Following the track of time: an actor-network study of the performance of teaching practices of prospective science teachers[1]

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RESUMO

In this text, we present the results of a research that investigated teaching practices performances in a Science Teaching Practices course in a Biology and Science Teacher Education Program at a university located in the state of Minas Gerais-Brazil. Based on references in the studies of Sørensen and Latour, we understand as performances the assemblages between human and non-human actors and the movements resulting from them, which allow reaching a certain result. The research data were collected through participant observation, recorded in a field notebook, audio and video, totaling nine classes, from August to October 2017. The course was located in the sixth semester of the Biology and Science Teaching Program but had the participation of students from other semesters. In our analyses, we identified that the performance of teaching practices was composed by entities with which the undergraduate students interacted in their lesson plans. One of them, the time, was followed in the verbal modulations that led the teachers in formation to move to the past, present and future. In addition, human and non-human actors featured in these class performances aroused a school imagined by them, which restricted their actions. If, on the one hand, this offered possibilities to make the lesson plans more flexible, adapting them to different school realities, on the other hand, it limited, prevented, weakened and/or conferred some anguish to their possibilities of acting in the school context. We highlight the relevance of academic disciplines such as the one investigated, since they represent a special curricular space-time in teacher's education programs, in which it is possible to better understand the complex and intricate processes of preparation for teaching.

KEYWORDS: Actor-Network Theory. Science Teaching Practice. Science Teacher's Education.

INTRODUCTION

In this text, we bring some results of a research that investigated performances (LATOUR, 1987, 2005; SØRENSEN, 2009) of teaching practices in a program of Science and Biology teacher's education. Our data analysis was focused on the presentation of the lesson plans produced by the students enrolled in a course of "Science Teaching Practice" at a public university located in the state of Minas Gerais-Brazil. These plans consisted on the main teaching strategy of the discipline, and their presentations and evaluations provided discussions on different topics considered important for teacher's education.

In this context, we ask ourselves questions such as: which subjects and things are regimented (put to work under the same rules) (LATOUR, 1987, 2005) by prospective teachers in their lesson plans? How do these different entities come together in planning? What are the effects of associations among actants? What emerges in these movements?

These questions are brought out from the conviction that "teachers' learning should be grounded in some aspect of their teaching practice" (PUTNAM; BORKO, 2000, p. 12). They, too, are associated with the fact that, in previous research, it was identified that prospective Science and Biology teachers build teaching theories understood as pedagogical principles that guide their lesson planning practices (VIANA, 2014; VIANA et al., 2015).

It is essential to emphasize that, when investigating teaching practices in a program of teacher's education, we generally need to adopt a concept of practice. This element is understood as extremely important in the teacher's education, since it must (or should) be assumed as a space-time producing academic, scientific and professional knowledge (SCHÖN, 2000; TARDIF; LESSARD, 2011). When located in the theoretical field of teacher's education, we align ourselves with perspectives that accept practice as knowledge, conscious or not, that are mobilized by teachers in the steering of their daily school tasks. Thus, it translates into knowledge or plural learnings that are consolidated in pedagogical actions so that opinions, beliefs, values and ideas as well as reports of experience and reflections are intertwined with abstract concepts and scientific theories of teaching and learning (GAUTHIER et al., 1998; SCHÖN, 2000; TARDIF; LESSARD, 2011; TARDIF, 2012; KORTHAGEN, 2001; ZABALA, 1998).

In the documents that comprise the Teacher's Education Policies in Brazil (BRASIL, 2002, 2015, 2019), there is a significant attention to the guidelines on more plural conceptions of practice. Such documents aim, for example, to differentiate the practices of supervised curricular internships, "in which professional activity is exercised" from a concept of practice, which should be carried out throughout the course, such as "in the moments when working in reflection on professional activity [...]" (BRASIL, 2001, p. 23). In the most current legislation, this conception of practice is broadened to comprehend it "both in the educational and pedagogical contents and in the specific areas of the knowledge to be taught" (BRASIL, 2019, p. 4).

