in argumentation and understand how to use it in their classes, and if simulated juries is working then it can be used as an alternative;
- simulated juries has additional contributions beyond argumentation given that: (1) participants interchange their roles, having opportunities to attack, defend and evaluate arguments from different perspectives; (2) they experience the decentralization process and (3) participants' roles are well established from the outset of the juries, so, we expect that this contributes for facilitating the students' evaluations of the posed arguments when acting as judges.

By means of discourse analysis, in this article we show how one simulated jury-based class activity contributed for the pre-service teachers participation, for the construction of their identities as active knowledge producers and for improving their learning. In this analysis, we focus in showing how the teacher's actions contributed for the promotion and management of this activity and for the development of the ongoing teaching and learning opportunities.

Related to this perspective, we raised the following questions:

(1) How the teacher and the pre-service teachers constructed instructional conversations in one simulated jury-class activity?
(2) Which teaching and learning opportunities were afforded by this activity and how they were addressed by the teacher?
(3) Which were the pre-service teachers' evaluations of the impact of the simulated juries on their learning during the physics teaching methods course?

Literature Review

Many official documents report the need of promoting the students' learning of more processes of science, which include the understanding of the role of argumentation in accomplishing science (American Association for the Advancement of Science, 1993; Commission et al., 2012; NRC, 1996; NRC, 2012; Brasil, 1999; Brasil, 2002). In this new perspective for teaching and learning science, students are meant to engage in more active roles in open-ended inquiries and in reasoned discussions, which include the consideration and debate of socioscientific issues and learning about the nature and history of science. That is, there is a clear trend in contemporary science education in promoting learning 'science as argument' (Kuhn, 1993; Osborne, 2010; Zembal-Saul, 2009).

However, science teachers and future teachers still lack of instruction regarding these new recommendations for science teaching. According to Duschl and Osborne (2002, p. 1), 'An examination of recent policy reports [...] strongly suggest that classroom and school environments and teaching practices, for all intents and purposes, remain essentially unchanged during this 50 year period.' Additionally, Osborne (2010) suggests that teacher training should be an ongoing process in which teachers engage and become familiar with various aspects of the scientific practices, starting from small activities and then getting into more detail. In the Brazilian context, the uses of argumentation-based activities is yet to be seen as a routine to be included in science classroom interactions, both in science education and in teacher education.

In response to this gap, a number of studies were designed to investigate how argumentation would be introduced into classroom. We will comment the results of some studies that are more related to our research interest in simulated juries.

Simonneaux (2001) established a comparison between teaching students via role-play and conventional debate situation for the same issue (animal transgenesis). Her study was conducted in two classes at the Agricultural Lycée in Auch, with

students in their second year of upper secondary vocational education geared to scientific subjects. She found that 'the main obstacle concerning the role-play was the teachers' lack of familiarity with role-play practice' (pp. 933). She goes on and, based on Kolstoe (2000), states that 'role-playing increases possibility to understand other people's point of view when you have to place yourself in their situation' and 'some (students) emphasized the difficult of acting the part of a person they did not agree with' (pp. 924). Such considerations are related to our assumptions regarding the simulated jury activities and reinforce the need to use role-play activities and simulated juries as a way to develop the students' and the teachers' arguments and their argumentative abilities. Also, if future teachers are meant to scaffold the students' arguments, then the simulated juries can contribute to this ability, since they would experience roles they do not agree with. We consider that this 'decentralization process' may be required for teachers when promoting and scaffolding argumentative discourse in their science classrooms. From this perspective, the relevance of the uses of simulated jury activities in science teacher education is clear.

Zembal-Saul and colleagues (2002) conducted a qualitative investigation on the uses of the software 'Galapagos Finches' in scaffolding pre-service science teachers' arguments. They made an in-depth analysis of two pair of pre-service science teachers enrolled in an advanced methods course. The authors found a number of results, from which we highlight the following. The pairs exhibited a number of limitations reported in the literature, such as the lack of alternative explanations, the nonuse of different types of evidence to support a claim and hasty conclusions and generalizations. Also, they did not provide justification (what links the data to a claim, that is, a warrant). And finally, there was the rejection of anomalous data, that is, data that serve as a counter evidence to the claim being pursued. These results confirm that approaching science learning with an emphasis on argumentation is complex and fraught with difficulties.

The authors state that the 'teachers' lack of pedagogical strategies to support students in engaging in argumentation, as well as the limited resources to assist teachers in doing so, have been identified as the major barriers to the inclusion of argumentation in school science' (pp. 440). We acknowledge that the simulated jury activities constitute an alternative resource to approach such a complex emphasis on argumentation in science teaching, especially in addressing explicitly alternative and counter-positions regarding a given subject. In this sense, it is important to note that in simulated jury activities there are formal and explicit separations of the positions in favor and against a given question, as well as the evaluations by the judges of the posed arguments and positions, which may contribute to enlarge the students' awareness of the positions and counter-positions been presented.

In a large research design, Simon and colleagues (2006) aimed to inform the teaching of argumentation in secondary science classrooms. They offered workshops and provided instructional resources for a group of 12 teachers from schools of the Greater London. Classes were audio and video recorded while teachers taught one zoo lesson. The authors assessed the quality of the arguments generated in classroom with the support of the Toulmin's argument pattern. In order to inform future

professional development, the practices of five teachers were analyzed in detail. For the concern of our study, we bring the case of Lucy, a teacher who used a role-play approach to teach the zoo lesson (a socioscientific issue about funding a new zoo). She organized roles to different students and organized students in pairs having opposing positions. By contrasting the teachers' practices, the authors found that Lucy was among the group of teachers who showed high-order processes in promoting argumentation in classroom.

We recognize that Lucy's uses of role-play had a positive impact in helping her to establish argumentation, since role-play activities demand explicitly separation and evaluation of positions; in fact, we consider that the role-play activity was a way to orchestrate counter-argument within her teaching. Thus, this perspective reinforces our argument about the need to bring more light into the uses of role-play and simulated jury activities in science teaching and in teacher education.

Cho and Jonassen (2002) studied the effects of scaffolds on argumentation and problem-solving of students enrolled in an undergraduate introductory economics course at a major university in the east of USA. From the outset, they recognize that 'direct instruction in argumentation has produced inconsistent results' (pp. 05), which motivated them to study the effects of online argumentation scaffolds to engage and support the students' development of coherent argumentation. Among their conclusions, we stress the following:

> We conclude that ill-structured problems are more affected by argumentation than well structured problems. [...] ill-structured problems provide students with more opportunities to make arguments than well-structured problems. (pp. 19)

The authors state that 'the use of rebuttals is a requirement for solving ill-structured problems' (pp. 19). We consider that the simulated jury activities are open-ended opportunities to students engage in attacking, defending and evaluating positions and problems that do not have one definitive and unique solution. That is, we argue that the simulated jury activities are akin to ill-structured problems and can influence positively the students' production of arguments and rebuttals, as well as to increase their awareness regarding the discussion that has been developed.

