A longitudinal study on the imaginary of future physics teachers about ‘learning assessment’

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Abstract. We present here partial results of a broader study aimed to investigate details of the initial education of Physics teachers, seeking to analyse the representations of these future high school teachers, from admission until their graduation from university, in order to understand how research has been introduced in or affected their early training. In this sense, we sought to analyse the profile of these future teachers and their imaginaries about “scientific knowledge”, “science teaching” and the “constitution of teaching knowledge”, from the moment of joining university in 2014 until the completion of the programme in 2017. Data collection took place in accord with a qualitative approach, using questionnaires applied at the beginning of each academic year in the specific courses of the programme. The data were treated by Discourse Analysis, originated by Pêcheux and developed in Brazil by Orlandi and other researchers. In this paper, we highlight the meanings produced in the discourses of future teachers on the theme ‘learning assessment’. The discourses show that the conditions of discourse production were fundamental in the changes of the future teachers’ imaginaries about this theme, and the power and impact that the programme and the institution have on the future teachers.

Keywords: Physics Education; Teachers education; leaning assessment; Physics teaching

Introduction

The initial training of physics teachers has been gaining attention over the years and has been increasingly present in research on Education and Science Teaching, which gives us a considerable number of publications that show trends and gaps [1], showing promising ways to follow the search for solutions to the main issues in the area. Among these problems, the small amount of advancements that reach basic education has been highlighted, even with this growing output [2]. One way to reduce this gap is to get prospective teachers to interact with research results during initial training. Therefore, discussions about teacher education are clearly important, especially with regard to the training models of teachers when completing a degree programme.

This paper presents partial results of a longitudinal study that analyses the changes in the discourses of future Physics teachers of a Brazilian Public University throughout a programme to qualify high school physics teachers (called ‘licenciatura’ in Brazil, licensure), more specifically during courses on “Science Teaching”. We highlight here the changes in the imaginary of these future teachers regarding the theme “learning assessment”. We also examined how the conditions of production of the discourses have affected changes of that concept.
1. Methodology
Research data collection followed a qualitative approach, based on André [3] and Flick [4]. Questionnaires were used at the beginning of each school year with a sample of undergraduate Physics students, preparing to become high school teachers. One of four data collection events took place yearly, for four consecutive years. The sample has diminished in size due to some students’ failing courses or having chosen to follow the BSc. This is because students choose, after admission, to follow either the teacher education track or the baccalaureate.

Initially, 49 students participated in the first data collection; in the second year, this number fell to 11; in the third data collection, eight students responded the survey; and in the last questionnaire only three students from the initial sample participated. At the end of the four-year period, only one participant was graduating within the anticipated time.

Although this decrease seems a very pertinent fact, it is consistent with previous research carried out by Kussuda [5], who, in his work, showed the drop-out rate in this Physics programme in the same University.

The theoretical-methodological foundation that supports the analysis of the future physics teachers’ imaginaries about “learning assessment” was the French Discourse approach advocated by Michel Pêcheux and developed in Brazil by Eni Orlandi. Authors who write on “learning assessment” have also been consulted for the purposes of this research in order to construct the analytical device. The main characteristic of this type of data analysis is the focus on promoting reflection on the interpretation, in other words, it shows the impossibility of having a direct access to meanings.

In this type of analysis, the main goal is to understand how an object leads subjects to make sense of it, and what is the importance of the resulting meaning [6], since “every discursive process supposes the existence of imaginary formations” [7].

In order to identify meaning connections in their discourses, we have tried to establish a bridge between identification and interpretation, finding meanings in the future Physics teachers’ discourse. In this context, it is important to note that there is a relationship of power that is predetermined by the institution in which the student is immersed, where the student plays the role of an author and the researcher plays the role of a reader, or analyst. Taking this into account, we highlight a general overview of the research, examining here the changes in the future physics teachers’ imaginaries about ‘learning assessment’.

1.1. Discourse production conditions
The enunciation of the speeches took place in the disciplines ‘Methodology and Practice of Physics Teaching’ I, III, V and ‘Didactics of Science’ in the ‘licenciatura’ curriculum (licensure are 4-year undergraduate programmes designed to educate future secondary/high school teachers in Brazil; in this case, licensure). These disciplines are within “axis two”, called “The Formation of Didactic-Pedagogical Knowledge of the Physics Teacher”. Axis two is one of the three integrating axes of the programme called “licenciatura in physics” in this university. Its pedagogical project includes two other axes: “axis one”, shared with the Bachelor's degree in materials physics, which contemplates the specific contents of physics, and “axis three”, which covers philosophical, historical, political, economic, sociological and anthropological aspects related to science and their impacts on classroom teaching.