Brazilian researchers points out that in these courses there is still a diversity of meanings about the practice (FERNANDES; MUNFORD; SERRA, 2014; TERRERI, 2008; TERRERI; FERREIRA, 2013; VIANA, 2014; VIANA et al., 2015). Terreri and Ferreira (2013, p. 36) claim that it is not possible to say "pure" meanings, since

these have been "historically hybridized". However, they indicate that "the meanings that the practice acquires in undergraduate courses can be considered in the relationship they establish with different knowledge mobilized in the pedagogical action" (TERRERI; FERREIRA, 2013, p. 1015). In the initial education of science teachers, Fernandes et al. (2014, p. 423), for example, have shown that, in the studies analyzed, "[...] more than one category of action was evoked as part of the practice. This trend highlights the polysemy and heterogeneity of the term".

Although the practice can be understood in a very broad and diverse spectrum, it also seems to be eminently contextual, being closely associated with the circumstances of the teachers' local actions (in the context of formal education or during their professional performance). Following this line of reasoning, we set out to investigate teaching practices from the perspective of performance. Which leads us to adopt a posture that sets us apart from a essentialist points of view of the concept, of what it should/could be and its respective reproduction in the investigated daily lives. We seek to feed our uncertainties (LATOUR, 2005) by asking ourselves what we can identify as practices that emerge in situations in which we study.

Therefore, in another direction and anchored in the Actor-Network Theory (ANT) (LATOUR, 1987, 2005), we follow the tracks left by the actions of that and those who were involved in the practice moments in the context of education for teaching.

With that in mind, the objective of this work was to investigate performances of teaching practices in a Biology and Science Teacher Education Program. Based on the Actor-Network Theory (ANT) by Bruno Latour and collaborators, we seek to understand how the actants (human and non-human) acted – being enlisted and enlisting other actants – during activities in the classroom and observing what emerged in that performance.

ELEMENTS OF THE ACTOR-NETWORK THEORY (ANT): THE CONCEPT OF PERFORMANCE AND COLLATERAL REALITIES

The Actor-Network Theory can be understood as a theoretical-methodological framework and data analysis, which began in the studies of Michel Callon, Bruno Latour, John Law and Annemarie Mol. Despite bringing the denotation "Theory" in its name, Latour himself (2005, p. 53) proposes to understand it as an infralanguage, "(...) something that has no other meaning besides allowing the shift from one frame of reference to another". This perspective would distance itself from the metalanguages adopted by other researchers, in which their languages overlap with those of the investigated subjects. For Sayes (2014, p. 142), "ANT's infralanguage is a tool that helps to explain, expand and associate – not as a detailed and rigorous series of cohesive, general and substantive claims about the world." Fenwick and Edwards (2010, p. 4) argue that ANT would be another way of intervening, "an approach that enables us to trace the ways that things come together, act and become taken for granted, or 'black-boxed'".

In ANT, the social is thought from deviations, transformations, movements, translations, flows of associations and aggregations between subjects and objects that outline it (FREITAS, 2017). From this perspective, the uncertainty of the action

to follow the traces and observe what is happening (or has happened) is emphasized. Therefore, preconceived and essentialist ideas should not be taken as a principle (ALLAIN, 2015), because we are leaving aside the idea of "cause and effect".

ANT is fueled by the guidelines of the Strong Program of the Sociology of Knowledge and expands the idea of symmetry in the understanding of social facts and processes which Bruno Latour and Michel Callon called the "principle of generalized geometry" (LATOUR, 1993). With this, the non-human agency is adopted, among other perspectives, and what its incorporation in social studies could contribute to reveal to us more about our political and moral associations (SAYES, 2014).

For humans and non-humans, Latour gives the name of actants, being understood as those that provide action, movement and difference (LEMOS, 2013). The label for actors in the social scene is awarded only after identifying the actions and analyzing their local effects. According to ANT, mediators are the actants who were able to print some change in the information they carried. Latour (2005) states that mediating for ANT means modifying the production of a network effect. Mediators "transform, translate, distort, and modify the meaning or the elements they are supposed to carry" (LATOUR, 2005, p. 39). When they have this function, they can be tracked. For the researcher, the central point is to say "what works and how" (LATOUR, 2005). Intermediate, on the other hand, is the term given to the actants that was not the main element of analysis – although it may be – since it did not change the course of the action. He simply transported it without any modifications, without transforming it (LEMOS, 2013, p. 46).

Latour (2005) understands that the actants are articulated in networks of bonds. Thus, its constitution occurs through relations between the entities. That is, their action is what defines their effects, which can be modified by them or by it modified. In ANT, the action has no special and unique place. It is "displaced" with a wide and diverse distribution. In order to be able to track it, it is necessary to follow the actants, not considering the choice of a privileged place, but considering where the action is abundant (LATOUR, 2005).