This review was meant to provide reasons for introducing simulated juries in science teaching and in teacher education programs. In the next section, we provide a rationale for comprehension of simulated juries and argumentation in science teaching.

Study Rationale—Role-Play, Argumentation and Simulated Juries

According to McSharry and Jones (2000), when engaged in role-play activities the students are meant to exert a determined role, that is, they have to imagine and pose themselves in a character's role, and their contributions to the ongoing activity have to be posed from this role perspective.

We comprehend that the simulated jury activity is a particular type of role-play, the specificity of which is that the engaged people are separated in groups which act in

favor, against, and as judges in a discussion about a given topic or question. That is, in simulated juries there are attackers, defenders and judges of a main given question. In a simulated jury-based classroom activity, the teacher may assume one of these roles, or be a mediator. In assuming the role of mediator, the teacher organizes and structures the groups' contributions.

Although the aforementioned roles are always present in a simulated jury activity, the way they operate would vary, which leads to differentiation of types of this activity. For example, in the observed classes, the juries comprised both face-to-face argumentations (one group present a claim that is counter-argued in the sequence by the other group) and separated presentation sections (one group presents a full set of claims and justifications and then the other groups present their set of claims), which was the case for the simulated jury analyzed in this article. The contribution of the judges would also vary: they can evaluate each of the arguments and claims during ongoing interactions or evaluate the two whole sections at the end of the jury activity. Other operational types of interactions in the simulated jury activities are possible, and may influence the class discursive production and, thus, may affect the learning outcomes.

Argumentation is a process of justifying claims through the presentation of evidence and data, and aims to convince or change one's opinion (Jiménez-Aleixandre & Erduran, 2008). The dialectical approach to argumentation (Billig, 1996; Kuhn, 1993) understands that one argument gains its meaning from the counter-posing of rebuttals or the counter-argument it seeks to respond. The link between argumentation and simulated juries is evident from this perspective, since in the simulated juries the students have to claim, counter-claim, ground their claims and evaluate them. But there is one important difference between more traditional argumentation and simulated juries: in the former the individuals' roles can change as a result of the convincing process; in the latter the roles are meant to be same during the thorough discussion, even if one's opinion was changed. Another aspect to be noted is that in simulated jury activities the roles are well established from the outset, which may facilitate the judges' evaluations.

Another important feature that distinguishes the simulated juries from more traditional argumentation processes is that in simulated juries people can interchange their roles, that is, they can exert a role in one activity and another role in a second activity regarding the same topic under discussion. In this sense, the students can experience and appreciate the role of counter-positions in the construction of arguments, which would propitiate the emergence of more complex discussions about a given topic, as was the case for two simulated jury activities regarding a socioscientific issue in the observed classroom: in the first day the pre-service teachers were divided into judges (two individuals), attackers and defenders of 'irregular electric connections.' In the second day, the activity followed the same structure, but the pre-service teachers interchanged their roles. The arguments production increased and acquired more complex forms in the second day, possible due to the development of the arguments posed in the first day, as well as the pre-service teachers' experience with the 'other side' role. For these juries, the pre-service teachers were asked to produce relevant written arguments in home previous to the discussion.

Given this picture on simulated jury activities, we consider the need to explore how the simulated juries contribute for argumentation processes and to the students' learning in science and teacher education classrooms through the teacher's orchestration of actions and procedures. In order to meet this issue and aiming to inform the field, we explore and analyze in detail the uses of one simulated jury activity in a physics teaching methods course. In our analysis, we provide a theoretically discourse-based perspective into the teacher educator's and the pre-service teachers' actions and roles. In the next section, we describe the context of production of this simulated jury activity.

The Context Investigated

The fourth author used an ethnographic orientation to collect data in a pre-service teacher physics methods course. The first author functioned as the course teacher educator (hereinafter called 'teacher') and had experience in teaching science in basic education. The purpose of the course was to develop the pre-service teachers' pedagogical knowledge through a variety of experiences. The teacher's openness to introduce innovations in classroom and his experience as an instructor and researcher were the reasons to investigate his discursive practices, since we expect they could inform other practitioners. The course observed was taught over one semester in a public university in Brazil. The course had approximately 26 contact hours and was mandatory for all undergraduate students (pre-service teachers) majoring in physics teacher education. Classes were videotaped and field notes were taken.

The discourse within this course developed from discussions of theoretical texts from the field of education and more specifically from teacher education, and from science education in particular, and their consequences to teaching science. The simulated juries were used by this teacher as a resource to promote discussions and content learning concerning the theoretical texts. Also, at the end of the course the teacher used two simulated juries for promoting discussion about a socioscientific issue: The problem of 'irregular electric connections' in the Brazilian commerce and residences. The pre-service teachers were evaluated based upon written work they completed concerning the texts discussed.

In this article, we present analysis of the eighth class of this course that comprised a simulated jury activity concerned with the theoretical text 'The teachers' knowledge and training,' authored by Tardif (2002). This text is an important and influential reference in the Brazilian literature concerning the teachers' professional knowledge and their professional development. In the previous class, also a simulated jury-based class, two groups of pre-service teachers (against and in favor of the ideas of the text) were asked to raise questions in favor and against the same text. The group of judges was asked to select a question and then the teacher developed discussion with the whole class about the selected question. The same structure operates in the next rounds: the groups raise a new question (against and in favor of the ideas of the text) and then the judges select one for discussion. In Class 8, the roles of the pre-service teachers in relation to the roles pursued in the previous class were changed. So,

there was an interchange of argumentative roles from Class 7 to Class 8. Also, in Class 8 the structure of the simulated jury was changed: each group presented a full set of arguments and positions and then the judges evaluated the discussion.

Considerations about Reliability and Trustworthiness

A number of steps were incorporated into the data analysis procedures to assure the trustworthiness of the findings. The ethnographic approach used in this study is based on a naturalistic paradigm (Lincoln & Guba, 1985). Such a paradigm establishes the validity and reliability of data analysis through well-established procedures on qualitative research. For this study, the following procedures were employed.

