

Creating meaning for science teaching in an experimental class**Criando significado para o ensino de ciências em uma aula experimental**

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ABSTRACT

We present, in this text, the partial results of a study that analyzed the construction of meanings in a Science teacher training class, with qualification in the discipline of Chemistry. The proposal was based on the students' role, in which they could teach classes to their classmates, after a series of reflections and theoretical studies on the elaboration of concepts. For this, we chose to present, as part of a larger study, one of the episodes given by the students. The data allowed us to consider that the episode taught has characteristics that closely represent the teacher's intention to create problems, but still characterized by the traditional approach, with little appreciation of the participation of students in the process of building their own knowledge.

Keywords: Chemistry, Science.

RESUMO

Apresentamos, neste texto, os resultados parciais de um estudo que analisou a construção de significados em uma aula de formação de professores de Ciências, com qualificação na disciplina

de Química. A proposta baseou-se no papel dos alunos, em que puderam ministrar aulas aos seus colegas de turma, após uma série de reflexões e estudos teóricos sobre a elaboração de conceitos. Para isso, optamos por apresentar, como parte de um estudo maior, um dos episódios dados pelos alunos. Os dados nos permitiram considerar que o episódio ensinado tem características que representam de perto a intenção do professor em criar problemas, mas ainda se caracteriza pela abordagem tradicional, com pouca valorização da participação dos alunos no processo de construção de seus próprios conhecimentos.

Palavras-chave: Química, Ciência.

1 INTRODUCTION

At present, much has been discussed about educational policies, teaching practices, didactic-pedagogical strategies and problems related to low school performance faced by students in Brazilian schools (Altarugio, Diniz and Locatteli, 2010; Siqueira and Gurgel-Giannetti, 2011; Santos et al., 2013), and other countries (Carrillo et al., 2015; Kulatunga, Moog and Lewis, 2013). In fact, this has become more constant in the results of research regarding classroom actions, the training of teachers and the knowledge necessary to practice teaching in the formation of meanings of students. However, there has been little research done on the process by which students can, from discursive interactions, createmeaning in science classes (Mortimer, 1996; Mortimer and Scott, 2002; Bezerra, 2015).

Mortimer and Scott (2002), Costas and Ferreira (2011), Santos, Santos and Silva (2014), Sessa and Trivelato (2017), among others, point out that meaning is constructed from the situations experienced by individuals. And, in this sense, the discursive interactions are considered constituents of the process of constructing meanings.

Mortimer and Scott (2002) have developed an instrument for analyzing how teachers act to drive the interactions that can result in the construction of meaning in science classes. Using the ideas constructed within the classroom, the teacher can guide students to construct new meaning, relating to previous knowledge already existing in their cognitive structure. According to Macedo and Mortimer (2000 apud Pereira, 2009), it is important that the teacher allows the students to confront their words, as this allows interaction and the generation of new meaning.

The tool, created by Mortimer and Scott (2002) is based on three categories: Teaching Focus, Approach and Actions. In each category, characteristics are included that aim the role of the teacher in the classroom. In the first category, Teaching Focus, one has, as aspects of analysis, the intention of the teacher and the content; in the second, Approach, the analysis is done by the communicative approach; Finally, in the third category, Actions, we have interaction patterns and teacher interventions.

The intentions of the teacher may vary according to the focus of the classes. Mortimer and Scott (2002) pointed out as possibilities for the teacher's intentions: to create a problem; explore students' vision; introduce and develop the 'Scientific Story'; to guide the students with the scientific ideas, giving support to the process of internalization; to lead the students in the application of scientific ideas and in the expansion of their use, progressively giving them the control and responsibility for this use; development of the 'Scientific Story'.

In relation to content, in the first aspect of analysis, Mortimer and Scott (2002) subdivided Teaching Focus into three possibilities: a) Description, which states a phenomenon; b) Explanation, which requires theoretical models to refer to a specific phenomenon or a system; c) Generalization, which develops independent explanations of a specific context.

The communicative approach of the second aspect of analysis is central to the analytical framework of the tool since it provides insight into how the teacher works the intentions and content of teaching through different pedagogical interventions and that may result in different patterns of interaction. The authors explain four kinds of classes of the communicative approach: interactive dialogic discourse, when the teacher considers what the student has to say from the student's point of view and more than one 'voice' is considered; discourse of interactive authority, when the teacher leads the students to reach the point of view of the scientific school discourse that is being elaborated; non-interactive dialogic discourse, which occurs when the teacher reconsiders, in his speech, several points of view; discourse of non-interactive authority, when the teacher presents a specific point of view.

In relation to the interaction pattern, Mortimer and Scott (2002) point out that this is analyzed when the teacher and students alternate moments of speech in the classroom. The most common are the I-R-A (Teacher Initiation, Student Response, Teacher Assessment) and I-R-F-R-F (Teacher Initiation, Student Response, Student Feedback, Student Feedback, Feedback) triads. However, depending on the direction of the lesson, the interaction pattern can be continuous, especially when the teacher allows the student to continue speaking. In this case, the pattern would be of type I-R-P-R-P -..., where P means a discursive action by the teacher.

Finally, in the third aspect of analysis, we have the Interventions, which will depend on the focus of the teacher. The teacher can explore the ideas of the students by introducing a new term. The teacher can also make meanings available to all students in the class by repeating the idea of one student to the whole class. Therefore, if the teacher's focus is to see what meanings the students are assigning in specific situations, he will have the intervention to check the students' understanding. Finally, if the focus of the teacher is to recapitulate meanings, the teacher will have the intervention to review the progress of the 'Scientific Story'.