Latour (1987) presents the concept of translation of interest, understood as the displacement, the invention and the creation of a new link, which did not exist previously and which brings changes in the agents. According to Viana and Coutinho (2019, p. 20), "the term denotes a process in which two actants become so related that one exerts force on the other". It is, therefore, a process that relates, at the same time, the deviation of a route in an action and the articulation in which the elements express interests of other elements. Thus, every translation involves actants and offers possibilities for interpreting interests (LATOUR, 1987).

The result of the movements of association and disassociation of the actants and their effects on the network can be understood as performance. According to Latour (2005, p. 35), the "rule is performance and what has to be explained", the result of the actions of the actants and their effect on the network. The concept of performance in Sørensen (2010) is understood as a result of a sociomaterial assembly, which allows us to question what can be achieved through an organization of parts that "interrelate" and act or participate in a particular practice. This participation concerns the way the actants act. Performance is

involved in an entire process, not just a simple act. Thus, it describes a variety of components such as the pre-existing reality, the text and the approach (SØRENSEN, 2010). In other words, the notion of performance is related to the question of what is performed and how it is performed. To assist in this understanding, Sørensen (2010) proposes that it is also necessary to consider in the performance the concept of participation by Lave and Wenger (1991), which refers to the agents who are almost always involved in the practice and how they help/provide each other's participation. Sørensen (2010) emphasizes that participants are always part of this practice, even when they do not "re-produce" it, but disagree or modify it. She uses the terms "participant" and "participation" to designate humans and non-humans based on the principle of symmetry from ANT.

Fenwick and Edwards (2010) point out that, in an actor-network analysis, many assumptions tend to change with regard to conceptions in the field of education, mainly about respect for learning, knowledge, identity, teaching, policies and practices. The authors also establish that knowledge and learning, for example, are not assumed to be universal and stabilized, but as effects of networks composed of multiple entities and with coinciding ontologies. Thus, the production of knowledge and learning occurs from negotiations and performances, translations and associations between humans and non-humans (SANTOS, 2016). ANT brings out, then, a great diversity of things that are at stake in educational environments, provides the identification of non-human agencies to associations between different entities and the effects of these interactions.

In this regard, we propose to identify which were the actants that acted in a specific class of degree in Biological Sciences during the planning of classes. The (dis)associations between these entities formed networks that allowed us to observe what emerged and what was achieved as a result of these movements in the work of connecting and disconnecting from the actants with each other.

According to the Actor-Network Theory (ANT), we understand that the teaching practices of prospective teachers are performed through varied networks of associations between human and non-human entities, often contradictory, incoherent and somewhat complex. Education and educational processes are not determined by a context, but crossed by countless relationships, varying according to the way they are performed (FENWICK; EDWARDS, 2010; FREITAS, 2017). ANT allows us to understand the course of actions that take place at educational contexts, bringing us closer to the subjects and objects that have the power to act, modify and establish different deviations and connections. Thus, it is possible to understand performance as the result of all this mobilization by and between actants. The performance, then, allows us to visualize some nuances, such as the daily events, the assemblies, the way in which the actants are connected, the materiality, the heterogeneity and the fluidity of these movements and agencies (ability of the actants to ally with each other and allow them to act together in a certain direction) that are carried out (FENWICK; EDWARDS, 2010; HARMON, 2007).

Some researches that have used the Actor-Network Theory (ANT) as a reference adopt the concept of performance. Allain (2015) investigated the controversies involved when investigating professional identities in contexts and processes of Science and Biology Teachers Education. In her results, she proposes

to understand the teaching professional identity as a performance, because, in this perspective, there would not be a single and stable identity, but "several identities" that perform in different realities and emerge from the teachers' experiences. In this sense, the author points out that the effort is "to describe the way in which these identities are built in action", that is, in their performances (ALLAIN, 2015, p. 73).

Freitas (2017) investigated the networks of actors who are involved in the performance of "spaces-times" (School Time and Community Time) in the education of prospective Life and Nature Sciences teachers in Rural Education. Their results indicate that, in "School Time", there are performances of space-times of "experience-learning-teaching", "critical education" and "reflection on knowledge systems". In "Community Time", however, there is a complexity of networks and performances linked to school problems. In this view, the author realized that, in School Time and Community Time, performances of hybrid space-times operate, since they encompass political, pedagogical, social and environmental entities, making it possible to perceive their translations.