First, the study was conducted over the course of one full semester with immersion of the assistance researcher (fourth author) in one classroom of the physics teacher methods course led by the teacher educator (first author). Familiarity with the context, local cultural norms and social practices were documented through this prolonged engagement (Creswell, 1998).

Second, the data analysis was triangulated through multiple sources of data. We applied a multi-level method for discourse analysis (Vieira & Kelly, 2014) across multiple textual sources of data presentation (e.g. field notes, narrations frames and propositional frames). Such a perspective drew from our theoretical framework (Vieira et al., 2012, Vieira & Kelly, 2014) and is consistent with ways of building trustworthiness through triangulation (Lincoln & Guba, 1985). By examining linguistics features across levels (activity, actions and operations) support claims were established, providing more validity to the study (Gee, 1999).

Third, the data analysis was triangulated through multiple observers and analysts. The first and fourth authors contributed to analysis with inside (emic) perspective, since they were members of the observed classroom. The second author contributed with outsider perspective. Thus, throughout the duration of the study, there were numerous checks on the analysis procedures by the first, second and fourth authors and divergences were resolved through agreement. Such a dialogical review contributed for convergence of analysis and to the reliability (trustworthiness) of the study, thus providing triangulations across different researchers (Hammersley & Atkinson, 1995).

Finally, the integration of the teacher educator as analyst into each of the levels of analysis brings member validation to the study since the discourse analysis and subsequent results were constructed, checked and recognized by this 'insider.'

These steps drew from the analytical framework (Vieira et al., 2012, Vieira & Kelly, 2014) and build on the reliability and trustworthiness of the study. In the next sections, we describe the theoretical bases and the method along with data analysis.

Method and Data Analysis

We used a multi-level method (Vieira et al., 2012, Vieira & Kelly, 2014) for discourse analysis of events accomplished in a physics teacher methods course taught in a large

and reputable Brazilian public university. The method is based on activity theory and appropriates resources from textual linguistics and sociolinguistics to perform articulated and multi-level discourse analysis. We applied this method to analyze one simulated jury activity accomplished in the eighth class of the observed course. We will present the method and the theory description along with data analysis of this class.

According to Leont'ev (1978), the founder of activity theory, human activity is structured in 'levels' (i.e. activity, actions and operations, see Engeström, 1999; Leont'ev, 1978, 1981). Such a perspective is useful to examine science classroom discourse, since analysis at one level offers context and feedback for comprehension across the other levels in an iterative and reflexive process of inquiry (Vieira & Kelly, 2014).

We will discuss briefly each one of the levels and show how the linguistics resources fit in this structure to inform discourse analysis.

Level of Activity—Motive

Activity has its origins in a need, whatever cultural or biological. For science teaching, this is a cultural didactic driven need that shapes classroom activity. The object that fills one need evokes and directs activity toward itself. This object can be material or ideal and it is called the motive of one activity. The motive is the 'motor' for the development of all actions that unfold from activity. The motive is, according to Leont'ev (1978), the distinctive factor among different activities. As noted by the author, the motive of a highly developed activity can be associated to a general goal that contributes to accomplish the activity, as is the case for the teacher when teaching science.

For the observed classes, we used the teacher's planning and field notes for identification of the motives (general goals). The motive of the class we analyze in this article was to promote discussion, via simulated jury, about the teacher's knowledge, with the support of the text 'The teachers knowledge and training,' authored by Maurice Tardif. The pre-service teachers were asked to read this text before the class. The text explored the sources of the teachers' knowledge and their relations to the teachers' professional development. The teacher divided the class into two random groups and handed to each group the following printed instructions (original emphasis):

> Favor group: Find in the text and in other sources the aspects that facilitate and allow teachers to construct, validate and manage their professional knowledge. Systematize and present the arguments.
>
> Against Group: Find in the text and in other sources the aspects that hinder teachers in constructing, validating and management of their professional knowledge. Systematize and present the arguments.
>
> Jury: The teacher will choose two pre-service teachers to compose the jury, each one from a different group. The groups will choose one colleague from the rival group to compose the group of four judges.

> The jury must reflect on the presented arguments and decide, REGARDING THIS SIMULATED JURY, if there was more evidence in favor or against the teachers' actions in constructing, validate and manage their professional knowledge. The jury must systematize and present the decision.

The class comprised 11 pre-service teachers; 6 males and 5 females. Most of them were aged from 20 to 25 years. Two pre-service teachers were older than 30 years. They were in the middle of the degree program and the majority had a day job. In addition, they were mostly middle-class.

The teacher interacted with each group and registered their responses in the white-board, asking for more elaboration and clarification when found necessary. At the end of the group presentations, the judges evaluated the responses and gave victory to the against group. The judges and the teacher constructed together a pattern for the ideas presented by the groups. The pattern concerned the 'ideological/possibilities–concrete/obstacles' categorizations of the groups' contributions. At the end of the class, one pre-service teacher of the group of judges asked two questions to the teacher about his own view regarding the discussion. The teacher gave victory to the favor group and justified this position through a pair of explicative actions. Finally, the teacher asked the pre-service teachers to answer in home questions concerned the simulated juries developed during the course.

Level of Action—Teacher's Goal and Discursive Orientation

This level is related to the isolation of a teacher's conscious or emergent goal. The purpose of this analysis is to identify the goal for each one of the teacher's actions. We adopted a methodological orientation in delimiting first the action and then assigning a goal to it. Our method for separation of actions is based on contextualization cues, a central concept of the sociolinguistic approach (Gumperz, 1982). This approach studies, from an emic perspective, how interactions and meanings are discursively created, conveyed and construed. From video and audio analysis, we identified contextualization cues such as intonation, pauses, proxemics and eye gaze, which often co-varies with changes in the direction and content of discourse.

Under this logic of investigation, we constructed the *Narrations Frame* (Table 1). While watching the video from the classroom interactions, narrations of the interactions and ongoing discourse were added in a separated column. Following this process, discourse was divided into segments through identification of the teacher's contextualization cues, thematic content of the talk and also through teacher's injunctive propositions and meta-discourse. The divided segments were considered the teacher's actions.

After completing these procedures, we assigned to each action what we have called one of a number of *discursive orientations.* This concept is derived from studies in textual linguistics (Adam, 1992; Bronckart, 1996) and from the grammar of text (Werlich, 1976). For science teaching, we consider relevant the following discursive orientations: argumentation, explanation, description, narration, injunction and dialogue.