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In this paper, we present the results of a study carried out in the discipline of Instrumentation for Teaching Chemistry, in an undergraduate course in Science, at a Brazilian University, in the state of Minas Gerais. In the study, we seek to understand how, and in what way, future teachers can act in the classroom to promote discursive interactions, aiming at the creation of meaning by the students. For this, we proposed to the students that they taught simulated experimental classes to their classmates.

2 METHODOLOGY

In order to carry out the research, we report a sequence of Science, specifically Chemistry, classes, in which the students taught simulated experimental classes to their classmates. In order to make possible the observation of the discursive dynamics of the class under study and to appropriate all the possible details of the classes, we made a video recording, since this is considered an effective form of keeping records of the discursive dynamics (Martins, 2004).

The classes were filmed by the teacher and later transcribed for evaluation. The transcription of the classes shows the dialogue between the teacher and students where, the teacher is represented as *Teacher*, and the students, with fictitious names, such as *Kyle*, *Lindsay* and *Chris*. For this work, we will present one episode of the simulated science class on the theme "fingerprints".

3 RESULTS AND DISCUSSION

The qualitative analysis carried out in this work sought to identify elements that can elaborate the scientific knowledge, especially Sciences/Chemistry, of the students and how the discursive interactions influence the creation of meaning.

The fragments chosen have a sequence in which their elements can be analyzed and discussed within the proposed context. Here we highlight fragments of Episode 1, chosen for presentation in this article, which discusses the subject matter of fingerprints.

Episode

Teacher: [...] Well, considering that in the last class we talked about fingerprints. What does impression mean? To print is to mark something.

Kyle: Whatdoes the fingerprint mean? I did not understand anything.

Lindsay: Digits is when you type. Scrub, touch, scan! The fingers show the fingerprints.Very well, this large amount of oils that we have that is constantly being renewed in our skin, it is able to leave impressions on all the materials that we lean on all the materials that we have contact are possible of people leave this amount of oil in the material. Am I right?

Chris: yes, you are.

Teacher: Well, based on that, it would be interesting if we could watch fingerprints program.Let's draw a little fingerprint here. Of course, may you have seen some television shows that balance the reagents to get a little fingerprint, right?

Table 1: The episode analyzed in this article.

From the point of view of the analytical structure of the Mortimer and Socott (2002) instrument, the episode shows excerpts from the teacher's intentions. When it is pointed out "*What does impression mean? [...]this large amount of oils that we have that is constantly being renewed in our skin[...]* ", we can see that the teacher intends to create a problem, since he/she(Teacher) tries to engage the students in the theme of the lesson.

In relation to the content, we characterized as generalization, because the fingerprints were generalized when the Lindsay says "*The fingers show the fingerprints*". Sometimes Professor *Teacher* used the table with synthetic schemes of what was being explained. His expositions were made from the theme of the class and, most of the time, the subject was worked in an expositive way, without spaces for the dialogue, characteristic of the authority approach.

The students had, at times, demonstrations in class; however, this does not guarantee to be interactive. Mortimer and Scott (2002) point out that in the interactive approach, the lecturer leads students to a specific point of view. The fact is that this did not happen in that episode. Even listening to the students' statements, they were not explored, thus favoring the communicative approach of non-interactive authority.

Concerning the patterns of interaction, we noticed that the teacher had the initiation with the speech ("*What does impression mean? To print is to mark something*"), then the student Kyle had a response ("*Whatdoes the fingerprint mean? I did not understand anything*") and, finally, the teacher did the evaluation was discoursed. So, we then observed that the pattern of interaction, predominant in the episode was I-R-A.

Regarding the fifth aspect of the analysis, the teacher's forms of pedagogical interventions characterize as "Sharing Meanings," with the focus of making meanings available to all students in the class. We can summarize the analysis of episode 1 in Table 2:

Teacher Intentions	Create a problem.
Content.	Generalization.
Approach.	Communicative of non-interactive authority.
Patterns of interaction.	I-R-A
Forms of intervention.	Sharing meanings.

Table 2: Results from the analysis of episode chosen.

4 CONCLUSION

The instrument used to investigate the episode is useful to analyze and to plan the teaching of science, highlighting the interactions that the teacher uses in the production of meaning of his students. We realized in episode 1 that the teacher could have effectively provided new concepts, bringing Science closer to the students, but in future studies we intend to show other episodes, confronting the results found here.

Another point that deserves to be highlighted in our research is the fact that the teacher, in initial formation, has difficulties to provide opportunities for interaction between students. The teacher could have, in his or her classroom performance, actions that more effectively allow the production of discursive interactions in the classroom, as opposed to imposing some predetermined discourse. Even with the readings, studies and reflections about the pedagogical actions and skills that teaching requires, we perceive difficulties that future teachers have to overcome authoritarian approaches.

The discursive interactions that arose during the lesson, even with certain limitations, created episodes that allowed the appropriation and sharing of meaning. In this sense it becomes important the intervention and participation of the teacher during the process of discursive interaction, because the formation of an argumentative environment helps the construction of the meaning.

In turn, we show that using the tool developed by Mortimer and Scott (2002) to plan and evaluate the pedagogical action to be used by the teacher can allow the expansion of pedagogical tools accessible to teachers in the study of Science/Chemistry Teaching, since highlights the Teaching Focus, the type of approach and the possible interventions of the teacher.

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