Viana and Coutinho (2017) analyzed the performance of the practice as a curricular component (PCC)(BRASIL, 2001, 2002) in the written curriculum of a Science and Biology Teachers Education course at the Federal University of São João del-Rei (UFSJ). The authors identified that this element assumes different performances in the document. For example, when translated (LATOUR, 1987, 2005), as academic courses, the PCC develops performances that refer to the verbs adopted in the syllabuses of the subjects. The performances are divided into three groups of subjects from three different departments: Teaching Practices (Department of Natural Sciences), Educational Psychology (Department of Psychology) and Teaching Structure in Brazil (Department of Educational Sciences). According to the teaching objectives found in the syllabuses, in the first, it proposes to "instrumentalize"; in the second, to "analyze"; and in the third, to "discuss". The authors point out that, not by chance, they are modes of action (or performances) most commonly represented within the professional fields of Biology, Psychology and Education, respectively.

For Annemarie Mol (2008), the concept of performance offers another way of looking at the "social constructions" of traditional sociology, since there is no stable "driving force" for the construction of things. What would exist, then, would be networks of hybrid entities and social practices, which, when performed, bring about diverse realities or multiple forms of reality. In this sense, when there are different performances, this allows us to say different versions and realities that coexist in the present (MOL, 2008).

The mobilization of the concept of performance for the study of practices also allows us to think about the processes of production and distribution of knowledge, and why not say interventions and practices, that is, how different performances can generate new entities and relationships in the world (SILVA; COUTINHO, 2016). From these new entities and relationships, the so-called collateral realities emerge (LATOUR, 2005; LAW; HASSARD, 1999; LAW, 2012), which are conditioned to the existence or not of materials, structures, laboratories, students and teachers. As stated by Mol (2008, p. 3), "If reality is made, if it is located historically, culturally and materially, it is also multiple". When describing the network, we find realities created randomly, without a prior intention, by our

studies, whose methods and approaches have performative effects. Realities that do not precede practices, however, are shaped by them (LAW, 2012; MOL, 2002).

Based on this argument, it was possible to reformulate one of the questions presented at the beginning of the text: "What emerges when we think about Science and Biology teaching practices?" As we wander and sniff, following the course of action in the sociomaterial network provided by the discipline, we realize that we can also question "what realities emerge when the undergraduate students present their lesson plans in the discipline of teaching practice?"

METHODOLOGICAL GUIDELINES

This investigation is located in the framework of qualitative research in education, since it comprehends the nature of the phenomenon investigated from a perspective of a more descriptive research, attentive to the subjective components that make up the lives of the subjects in the regular routine of their actions (LÜDKE; ANDRÉ, 2017). Thus, we investigate the interactions between undergraduate students, teacher-trainer, objects and pedagogical content.

The research was developed in the course of "Science Teaching Practice" of a Science and Biology Teacher Education program, at a public university located in southeastern Brazil, identified in this text as University.

In the class that was monitored in our investigation, there were 31 students. These were part of different terms of the course; the age group was around 20 years old and the division between sexes was 21 women and 10 men. In addition to the undergraduates, the class also consisted of the teacher-trainer and two interns – the professor's master's advisees, who were fulfilling the requirements for scholarship holders in higher education. In order to preserve the anonymity of the participants, their names have been replaced by pseudonyms. All participants consented to their participation in the research and signed the Informed Consent Form (ICF). The ethical research procedures respected and complied with all protocols and processes established by internal organs of the Federal University of São João del-Rei (UFSJ).

For data collection, observations were made throughout the second half of the year 2017, totaling nine accompanied classes, each lasting about one hour and 30 minutes. The research data were produced from the collection of videos, audios, images, photographs, notes and artifacts. We also asked the undergraduates for the materials produced during the course. However, only one group sent us the final work, in slide format, and a booklet provided during the class. We present a general table (TABLE 1), which summarizes the set of data that were collected.