Table 1. Small segment of narrations frame for selected actions of Class 8

Class 8—Primary source of information: video Mapping the teacher's actions				
N° action Time (h:m:s) Length (m:s)	Discursive orientation	Narrations of the discursive interactions of actors and ongoing discourse Underline—contextualization cues (and also the teacher's injunctive propositions and meta-discourse) signaling action change	Teacher action	PG—pragmatic goals T—emergent themes *R—researcher's observations*
11 01:15:55 00:26	Explicative (judges)	The teacher sits behind the pre-service teacher Bill who explains the judges' conclusions and evaluations The teacher stood up and says: Ok, I got it	Understanding the judges' evaluations	PG—Understand the judges' evaluations *At the end of this action there were still 15 minutes to the class end*
12 01:16:21 07:28	Explicative—dialogue	The teacher positions himself at the front of the class and affirms that the judges said that the information against was more concrete than the information in favor, which was more 'ideology,' 'things that could turn out to be.' He says that by one side we have the reality against and by the other side the ideology acting in favor The teacher says that the judges made a good synthesis. He registered on the whiteboard 'ideological plane' and 'concrete plane' The teacher says: 'in your opinion (the judges' opinion) what is more important, the ideological or the concrete? Or they both are in a dialectical relation? Look, the concrete opens space for the emergence of ideologies and ideology brings out the concrete' The teacher asks the judges why they choose the concrete The pre-service teacher Bill answers saying that 'the concrete denotes more the reality'	Elaborating and making reasoned the judges' evaluations	PG—Communicate and systematize the judges' evaluations T—Pattern 'ideological/possibilities—concrete/obstacles' *R—The teacher constructs and develops with the pre-service teachers the idea of a pattern—'ideological/possibilities and concrete/obstacles'*

(*Continued*)

Table 1. Continued

Class 8—Primary source of information: video Mapping the teacher's actions				
N° action Time (h:m:s) Length (m:s)	Discursive orientation	Narrations of the discursive interactions of actors and ongoing discourse Underline—contextualization cues (and also the teacher's injunctive propositions and meta-discourse) signaling action change	Teacher action	PG—pragmatic goals T—emergent themes *R—researcher's observations*
		The teacher asks: 'You are choosing this due to an epistemological, personal perspective in believing that the concrete is more important than the ideological?' The judges answer 'no.' The teacher asks: 'so, why did you choose this side?' The pre-service teacher Sara answers saying that the against aspects weigh more, they are stronger than the ideological The teacher says that the jury gave victory to the against group The teacher and the judges begin to make comments about the simulated jury activity, and culminated in the teacher saying that he liked the raised aspects and affirming that he would be in doubt if he was intended to give the decision The pre-service teacher Roy asks: And what would it be?		*R—The teacher made many questions to the pre-service teachers, but at the end of this action one pre-service teacher assumed an active role in questioning the teacher*

(*Continued*)

Table 1. Continued

Class 8—Primary source of information: video Mapping the teacher's actions				
N° action Time (h:m:s) Length (m:s)	Discursive orientation	Narrations of the discursive interactions of actors and ongoing discourse Underline—contextualization cues (and also the teacher's injunctive propositions and meta-discourse) signaling action change	Teacher action	PG—pragmatic goals T—emergent themes *R—researcher's observations*
13 01:22:49 01:25	Explicative	The teacher explained that he would give victory to the favor group, because the against group did not mention about the practical knowledge. He highlighted that it is about this practical knowledge that the teacher should begin to have control and domain and then establish a dialogue with the other types of knowledge The pre-service teacher Roy says: Ok, but how we can go against this view? This is highly correct (The other judges agreed with him). How we can use something against this? This was the problem for us	Presenting and justifying his own opinion about the jury	PG—Answer a question regarding the jury T—Practical knowledge *R—Pre-service teacher Roy assumed again an active role in questioning the teacher*

(*Continued*)

Table 1. Continued

Class 8—Primary source of information: video Mapping the teacher's actions				
N° action Time (h:m:s) Length (m:s)	Discursive orientation	Narrations of the discursive interactions of actors and ongoing discourse Underline—contextualization cues (and also the teacher's injunctive propositions and meta-discourse) signaling action change	Teacher action	PG—pragmatic goals T—emergent themes *R—researcher's observations*
14 01:24:14 01:08	Explicative	The teacher explains that the group could offer things that create obstacles for the construction of this practical knowledge. The teacher says that they erased the practical knowledge The teacher gives a number of instances about how it could be done. He notes that in many times teachers do not have opportunities to communicate their procedures to other teachers and researches in spaces like congresses. The teacher says that the way the other knowledge are imposed hamper the construction and development of the teacher's practical knowledge, like the curricular choices, about which the teachers' are often impeded to do He says: I liked it, the discussion was cool	Presenting and justifying his own opinion about the jury	PG—Answer a question regarding the jury T—Practical knowledge

(*Continued*)

Table 1. Continued

Class 8—Primary source of information: video Mapping the teacher's actions				
N° action Time (h:m:s) Length (m:s)	Discursive orientation	Narrations of the discursive interactions of actors and ongoing discourse Underline—contextualization cues (and also the teacher's injunctive propositions and meta-discourse) signaling action change	Teacher action	PG—pragmatic goals T—emergent themes *R—researcher's observations*
15 01:25:22 00:31	Injunctive	The teacher says that he wants the pre-service teachers to answer the questions about the jury and make a reflection about this experience He says: 'Ok? Thank you'	Giving instructions for the next class	PG—Give instructions T—Simulated juries
16 01:25:53 00:20 End of recording	Dialogue	The pre-service teachers stand up to leave and to talk with the teacher	End of the class	End of the class

Each one of the discursive orientations offers a field of possibilities and constraints for the teacher's and students' discursive contributions; so each one of the discursive orientations can be considered as a psychological instrument for human action. In this sense, the modes by which individuals engage into discourse in socially appropriate ways are dependent on the discursive orientation at stake. In our case, we are interested in science teachers' actions. Thus, we can speak of explicative didactic actions, argumentative didactic actions, narrative didactic actions and so on.

Based on the narrations of the actions and their articulations, the analyst assigned, in a separated column, one name and a pragmatic goal for each one of the actions. This was an inferred goal from the teacher's perspective. The analysis process inferred the goals from monitoring the discursive correlations and immediate conditions (what is discursively accomplished). Thus, we are mainly focused on how we can deal with goals through the establishment of coherent correlations among discourse segments.

The emergent themes developed were ascribed to each action in the last column, as well as the researcher's comments and observations. Finally, the actions were numbered and stamped with their initial time and temporal length according to the video time.

