Imaginary formations of teachers in the initial years of elementary education on physics and their teaching in a continued training program

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Abstract. We present here part of outcomes of research that was carried out in a public school, through a partnership with the university which was willing to advise teachers in the initial years of elementary education, acting in the first and second cycles, in matters related to the teaching of Sciences, particularly Physics. The design of the program was determined by the "imaginary formations" presented by the teachers during an Initial Focus Group (IFG), which permitted to ascertain teacher training needs, their conceptions and desires related to Physics and Science Teaching. The study is grounded on theoretical-methodological references in French Discourse Analysis. The main imaginary formations detected with regard to Science Teaching in the context of the course were: "experiments draw student attention and break the routine of the ordinary classes"; "Themes in Science related to the Universe are attractive for the student"; "The advice of a specialist in the area has helped a lot"; "Unlike a lecture given when a specialist shows up at school." In addition, the IFG allowed us to verify imaginary formations present in the teachers' discourses, full of discrepancies between what the Curriculum of Sciences proposes in the initial and final cycles of the early years of elementary education in the State of Minas Gerais, and how teachers understand that curriculum for the preparation of lesson plans. Regarding the "imaginary formations" of teachers related to science, we found at the beginning and at the end of the program that aspects of an empirical-inductive vision prevailed (the role of observation and experimentation are highlighted), a rigid view of scientific activities and the scientific method is considered as a set of steps to be followed). And we understand that there were signs of "imaginary formations" of science as the work of geniuses, but scientists do not have to live "in isolation" from the world, for they are ordinary people, like teachers, and research phenomena that do not necessarily have to be investigated in the laboratory. In addition, we have realized at the end of the process that the teachers in the sample show that there is evidence of a constant reconstruction of Science.

1. Introduction

According to the National Curricular Parameters (NPC) for Natural Sciences for the initial years of elementary education [1], there are several areas of knowledge, e.g., Astronomy, Biology, Physics, Geosciences and Chemistry, which should be addressed in class of natural sciences through activities that enable the use of
materials, arousing curiosity about and interest in the systematization of the contents presented [2]. However, most teachers, at the educational level, teach several subjects (courses) that cover the various areas of knowledge [3].

In this sense, we agree with Carvalho and Gil-Pérez [4] when they claim that the teacher has real limitations, and that it is up to him to question the visions of Science that are worked in repetitive, dogmatic and uncritical forms, in order to break away from the simplistic common-sense approaches to their teaching. The requirements of a thorough initial training are so numerous that, in order to fulfill them, the process would demand an absurd duration. This is obviously not possible in the usually limited time of the typical initial training, which therefore calls for a more superficial approach [5]. Thus, there is a need for actions that promote the continuing education of teachers in the area.

The present article reflects part of larger doctoral research related to Physics Teaching in the initial years and continuing education in a public school, through a partnership with the university that was willing to advise teachers in the early years of elementary school, acting in the first and second cycles, in matters related to the teaching of Sciences, particularly of Physics. This article centers on this research question: What are the imaginary formations of teachers who participated in the continuing education course, in relation to Science and its teaching in the initial years of Elementary School?

2. Theoretical-Methodological Rationale: Discourse Analysis (imaginary formations)

According to Orlandi [6], through psychoanalysis, we are spoken by the unconscious; and through Discourse Analysis, we are spoken by ideology. In general, according to Orlandi [6], we can say that ideology is the imaginary that relates us to our conditions of existence. It does not mean concealment in the way one thinks, because one's own interpretation shows the ideological position and when one person interprets in one way and another person in another, ideology becomes explicit.

Thus, we can relate two terms that are linked to the concept of ideology: ideological formation and discursive formation. Pécheux and Fuchs ([7], p. 167 apud [8], p. 85, authors' italics) exemplify:

   [...] religious ideological formation constitutes, in the mode of feudal production, the form of the dominant ideology; it performs "the interpellation of individuals into subjects" through the ideological apparatus of the "specialized" religious state in God's relations with men, subjects of God, in the specific form of ceremonies (offices, baptisms, marriages, burials, etc.) under the figure of religion, actually intervenes in juridical relations and economic production, therefore within the interior of feudal relations of production. In the realization of these ideological class relations, several discursive formations intervene as components combined each time in specific forms; for example, and as a historical hypothesis to be verified: on the one hand the peasant preaching reproduced by the "lower clergy" within the peasantry, on the other the sermon of the high clergy for the greats of the nobility, then two discursive formations[...].