Table 1 – List of data collected from the discipline "Science Teaching Practice" in the second semester of 2017

Record Type	Resource used or record type	Activity developed to obtain registration	Volume of records collected
Audio	Mp3 Recorder	Classroom observations.	About 12 hours
Audio-video	Digital camera and smartphone	Classroom observations.	About 12 hours
Notes	Field notebook	Classroom observations.	30 pages
Documents	*PowerPoint* File	After observation, we requested the final works of the discipline.	One *PowerPoint* slide show

Source: adapted from Viana (2014).

Our intention was that the different ways of collecting the records of actions in the classroom would provide us with different and complementary paths for understanding the performance of the practice in the investigated classroom. According to Green, Dixon and Zaharlick (2005), technological records – such as video and audio recordings – bring us possibilities to analyze the phenomenon after observation, that is, after the researcher leaves the field. The authors also emphasize the importance of the researcher not going to the field with predefined and closed questions. Malinowski (1990, p. 45) already stated that "good theoretical training and approximation with recent results are not the same as having preconceived ideas".

In the Actor-Network Theory, the researcher must go to the field and see what the actants do, weaving long descriptive reports in order to distance themselves from a methodological perspective that proposes to explain what they are doing (LATOUR, 1987). Therefore, our investigation followed the traces left by the actions of the actants during the presentations of the lesson plans of undergraduates, realizing what was associated and what remained stable (even if momentarily) and thus configuring the performance of teaching practices. The analysis categories that were configured in the different performances of the identified teaching practice were not established a priori, but only after the systematic analysis of the video recording data, audio and field notes and the perception of how it was being passed on by the participants, human and non-human actants involved.

In general, our entry into the selection of events for analysis was based on the attention to the form and content of the presentations of the licensee's lesson plans. In this movement, we were trying to understand what the objectives of the classes were, what elements were associated with the classroom, the school and the students, and how they produced the organization of the teaching content.

In the following item, we present our analyzes in excerpts from the reports of some groups of undergraduate students, performing (LATOUR 1987, 2005; SØRENSEN, 2010) their presentation on the lesson proposal. A trail that proved to be quite expressive in our analyzes and that acted strongly in these presentations was the relationship with "time". In our analyzes, we noticed that the impressions of time modulated the verbs of the students and were related to a school imagined by the undergraduates with certain particularities. Our intention, in the next item,

is to compose the report in such a way that the traces that led us to statements and to the conclusion become evident to the reader.

FOLLOWING THE TRACK OF TIME IN PROSPECTIVE TEACHERS CLASSES PLANNING

The investigated class was taking the subject "Science Teaching Practice", in the sixth term of the course, with an academic load of 36 hours. The main teaching strategy of the course was for prospective teachers to present lesson plans for Science content in Elementary Education II, especially around two major themes: "Environment" and "Health". The student-teachers organized themselves into groups to plan their classes. Then, the dynamics for the presentation were free, in which each group could choose different teaching strategies to compose their lesson plan.

In the analyzes that follow, we adopt methodological and analytical orientations of the Actor-Network Theory, in which we assume that the social scientist must write texts in order to compose a risk report (LATOUR, 2005). Such position assumes that, in this textual account, local circumstances are not given, purified and stabilized. On the contrary, it is necessary to describe the actions connecting the entities and observing what (or who) emerges, thus composing the social (LATOUR, 2005).

The first example that we bring concerns the way the presentations were organized. As you can see in the following excerpt, a group of licensees presented a teaching proposal on the ABO Blood System and started with the student Ana talking about the organization of her lesson planning: "Yes ... our presentation is not going to be... a class, right. We thought more about doing... showing you how we thought about teaching this class. First, we thought about checking the students' prior knowledge" (Ana, 09/05/17, 0:15).

When Ana says "our presentation is not going to be ... a class" and "showing you how we thought about teaching this class", she tells us that she will differentiate her presentation from a class, properly speaking, of the ABO system for the professor and the peers. Ana wants to emphasize that the group will present a proposal on how the teaching content could be approached in a basic education classroom. In the excerpt of Ana's speech, one aspect that struck us is to see how there are modulations of verbs in her sentence: "we thought", "showing" and "going to be". Traces that show us that her presentation dealt with different actions of time, a past – from the construction of planning –, the present – the presentation of planning itself – and a future, the class in basic education itself. Interested on this, we chose to follow the traces of time in the speeches of the undergraduates trying to observe with whom, what and when it is being associated with and what makes it emerge in the graduates' presentations. From that case, we started to take time as an actant, an entity that is mobilized by the student-teachers in their planning. We suspect, as proposed by Latour and Woolgar (1986, p. 76), that time does not act as a "coherent whole", but that it is founded by the "connection among beings".