These methodological steps for the action level are shown in the *narrations frame*. This frame was constructed for selected classes of the observed course. In Table 1, we show a small segment of this frame for selected actions of the analyzed class.

We identified a discursive pattern in the observed simulated jury. It was composed by a set of interactive injunctive-dialogue-explicative discursive orientations. The motive and the context of production of this activity created rules, which constrained and afforded discourse interactions and meaning-making processes.

The main rules and roles were the following: (1) both groups have to elaborate their points of view and then present them, independent of the other group's presentation; (2) the judges have to evaluate the presentations and decide which group presented more evidence for the defended view; (3) the teacher acted as 'animator' of the pre-service teachers' actions and (4) the pre-service teachers have the right to elaborate genuine questions. These rules and roles shaped certain teaching and learning opportunities, which culminated in the elaboration of a pattern 'ideological/possibilities–concrete/obstacles' for the groups' contributions. The pattern was derived from the judges' evaluations and the teacher elaborated and made it reasoned to the whole class through his explicative action 12, which we discuss in the next section.

Level of Operation—Conditions and Methods

This level is related to the moment-by-moment interactions among individuals. Operations are the methods that one individual uses to achieve the goal of his action under determined conditions. Any action develops within specific objective conditions, which determines the operations (methods) of accomplishing the action (Leont'ev, 1978).

The moment-by-moment constructed and construed meanings and operations are shaped by the goal of one individual's action (we can say that intention is one step ahead of discursive operations); by the immediate conditions (other individuals' words, the words posed before by the individual who talks, the material conditions and so on); by the cultural background; by the discursive genre and, as we have found in a previous study (Vieira et al., 2012), by the discursive orientation at stake.

It is in this level of analysis that we highlight the relevance of studying the teacher's *Discursive Didactic Procedures* (DDPs). The DDPs are means (mechanisms) that the teachers use to conduce and manage discourse in their science classrooms. From the transcriptions, we segment the individuals' speech into propositions, thus constructing the *Propositional Frame* (see Vieira et al., 2012, Vieira & Kelly, 2014). Each proposition is considered the smallest unit of meaning we identified from sociolinguistics contextualization cues, and from linguistic criteria (i.e. the presence of verbs). This process introduces an emic perspective in segmenting the propositions, since it is based on sociolinguistics criteria.

After this procedure, the propositions with 'convergent meanings'[1] are grouped and given a name, constituting a specific DDP that pursues one of the teacher's goals. This categorization is similar to what linguists have called micro-speech act (Adam, 2008; Searle, 1969). The DDPs are, accordingly to the multi-level analysis, the operational

level of a motivated activity, realized by diverse actions that are characterized by specific goals and discursive orientations. Such goals and discursive orientations orient and shape the DDPs of one individual's action.

Table 2, called the *Propositional Frame*, presents example of the process of categorization of propositions into DDPs, for the teacher's explicative action 12. The propositions are stamped on the left side and the DDPs on the right side. The numbering on the right side refers to a set of propositions composing a specific DDP. The commas represent the participants' pauses. Words between bars represent simultaneous talk.

The analysis shown in Table 2 evinces the teacher's explanation for the judges' evaluations: The identification of a pattern in the set of the groups' responses registered in the whiteboard. The pattern concerns the 'concrete' aspect of the reality acting against the teachers' professional development and the 'ideological' aspect acting in favor of this development.

The mapping of the teacher's procedures showed how he made the judges' decision reasoned and fully available to the whole class. Also, the teacher's elaborations culminated in the presentation of an explanatory principle for the pattern proposed by the judges: a dialectical perspective, which was recognized and validated by a number of pre-service teachers ('this is important,' 'yes'). We consider this an important learning opportunity that unfolded from the simulated jury activity and from the teacher's procedures in pursuing the explicative action of making the judges' decision reasoned and explicit for the whole class as well as to himself.

There were no moment-by-moment argumentations in this class in the traditional definition of interchanging of positions and contrapositions followed by justifications (Vieira & Nascimento, 2009). Indeed, this situation demanded evaluations and presentation of positions, but they were not directly counter-posed to other positions. This was a different result of this simulated jury activity when compared with previous classes of the observed course which were driven under different contexts of production. In these previous classes, the groups were asked to respond directly to other groups' positions. Each one of the groups was asked to defend and to attack one view, and had about 5 minutes to elaborate a response to the other group positions which in turn can be replied. So, there were different contexts of production of the simulated jury activity organized by this teacher in the observed course.

Discussion

In Table 3, we present a scheme of the main groups' contributions registered in the whiteboard by the teacher (comments and clarifications are presented between parentheses).

Findings in this table denote that in some cases the aspects that hinder the teachers' development of professional knowledge are a sort of lack of 'something' that is 'resolved' by the other group. This is the case for the 'teachers have little continuing education' in the left side and its solution in the right side by 'continuing process of

Table 2. Small segment of the propositional frame for a stretch of the teacher's explicative action 12

	Turns of talk	Propositions (units of meaning)	DDPs
Explicative action 12 *Goal: communicate and systematize the judges' evaluations*	1—Teacher	1. The judges are saying, 2. that the against raised aspects, 3. are more concrete, 4. than the favor raised aspects, 5. that are more ideology, 6. something that may could come to be, 7. so in this side here we have, 8. let's sat this way, 9. the reality acting against, 10. and in that side we have the, 11. ideology acting in favor, 12. It's clear?, 13. so we can say that this (pointing the favor side on the whiteboard) is more in the ideological plane?, 14. it seems so, 15. you made a good synthesis, 16. now I am envisioning this, 17. don't you agree?, 18. synthesis (writes on the whiteboard), 19. here you have the ideological plane, 20. of justification, right?, 21. cool 22. cool, 23. and here it is the plane |Bill: concrete|, 24. concrete plane of justification |Bill: of justification|, 25. everybody understood this?, 26. so you were in favor of the concrete, 27. because in your opinion what is more important, 28. the ideological or the concrete?, 29. or both are in a dialectical relation? (one pre-service teacher says this is important, other pre-service teachers make inaudible comments), 30. Look to this look to this (the teacher gestures and speaks in a playful tone), 31. Look the concrete 32. makes ideologies to emerge, 33. and the ideology brings out the concrete |Roy: yes|, [. . .]	1. Attribution of authorship 2–5. Establishment of relations 6. Presentation of situated definition for 'ideology' 7–9. Categorizations of the against aspects 'as reality' 10–11. Categorization of aspects in favor 'as ideological' 12. Rhetoric question 13. Rhetoric question 14. Answer to his own question 15–17. Positive evaluation of the judges' synthesis 18–24. Systematization of the conclusions (with pre-service teachers assent) 25. Rhetoric question 26–28. Rhetoric question 29. Rhetoric question 30–33. Justification of a point of view (with pre-service teachers assent)