According to Barros [8], this example clarifies well the conceptualization of ideology as an ideological formation within discours discourse theory, since "there is, in the example, a single ideological formation, which permeates two other examples of discursive formation, but which, given the conjuncture presented, can contain a much larger number of them "(p. 84).

The imaginary formations of the subject of discourse are constituted of: the way one speaks; the way his words produce certain meanings and not others; and the way it is heard and seen, which are linked to certain ideological positions [9]. According to this definition of the term, Orlandi [10] establishes three imaginary mechanisms of discourse functioning.

To speak in speech is to speak in conditions of production, and in relation to these conditions we would like to point out that, as exposed by Pécheux [11], they are imaginary formations, and in these formations the relation of power count (the social places of the interlocutors) and their position (the chorus of voices, intertextuality, the relation that exists between one discourse and others) and the anticipation (the way the speaker represents the representations of its interlocutors and vice versa) (p. 158, emphasis added).
These mechanisms of the functioning of discourse (relations of meanings, relations of power and anticipation) are the imaginary formations that, for Pêcheux [11], designate the place that A and B attribute to each other and to the other, the image they make of his own place and of the place of the other. Thus, according to Orlandi [12], it is not the physical subjects or their empirical places, as they are registered in society, that could be sociologically described that function in discourse, but rather their images that result from projections.

In this article, the objective is to interpret teachers’ imaginary formations, evidencing the relations of power, meanings and anticipation in their discourses.

3. Methodology

The methodology we used adhere to parameters of the qualitative approach. According to Gonzales-Rey [13]: "The qualitative research that assumes the principles of Qualitative Epistemology is characterized by its constructive-interpretative, dialogical character and by its attention to the study of singular cases" (p.12).

The conditions of production in which the research data were constituted essentially comprise the subjects and the situations in which they live. As for the subjects, it is a sample of teachers from the initial years of Elementary School, who teach science classes. It is necessary to consider each of these teachers, having a life history, including their professional experience, which guides their eyes and justifies certain interests and needs [15, 2010].

The data were based on the situations experienced by the participants, which gave rise to the ongoing training course, promoted during the Teaching and Learning Period (HTPC) or Pedagogical Meetings in the school, for twelve months. The sequence, in which the data were constituted and their production conditions, was recorded as follows: description of the context, that is, the setting description (School, weekly pedagogical meetings) and the activities developed in the course.

The course developed during HTPC's school hours was titled "Physics Activities in the Science Classes of the Early Years in Elementary School" and was developed in 4 stages: The first stage was basically the choice of the school, participation of the researcher in pedagogical meetings, knowledge of the Pedagogical Project of the institution, and diagnosis of the teachers’ needs. The second stage: It was verified that the teachers had great difficulties in two main axes required by the school curriculum: Earth and Universe, and Science and Technology. Thus, the selection of the practical activities developed in the course (one of the teachers’ request) was based on academic publications in the area of Physics Education in the initial years of Elementary School ([15, 1997]; [16,2013]; [17,2015]; [18,2012]; [19, 1996]). The third stage: Teachers’ report on the activities developed with their students. A ceremony to award certificates. The fourth and final stage: After one year, impact indicators were recorded in teaching practices, as were suggestions other topics for a new course.

The present article analyzes the first stage of the course, in which we interpret the imaginary formations of the teachers in the early school years related to their respective views on "science" and "the teaching of sciences".

4. Analysis of the first stage in the course: the initial imaginary formations

a) Teachers' views on Science, according to their answers to the VOSTS Questionnaire

The VOSTS questionnaire was developed by Aikenhead and collaborators during the 1980s. The content of the 114 questions that comprise the VOSTS questionnaire was also based on the literature referring to the epistemological, social and technological aspects of Science, as in: Science, Technology & Human Values, or Bulletin of Science, Technology & Society, in books and articles such as Barnes Fleming, Gauld, Holton, Kuhn, Snow and Ziman [20, 1992].

The complete edition of the instrument appeared in 1970, which is quite extensive and demanding to be used in this research. Therefore, we have chosen to use an abbreviated VOSTS scale, with questions on the following topics:
1) Definition of science, 2) uniformity of scientific knowledge, 3) nature of scientific knowledge, 4) gender effect in careers, 5) nature of scientific models, 6) scientific method, 7) importance of consensus in science, and 8) production of knowledge.