Still in this example, Hugo, another licensee who was part of Ana's group, immediately afterwards, complements the colleague's speech and states that,

based on the students' answers, they would build a kind of "keywords" on the blackboard:

> Yes ... in these questions and this checking, their answers, we would write them down in a corner of the board as a kind of keyword and, I don't know, let's suppose that in the middle of a question there would come up an 'aah, blood A', we would take note you know ... (Hugo, 09/05/17, 0:30).

Attentive to the traces of time, we realized that, in this excerpt, Hugo makes a projection of what this class would be like and flexes the verbs: "would write", "come up" and "would take note". In order to act in this future class (the proposal for planning), he associates himself with entities and builds the context in this way: "questions/checking of previous knowledge / answers / undergraduates / students / keywords / teaching content – the blood –". Still, its future actions are marked by elements of uncertainty and conjecture effects. When Hugo says: "let's suppose" or "appear", the verbs adopted indicate that possibilities are created for events conditioned to what may (or may not) happen in the classroom. As a result, we can observe Hugo experiencing a class at a school in the future in which he imagines what could happen and tries to include in his planning openings for other possibilities.

This is a typical movement in this educational contexts, in which prospective teachers make projections and imagine a possible or desired scenario. They enlist actants (LATOUR, 1987) – the ideal student, the appropriate question, the necessary and available teaching resource –, which surround them with certainties and possible strategies to deal with what is expected and desired for the development of their action as educators.

From another perspective, it is possible to say that we see the licensee providing evidence (even though occasional) of the construction of what the specialized literature calls learning in practice (GAUTHIER et al., 1998), knowledge in practice (SCHÖN, 2000) or, even the epistemology of practice (TARDIF, 2012), since it is "in" and "by" these movements that the teachers in formation creates and models their pedagogical actions.

The second example of our analysis leads us to the wishes and expectations stated by the undergraduate students and allows us to better describe what emerges from this great network mobilized by this activity in the discipline "Science Teaching Practice". In another presentation of lesson plans by the group of Mara and Ivo, these undergraduates also associate themselves with the future time and not only build assumptions of what the class would be like, but already anticipate possible responses from students:

> Many already know. Then, they will answer. Well, then, many times, we have answers, oh... we eat, because we are hungry, because it is tasty and such, and we would explain why there is this type of answer (Mara, 09/26/2017, 04:37).

> Here, in this importance, we will also talk a little about diseases, which usually generates a lot of doubt in the classroom. Obesity, which is a disease, like, which appears more and more. So, they ask a lot and, like, we think they would ask, we would explain that it is a disorder, or overeat, or in a not very well-balanced diet. We would talk about these things like that, which is what generates more talk in the classroom (Ivo, 09/26/2017, 06:32).

In the first section above, Mara tries to predict, with a certain degree of certainty, what basic education students will answer through her questions and says: "(...) then, they will answer" / "we eat, because we are hungry, because it is tasty and such". Soon thereafter, she already offers a counter-response to the students' likely responses. There is, therefore, a time advance into the future, which goes from one closer to a little more distant, marking a temporal succession with imperative actions.

Ivo, his presentation partner, also continues this movement of anticipating the students' answers: "we think they would ask", "which usually generates a lot of doubt in the classroom"; "So, they ask a lot"; "which is what generates more talk in the classroom". However, Ivo softens his certainties: "we think" / "usually". We see, in these excerpts, the licensees gather (put to act under the same regiment) a set of entities (LATOUR, 1987, 2005) for their classes: "undergraduates / students / classroom / questions / answers / content – disease, obesity, disorder, eating. The way in which the planning is composed by the association of entities and the modulation of verbs for the future makes elements of greater and lesser certainty appear, allowing the undergraduate students to organize their lesson proposals with a certain flexibility of what could happen at the moment of the classes. Contingencies that they would "write down" if something "came up".