Table 3. The aspects in favor and against the development of the teachers' professional knowledge

Aspects that hinder the development of the teachers' professional knowledge GROUP AGAINST	Aspects that contribute to the development of the teachers' professional knowledge GROUP IN FAVOR
COMMENTS: Lead pre-service teacher: Victor The pre-service teachers of this group categorized some of their contributions according to the source of knowledge—these are showed IN CAPITAL	COMMENTS: Lead pre-service teachers: Lara, Tony and Alex
Distance of the researchers and their production from the teacher education—lack of feedback for teachers KNOWLEDGE OF PROFESSIONAL EDUCATION	Teachers can learn from the pre-service teachers
Growth of increasingly specialized groups—teachers and researchers KNOWLEDGE OF PROFESSIONAL EDUCATION	Interchange of experiences among the teachers
The teachers have no active voice regarding what is selected to be taught—lack of force of the teachers' category CURRICULUM KNOWLEDGE	Teachers must have more access of research in education
Validation of disciplinary knowledge is too much distant from the teachers—it comes from the scientific community DISCIPLINARY KNOWLEDGE	Dialogue among teachers and researchers in education
Untrained teachers in-service—this weakens the category	More integration among teacher-school-university
Teachers have little continuing education	The class council as a space for discussions concerning the teachers' practices
Lack of infrastructure for the development of professional knowledge	Participations in congresses and events of the area Teachers can use the practical knowledge (experience knowledge) to perform the validation of others' knowledge Continuing process of construction of professional knowledge

construction of professional knowledge' and 'interchange of experiences among the teachers.'

After evaluating the arguments, the group of judges identified that in one side of the whiteboard there were 'concrete' aspects (offered by the against group) and on the

other side there were 'things that could turn out to be' ('ideological aspects' accordingly to the situated definition used by the teacher). This is a product of the judges' action of high meta-discursive value since it was a pattern identified in the groups' contributions, something not yet available to the whole class up to this point. The teacher was attentive to the importance of the identified pattern and performed the explicative action 12, aiming to systematize the pattern and make it reasoned for the whole class.

The teacher recognized that the judges made a good synthesis and evaluation. He wrote in the whiteboard 'ideological plane' in the side of the favor statements and wrote 'concrete plane' in the side of the against statements. He reaffirmed the judges' decision in favor of the against group and stated:

> in your opinion (the judges' opinion) what is more important, the ideological or the concrete? Or they both are in a dialectical relation? [...] Look, the concrete opens space for the emergence of ideologies and ideology brings out the concrete.

The pre-service teachers agreed with the teacher. He went on: 'you choose this because of an epistemological reason, something personal of believing that the concrete is more important than the ideological?' Many pre-service teachers said 'no.' The teacher questioned: 'So, why did you chose this side (concrete)?'

Sara (member of the favor group) answered:

> Because they made us weigh, they are things much stronger than the ideological side. (Procedure of justification of an opinion)

And then Bill (member of the favor group) added:

> Although we want the favor group to win. (Concessive procedure)

Thus, in this simulated jury the concrete aspects had major impact on the judges' evaluation. An analysis of the actual situation of Brazilian education from the perspective of this jury reveals an adverse context for the construction and validation of the teachers' own knowledge: the impediments are evident (concrete) and the aspects that may allow this construction are all 'ideological' (accordingly to the situated definition used by this teacher).

This result is indicator of a problematic situation of the Brazilian education, since 'ideology' and 'concreteness' were polarized. One healthier situation can be visualized as a less polarized distribution, in which positive aspects as well as negative aspects may be manifested in both ideological and concrete forms. Although this type of discussion was not developed in the observed jury, we believe it can be introduced into classroom and enrich the debate, affording opportunities for criticisms and reflections.

At the end of explicative action 12, the teacher and the judges made comments about the simulated jury activity. This action culminated in the teacher saying that he liked the raised aspects and that he would be in doubt if he was intended to give the decision. At this point, the pre-service teacher Roy (member of the against group) takes the floor to speak assuming a questioner role and asked the teacher: 'And what would it be?'

The teacher explained that he would give victory to the favor group because the against group did not mentioned the practical knowledge. He highlighted that it is about this practical knowledge that the teacher should begin to have control and domain and then establish a dialogue with the other types of knowledge.

Roy assumed again an active role in questioning the teacher:

> Ok, but how we can go against this view? This is highly correct. (The other judges agreed with him). How we can use something against this? This was the problem for us.

The teacher explained that the group would offer aspects that create obstacles for the construction of this practical knowledge. The teacher gave a number of instances concerning how it could be done, as presented in action 14 of the 'narrations frame,' Table 1. At the end of his explanation, he said: 'I liked it, the discussion was cool.'

In finishing this class, the teacher gave instructions to the pre-service teachers, asking them to answer in home the questions about the jury and provide reflections about this experience. The pre-service teachers answered and reflected about the simulated juries and evaluated positively the experience, recognizing that they had good learning opportunities, as shown in the following excerpts:

Iza (one of the judges and a member of the against group):

> The simulated jury activity contributes positively for our education, due to the fact that we are always in contact with the school's universe, so it is very important that we know deeply the ideas in favor and against one given question, since with such knowledge we can create debates, make constructive criticisms and "open the mind" of the student, making that everyone can understand the dimension of one given question [...].

Victor (a member of the against group):

> [...] This class dynamic made us to think more in what is being studied, understand its meaning and learn its content instead of just reading. I never learned so much in so little time.

Tony (a member of the favor group—original emphasis):

> [...] in short, the simulated jury was very important to me since I could see from different perspectives (against, favor and judge) the different types of knowledge [...] ultimately it helped me to see from different points of view the 'mechanism' called education.

Alex (a member of the favor group):

> Well, I think that the idea of simulated juries was very valid, even because in some cases I became confused with the ideas of the text. [...] There was a very good growth in terms of argumentation, professionalism and specially for me, of relation with the other.

The future teachers recognized the positive role of simulated juries in approaching the other's perspective. We believe this is a main contribution of the simulated juries to the development of the future teachers' argumentative ability of 'placing yourself in the other's perspective,' which, according to Simonneaux (2001, p. 924), 'increases possibility to understand other people's point of view.' We consider this as a crucial didactic ability for teachers and future teachers in promoting and developing argumentation in classroom.