The analysis of the VOSTS evidenced distortions in teachers' conceptions, revealing the belief in a Science based on the scientific method, disconnected from the social aspect of its construction. In addition to conceptions marked by empirical-inductivist views of Science, decontextualized, socially neutral and the rigid view of scientific activity. In the re-discussion part of the VOSTS questionnaire, we will analyze if these conceptions persisted after the course.

b) Teachers’ views on Science Teaching, through a Focus Group
This section presents the teachers' discourses, generated in response to the researcher's question about aspects related to their views concerning the importance of teaching science in the school context.

**Researcher:** Why is teaching science important?

After 5 to 7 seconds of silence

**Mara:** His existence is science, so it is part of it.

**Creice:** Yeah! To get to know each other! I have to know myself / same, I was teaching to the boys, there I was explaining ... why it is very difficult, right? Explain the reproductive system, right? / Then they laugh, like this, and then I was explaining that I have to know myself, to feel / I have to know what I like, for me to know how to pass / Then, afterwards, it goes on encompassing ... / It's me out ... / Then, there comes the nature part and everything else ... hey I find it difficult to explain when it comes to that part.

**Researcher:** Who else? According to your conception of science, why is it important for the student to learn science?

**Celia:** Because I think that, from the moment he learns science, he will learn everything that is around him, that is, nature, the origin of life ... so he has to have this knowledge so he can live well with it, right? With what's around him.

**Deise:** So ... even what happens to himself / the transformations of the body, so when he begins to feel, he comes to understand better what is happening. Now if he does not know, he searches for the explanations, hypotheses, and over time he confirms. Now if he has knowledge, he will understand why his voice is breaking ... so it is only a comparison, but this can be taken elsewhere as well ...

**Researcher:** Any more opinions ... they can talk!

**Ruth:** I think science is also a matter that instigates a lot / because sometimes, they are having some difficulty in Portuguese, mathematics; they do not have / they do not ask so much, they do not question so much / so when they enter there in the sciences part is a matter that awakens and even their vocabulary, and also, not to be ashamed to speak ... I think it's a matter that arouses much interest in wanting to know, in questioning, in asking, because as that is, and sometimes, so a matter of history and geography they do not int ... it is not that they are not interested, but does not put out what they are thinking, doubt that has ...

**Pedagogical Coordinator:** Does not sharpen curiosity . .
Teacher Creice's speech "is of the self out ... / there then comes the part of nature and everything else ..." indicates that it organizes the contents to be taught in the subjects (course), from aspects related to the human body and then broadens to "outward" aspects related to the nature and origin of life. And Teacher Deise's speech: "... even what happens to himself / the transformations of the body ..." also highlights aspects related to the human body (Table 25) that are worked by the teachers in the teaching of Science. Thus, Creice shows her difficulty dealing with the theme "reproductive system". Later, in this study, other difficulties related to the same theme will be presented.

Teacher Rute's speech indicates that students feel more comfortable exposing their doubts and curiosities in science classes, unlike in other subject classes, in which they feel more reticent. This preference of students for themes related to Science (Box 25) appears again in the CP's discourse: "... they left a literature book to pick up the science magazine ..." when reporting their experience as teachers, when they took the students to the library for class.

In this sense, we emphasize and agree with the idea of Souza [21,2013]: "Science teaching, although fascinating and arousing great curiosity in people, can be very superficially performed because the teacher does not know how to explore or may not be aware of this potential that is typical of the subject area"(p. 20).

Thus, in view of the teachers’ "imaginary formations" regarding the importance of teaching science, during the course that was taught, we tried to explore and stimulate the participants to use innovations published in area research.

5. Final Considerations

In view of the "imaginary formations" of the teachers related to the importance of teaching science, we tried to explore and stimulate the participants to use innovations from the science and physics education research. Most teachers continue to naively interpret that, in science, the consensus among researchers is achieved through conclusive demonstrations of results, ratifying the theory as true. However, we highlight as something positive that most of them believe that there is a constant reconstruction of Science.

It is important to emphasize that throughout the development of the course, there was no activity directly associated with studying aspects of the history and philosophy of Science. In this sense, we understand that, although there has been an improvement in the conceptions of some teachers, especially when they approached the conception of the modern epistemology of Science, aspects of an empirical-inductive vision (the role of observation and experimentation are highlighted) and a scientific method (the scientific method is considered as a set of steps to be followed) prevail.

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