Ivo, Mara and Hugo, when considering elements of uncertainty and possibilities in their lesson plans, open space for what Diniz-Pereira and Lacerda (2009, p. 1234) call "two of the most significant characteristics of teaching practice: unpredictability and movement". According to the authors, the practice would not be a point of arrival from which a theory would start, since the practice "[...] is not an inert place where something can simply be deposited" (PEREIRA; LACERDA, p. 1234). In this sense, we see graduates modulating in their performance learnings/knowledge/epistemologies in their own pedagogical way and in the action of presenting their teaching plans.

In the third example, another group makes a proposal for a Digestive System lesson. We were able to observe that the projections of the undergraduates' actions are linked to the school in which they intend to develop the class:

> Then, the second class would be more expository. After seeing the students' previous concepts, it would be more expository. Then, we would use it, it would be expository to talk about the digestive system, to identify the organs, the functions of each one, and to make students understand the importance of each stage of digestion. Then, we would use the blackboard to draw, make diagrams also according to the school's resources, some have projectors, others don't, right. (Rosa 04/10/2017 43:00).

> Then, we thought about taking material too, that human torso if the school had it, for a better visualization for the students. That material that has the pieces that can be removed, is a human torso, but if it doesn't have, we can use other materials available, such as those banners they have (Beatriz, 04/10/2017, 42:43).

> Or even the drawing, right, because if you have nothing (Rosa, 10/04/2017, 0:22).

When Rosa associates herself with the "previous concepts" and the "expository class" to present her lesson plan, she brings into her teaching practice

actants with indications of teaching theories or pedagogical learnings (TARDIF, 2012). At the same time, when the members of this group imagine the possible resources of the school, they allow us to see other entities (or actants) (LATOUR, 1987, 2005) with whom they would associate to build their classes in this case: the "blackboard", the "projector", the "human torso" the "banner" and even the "drawing". For the prospective Science and Biology teacher, the presence or absence of these actants marks their projections of sociomaterial networks on the teaching of school content.

It is necessary to highlight the sociomaterial importance of objects in the constitution of educational spaces. Fenwick and Edwards (2010) emphasize that they see them as mere products of human desire, controlled by human action. It is, in a way, underestimating the strength of how these objects contribute to actions and associations. The authors claim that objects not only "respond" to human intentions, but modify their meanings, relationships, memories and even their perception of themselves. On the one hand, the difficulties of not being able to count on these elements make the prospective Science and Biology teachers' class plannings open paths for it to occur even with minimal resources. On the other hand, not being able to count on what they consider to be important for the conduction of the class – the projector and the human torso –, limits their actions and makes them adopt more classic or established methods of class such as the blackboard or banners, that may not be desired.

In the Science and Biology teachers' statements, we followed the traces left by time in verbal modulations in their presentation of the lesson plans, which indicated that there was an alternation between past, present and future. Classrooms are places where other times appear. Dealing with these times and future entities involves figurative movements in which the apprentice is no longer surrounded by pure concepts from the natural sciences (COUTINHO et al, 2014). For Latour (1993, p. 74), ""Time is not a general framework but a provisional result of the connection among entities". By this, he means that time is composed of momentary associations between entities that give an instant a condition of being: past, present, future. Therefore, an abrupt split between past, present and future is an effort that moderns make to purify the world by placing them in a unidirectional line (LATOUR, 1993, 1999).

Latour proposes (1993, p. 74): if, instead of a line, we organized them in a spiral, we would observe that the future would expand like a circle in all directions and the past would be ""revisited, repeated, surrounded, protected, recombined, reinterpreted and reshuffled". Our actions are, therefore, "polytemporal". Quoting Michel Serres, Latour (1993, p. 74) reminds us that "we are exchangers and brewers of time". Our traces showed that the presentations of the lesson plans of the prospective Science and Biology teachers revealed poly or multitemporal environments.

In the previous examples, we saw the undergraduates Ana, Mara, Beatriz, Ivo and Hugo perform teaching practices and associate themselves with "possible entities in the world", something that, for Coutinho, Figueirêdo e Silva (2016, p. 384-385), means that "making a decision is to plan a possible state of the world or, according to the notion of futurology, to outline a scenario". According to the authors, to perceive the ontological dimension of knowledge is to take into account that "the entities exist in the world, what relationships these entities can maintain,

how people react to these entities and relationships, how the world might behave in the future", which could completely transform the character of an issue (COUTINHO et al., 2016, p. 387).