Finally, we consider that the pre-service teachers' well-established roles from the outset of the simulated jury contributed for facilitating the judges' evaluations of the posed arguments, which we believe had contributed for the judges' higher order process of identification of the 'ideological-concrete' pattern in the groups' responses.

Conclusions

We highlight that the simulated juries in the observed course afforded the participants to address arguments and counter-arguments explicitly and structured across multiple levels of activity. In this article, we analyzed the teaching and learning opportunities afforded to pre-service teachers in one class based on simulated jury activity. This jury concerned the development of the teachers' professional knowledge in the Brazilian context. The analysis showed how this activity concluded with the judges' recognition of a pattern in the groups' contributions and how this pattern provided insight into this classroom through the teacher's actions and procedures. The teacher was attentive to the importance of the recognized pattern, systematizing and making it explicit and reasoned for the whole class.

The analysis evinced how this simulated jury strategy was positive for improving classroom discourse production and for the development of teaching and learning opportunities. The pre-service teachers assumed an active identity of knowledge producers rather than passive consumers. The teacher had a fundamental role in 'animating' the pre-service teachers' actions and procedures. Also, the pre-service teachers made positive evaluations concerning the uses of simulated juries in the observed course, as well as a positive evaluation of the impact of these juries for their personal learning.

Furthermore, the pre-service teachers evaluated that the teaching via simulated jury activity engendered by opposing perspectives contributed to the improvement of their pedagogical knowledge. In this concern, the teacher and the pre-service teachers developed and comprehended a low opinion about the actual condition of the educational Brazilian context.

The teacher's roles in this jury ranged between managing, evaluating and 'animator' of the pre-service teachers' procedures and contributions: The teacher questioned the pre-service teachers, complemented their utterances, elaborated and developed points of view and asked for more clarification. The teacher was attentive to the ongoing teaching and learning opportunities, some of which he developed and articulated to the whole class. That is, the teacher acted in many times as 'animator' of the pre-service teachers' actions. This posture implied in the teacher's responsiveness to deal with circumstantial events and develop them appropriately according to well-defined didactic intentional focus.

Based on the obtained results, it is important to note that, according to the definition of argumentation as the presence of counter-posed opinions followed by justifications (Billig, 1996, Vieira & Nascimento, 2009), the whole class can be considered an argumentative activity, which was realized by a set of injunctive-explicative-dialogue actions. In other words, we have argumentation at the activity level that was not constituted by moment-by-moment contradictions and arguments. The actions and operations were

articulated to establish argumentation in another level via simulated jury activity. This was constituted by, and also constitutive of, the pre-service teachers' and the teacher's actions and procedures.

We reaffirm the teaching potential of simulated juries for teaching and learning and for the development of the pre-service teachers' argumentative abilities in science teacher education. This teaching potential should be further explored by research in order to inform the uses and reflections of this resource in promoting more innovative and argumentative practices in science teaching and in teacher education. Therefore, questions and research directions arising from this study regarding the uses of simulated jury activities in science teaching include the following:

- How do other operational types of interactions in the simulated jury activities influence the class discursive production and, thus, how may they affect the participants' learning?
- How could a simulated jury based on the students' pursuing their own opinion contribute for different discourse production?
- What are the consequences of different modes of classroom spatial organizations for discourse production in simulated jury activities?
- How can simulated juries be used as a resource in basic education? What are the similarities and differences between simulated juries in teacher education and basic education?
- What are the differences and convergences between simulated juries based on scientific and physics content and simulated juries based on socioscientific issues? How can simulated juries regarding physics content be established?
- How do the simulated juries and the interchange of roles (attack, defend and evaluate) contribute for the decentralization processes of future teachers (put themselves in the other's perspective) and for their scaffolding postures when teaching science?
- How can the use of simulated juries in teacher education advance future teachers' argumentative abilities? Will such an approach have an impact on teachers' practices? Will they use more argumentation practices in their classrooms?
- What are the consequences of the uses of simulated juries in teacher education for teachers in the short, middle and long terms? Would they use this resource? How?

In line with the aforementioned questions, research focused on the teachers' actions and procedures in simulated jury activities would contribute to establish a thorough description of the teachers' discursive moves which influence classroom discourse and the students' learning. Therefore, such a research focus can contribute to expand the repertory of the teachers' practical knowledge and in promoting more theoretically based reflections about the uses of simulated juries in science teaching. In particular, investigations on the teachers' discursive procedures when acting as 'animator' can clarify how the teachers' procedures shape the students' discourse and participation. Also, the study of the teachers' systematizing actions can enlighten more about the roles of such actions and procedures in orienting and forwarding classroom discourse within simulated jury activities.

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Note

1. Convergent in the sense they are 'doing' or 'signifying' similar processes.

References

Abd-El-Khalick, F. (2003). Socioscientific issues in pre-college science classrooms. In D. Zeidler (Ed.), *The role of moral reasoning on socioscientific issues and discourse in science education* (pp. 41–62). London: Kluwer Academic Publishers.

Adam, J. M. (1992). *Les textes: Types et prototypes*. Paris: Nathan.

Adam, J. M. (2008). *A lingüística textual: Introdução à análise textual dos discursos*. São Paulo: Cortez.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy: Project 2061*. New York: Oxford University Press.

Billig, M. (1996). *Arguing and thinking: A rhetorical approach to social psychology.* Cambridge: Cambridge University Press.

Brasil, Ministério da Educação, Secretaria de Educação Média e Tecnológica. (1999). *Parâmetros Curriculares Nacionais: Ensino médio.*Brasília: Ministério da Educação.

Brasil, Secretaria de Educação Média e Tecnológica. (2002). *PCN+ Ensino médio: Orientações educacionais complementares aos parâmetros curriculares nacionais. ciências da natureza, matemática e suas tecnologias*. Brasília: MEC, SEMTEC.

Bronckart, J. P. (1996). *Activité langagière, textes et discours: Pour un interactionisme socio-discursif.* Neuchâtel: Delachaux et Niestlé.

Bybee, R. W. (2011). Scientific and engineering practices in K-12 classrooms: Understanding "A framework for K-12 science education". *Science and Children*, *49*(4), 10–16.

Cho, K.-L., & Jonassen, D. H. (2002). The effects of argumentation scaffolds on argumentation and problem solving. *Educational Technology Research and Development*, *50*(3), 5–22.

Commission, E., EACEA, Eurydice. (2012). *Developing Key Competences at School in Europe: Challenges and Opportunities for Policy* – 2011/12 (pp. 1–72).