Our data, as well as those of Viana (2014) and Viana et al., (2015), identified that, in the planning of classes of undergraduate students in Biological Sciences, hypothetical-imagined contexts arise and offer them different possibilities of performance. This school is imagined and makes future teachers plan classes for a context that they do not know. In addition, it also showed itself contingent, as it must deal with different possibilities that can be found in the workplace. We noticed that imagining a school with contingencies (of what it might or might not be) brings elements to think about the issue of (im)predictability (DINIZ-PEREIRA; LACERDA, 2009) and the (in)certainties of teaching action, exercising the thought of what it is possible to happen when teaching classes in basic education. However, since basic conditions on this process of creating lesson plans are not negotiated, free imagination generates a certain "anguish" on the part of these licensees, since the plans still have to deal with the possibility of something happening or not. It seems, therefore, that the undergraduates are walking in two movements, sometimes preparing for different realities, sometimes without really knowing what can be found ahead.

FINAL CONSIDERATIONS

Understanding teacher's education classrooms as poly or multitemporal environments implies, for the teacher-trainer, knowing how to dialogue with time. It is common to access the memories of future teachers in the moments of activities as "memorials", in which we seek to know and re-signify the visions and concepts that they bring about school and teacher considering the expressive time of environmental experience since the early years of their schooling. Similarly, we think it might be interesting to understand which entities are being enlisted by students at these times and that are projected in their future classes in schools.

Our research allowed us to identify which actants in the school (human and non-human) act, convincingly, in the prospective Science and Biology teachers' class plannings and led to the emergence of an "Imagined and Contingent School". When we consider this school acting in the context of teacher's education, we note that there is an exercise in fostering imagination and creation in face of what is idealized and expected for/from this school that is not known. However, this opening to the possibilities of what may be, especially for professionals with little or no teaching experience, has generated a set of "disorders" in their plannings. Thus, it is important to establish a balance between those actants who will/should be in their plans at the same time that we open possibilities for those who can and cannot.

In the present study, the Actor-Network Theory (ANT) allowed us to show that prospective teachers during their professional preparation at the University brought out some realities in their lesson plans. In these movements, students, classrooms, schools, teachers and teaching contents were enrolled, which formed circumstances in which teaching practices were performed. Such curricular space-time also revealed that hybrids proliferated (LATOUR, 1993) as past-present-future, real-imagined, as well as theory-practice.

Finally, it is necessary to value academic courses such as the one investigated, "Science Teaching Practice", as a special curricular space-time in teacher education programs, in which one can better understand the complex and intricate processes of teaching preparation of young teachers.

Seguindo o rastro do tempo: um estudo ator-rede de performances de práticas de ensino de licenciandos em ciências biológicas

RESUMO

Neste texto, apresentamos resultados de uma pesquisa que investigou performances em uma disciplina denominada "Prática de Ensino de Ciências", em um curso de Licenciatura em Ciências Biológicas de uma universidade situada no estado de Minas Gerais. Com referências nos estudos de Sørensen e Latour, entendemos como performances os agenciamentos entre atores humanos e não humanos e os movimentos decorrentes destes, os quais permitem atingir um determinado fim. Os dados da pesquisa foram coletados por meio da observação-participante com registro em caderno de campo, em áudio e em vídeo, em um total de nove aulas, no período de agosto a outubro de 2017. A disciplina observada estava localizada no sexto período do curso, porém contava com a participação de estudantes de outros períodos. Em nossas análises, identificamos que as performances das práticas de ensino foram compostas por entidades com as quais os licenciandos interagiam em seus planejamentos de aulas. Uma delas, o tempo, foi seguida nas modulações verbais que levaram os professores em formação a se moverem ao passado, presente e futuro. Além disso, atores humanos e não humanos figurados nessas performances de aulas fizeram emergir uma escola imaginada por eles, a qual contingenciava suas ações. Se, por um lado, isso ofereceu possibilidades de se flexibilizarem os planejamentos de aula adequando-os às diferentes realidades escolares, por outro, limitou, impediu, fragilizou e/ou conferiu certa angústia às suas possibilidades de atuação no contexto escolar. Destacamos a relevância de disciplinas acadêmicas como a investigada, uma vez que se configuram enquanto espaço-tempo curricular especial em programas de formação de professores, nos quais se permite melhor compreender os complexos e intricados processos de preparação para a docência.

KEYWORDS: Teoria Ator-Rede. Prática de Ensino. Formação de Professores.

NOTES

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