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage.

Dawson, V., & Venville, G. (2010). Teaching strategies for developing students' argumentation skills about socioscientific issues in high school genetics. *Research in Science Education*, *40*(2), 133–148.

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education*, *84*(3), 287–312.

Duschl, R. A., & Osborne, J. (2002). Supporting and promoting argumentation discourse in science education. *Studies in Science Education*, *38*, 39–72.

Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engeström, R. Miettinen, & R.-L. Punamaki (Eds.), *Perspectives on activity theory* (pp. 19–38). Cambridge: Cambridge University Press.

Evagorou, M., & Dillon, J. (2011). Argumentation in the teaching of science. In D. Corrigan, J. Dillon, & R. Gunstone (Eds.), *The professional knowledge base of science teaching* (pp. 189–204). New York: Springer.

Friedrichsen, P., Driel, J. V., & Abell, S. (2010). Taking a closer look at science teaching orientations. *Science Education*, *95*(2), 358–376.

Gee. J. P. (1999). *An introduction to discourse analysis: Theory and method*. New York: Routledge.

Gumperz, J. J. (1982). *Discourse strategies*. Cambridge: Cambridge University Press.
Hammersley, M., & Atkinson, P. (1995). *Ethnography: Principles in practice* (2nd ed.). Routledge: New York.
Jiménez-Aleixandre, M. P., & Erduran, S. (2008). Argumentation in science education: An overview. In S. Erduran & M. P. Jiménez-Aleixandre (Eds.), *Argumentation in science education: Recent developments and future directions* (pp. 3–27). Dordrecht: Springer.
Kelly, G. J. (2007). Discourse in science classrooms. In S. Abell & N. Lederman (Eds.), *Handbook of research on science education* (pp. 443–470). Mahwah, NJ: Lawrence Erlbaum Associates.
Knight, A. M., & McNeill, K. L. (2011). *The relationship between teachers' pedagogical content knowledge and beliefs of scientific argumentation on classroom practice*. In annual meeting of the National Association for Research in Science Teaching, Orlando, FL.
Kolstoe, S. D. (2000). Consensus projects: Teaching science for citizenship. *International Journal of Science Education*, *22*, 645–664.
Kuhn, D. (1993). Science as argument: Implications for teaching and learning scientific thinking. *Science Education*, *77*(3), 319–337.
Leont'ev, A. N. (1978). *Activity, consciousness, and personality*. Englewood Cliffs, NJ: Prentice-Hall.
Leont'ev, A. N. (1981). *Problems of the development of the mind*. Moscow: Progress Publishers.
Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage.
McNeil, K. L., Lizotte, D., & Krajcik, J. (2006). Supporting students' construction of scientific explanations by fading scaffolds in Instructional Material. *The Journal of the Learning Sciences*, *15*(2), 153–191.
McNeill, K. L., & Krajcik, J. (2012). *Supporting grade 5-8 students in constructing explanations in science: The claim, evidence and reasoning frame work for talk and writing*. New York, NY: Pearson Allyn & Bacon.
McSharry, G., & Jones, S. (2000). Role-play in science teaching and learning. *School Science Review*, *82*(298), 73–82.
National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.
Newton, P., Driver, R., & Osborne, J. (1999). The place of argumentation in the pedagogy of school science. *International Journal of Science Education*, *21*(5), 553–576.
NRC. (2012). *A framework for K-12 science education*. Washington, DC: National Academies Press.
Osborne, J. (2010). Arguing to learn in science: The role of collaborative, critical discourse. *Science*, *328*(5977), 463–466.
Osborne, J. (2014). Teaching scientific practices: Meeting the challenge of change. *Journal of Science Teacher Education 25*(2), 177–196.
Osborne, J., Simon, S., Christodoulou, A., Howell-Richardson, C., & Richardson, K. (2013). Learning to argue: A study of four schools and their attempt to develop the use of argumentation as a common instructional practice and its impact on students. *Journal of Research in Science Teaching*, *50*(3), 315–347.
Plantin, C. (2005). *L'argumentation*. Paris: Presses Universitaires de France.
Sadler, T. (2006). Promoting discourse and argumentation in science teacher education. *Journal of Science Teacher Education*, *17*, 323–346.
Searle, J. (1969). *Speech acts: An essay on the philosophy of language*. Cambridge: Cambridge University Press.
Simon, S., Erduran, S., & Osborne, J. (2006). Learning to teach argumentation: Research and development in the science classroom. *International Journal of Science Education*, *28*(2/3), 235–260.
Simonneaux, L. (2001). Role-play or debate to promote students' argumentation and justification on an issue in animal transgenesis. *International Journal of Science Education*, *23*, 903–927.
Tardif, M. (2002). Os professores diante do saber: Esboço de uma problemática do saber docente. In M.Tardif (Eds.), *Saberes docentes e formação profissional* (pp. 31–55). 8th ed. Petrópolis: Vozes.

Van Aufschnaiter, C., Erduran, S., Osborne, J., & Simon, S. (2008). Arguing to learn and learning to argue: Case studies of how students' argumentation relates to their scientific knowledge. *Journal of Research in Science Teaching*, *45*(1), 101–131.

Vieira, R. D., & Nascimento, S. S. (2009). Uma proposta de critérios marcadores para identificação de situações argumentativas em salas de aula de ciências. *Caderno Brasileiro de Ensino de Física*, *26*(1), 81–102.

Vieira, R. D., Kelly, G. J., & Nascimento, S. S. (2012). An activity theory-based analytic framework for the study of discourse in science classrooms. *Ensaio: Pesquisa em Educação em Ciências*, *14*(2), 13–46.

Vieira, R. D., & Kelly, G. J. (2014). Multi-level discourse analysis in a physics teaching methods course from the psychological perspective of activity theory. *International Journal of Science Education*, *36*(16), 2694–2718.

Vieira, R. D., Melo, V. F., & Bernardo, J. R. R. (2014). O Júri simulado como recurso didático para promover argumentações na formação de professores de física: o problema do "gato". *Ensaio: Pesquisa em Educação em Ciências*, *16*(3), 203–225.

Werlich, E. (1976). *A text grammar of English*. Heidelberg: Quelle & Meyer.

Zembal-Saul, C. (2009). Learning to teach elementary school science as argument. *Science Education*, *93*, 687–719.

Zembal-Saul, C., Munford, D., Crawford, B., Friedrichsen, P., & Land, S. (2002). Scaffolding preservice science teachers' evidence-based arguments during an investigation of natural selection. *Research in Science Education*, *32*(4), 437–463.