2. Analysis
The profiles of these future physics teachers were analysed in previous studies [9], [10]. Thus, we can observe that the three licensees (future high school physics teachers) who participated sequentially in all data collection surveys come from regular high schools of the private network and, during their graduation, participated in extension or research projects.

In this sense, by knowing the profile of these students, it is possible to build a bridge between the identification of the individuals and their discursive productions, thus identifying the connections of meanings in their discourses.
In order to identify meaning connections in their discourses, we have tried to establish a bridge between identification and interpretation, finding meanings in the future physics teachers’ discourse. In this context, there is a power relation, since the student ends up taking on a role as author of the discourse, and the researcher the role of reader, an analyst. Even if the researchers made it clear that the answers given to the questionnaires would not be considered in the programme evaluations, the students, by mechanism of anticipation, try to meet the "expectations" of the researchers. Taking this into account, we will examine here the changes in the future physics teachers’ imaginary about “learning assessment”.

2.1. First Student

We highlight the student's response in the first of the questionnaires, whose main objective was to understand the context of the student as an undergraduate (2014):

I graduated from regular high school, all in private school. From kindergarten [...] After high school I took prep courses for university [...]

The transcript reveals that this student had only attended private schools and completed his secondary schooling in a preparation course for university entrance examinations - also in a private school in his city of origin. At the time the questionnaire was administered (2014), he was already a teacher in that same school where he took the preparation course for university. In this perspective, we begin by examining the question: "What is the meaning of "test" (evaluation/assessment) for you? Below are the responses of this student in each of the yearly questionnaires.

Table 1. Answers from the first student, year by year

| Year | Answer |
|------|--------|
| 2014 | The test [...] should not be a method of "bulldozing" the student. Besides evaluating how much the learner has learned, it can evaluate where the teacher can readjust the classes [...] |
| 2015 | Evaluation is an extremely interesting time for the teacher to analyse himself. A coherent test shows whether the content has been assimilated or not [...] |
| 2016 | Evaluation is the moment that the teacher should use to guide the following classes. Evaluation, if done correctly, will serve as a diagnosis of the student and his understanding. |
| 2017 | Evaluation is a very important moment in the teaching and learning process [...] It is a moment of evaluation of the teacher himself, his methodologies and their effectiveness. |

We note in these excerpts that, in the first three years, he understands evaluation as summative, in the sense advocated by Luckesi [8], that is, it is evident in his discourse that evaluation has the function of rating student success and that, with evaluation, the teacher can detect problems to be corrected later. In the last year of the programme, the student constructs his discourse based on the perspective of continuous evaluation, highlighting the importance of evaluation in the teaching and learning processes. Apparently, the student is familiar with the theory of continuous assessment, but he still cannot clearly understand how to use it in the classroom.

In addition, in the construction of his speech, the student expresses the need to be a reflective teacher, which may be related to his teaching experience, since the student acts as a teacher since he joined the programme to attain his teaching degree. However, his speech is still traditional, indicating that he idealises being a reflective teacher as important practice, but that - until now - has not been incorporated into his actions.
2.2. Second Student
This student attended private high school and started the physics licensure with the following motivation:

Willingness to help people understand physics.

From the second year of the course onward, this student came into contact with university research, referring to it as:

Research activities in the "hard" area (scientific).

What he defines as "hard" area and "scientific" is the research in the field of Material Physics. It can be noticed that the student, in using these terms, believes that research in "hard" physics is synonymous with "scientific"; probably, comparing it with the research in physics teaching.

Regarding the answers given to the analysed question, we have:

Table 2. Answers from the second student, year by year

| Year | Answer |
|------|--------|
| 2014 | A way to see what the learner has learned and what has prevented learning, or what the learner has not understood. |
| 2015 | A way to see what the student has learned. |
| 2016 | A way to see what the learner has learned, what was not very clear to him (and somehow manage to come back and explain again to the student). |
| 2017 | Evaluating the content that the learner has learned and what has remained in deficit, the traditional models of evaluation are deferred. |

In the four questionnaires, it is possible to observe that the student frequently uses the phrase “a way to see what the learner has learned”, which makes his conception of summative evaluation clear. He understands evaluation as only a way to rate student learning and detect possible problems that are supposed to be corrected later. Moreover, the future teacher does not present in his speech any concern with the reflection of his teaching practices, seeing evaluation only as something to be carried out by the student.

In the last questionnaire, he shows that the traditional evaluation models are out of date; however, despite having this conviction, the licensee does not yet have a broad understanding of evaluation models nor how to use them.

2.3. Third Student
He completed his regular high school in a public institution, and his motivation for choosing the physics programme was:

The supposed ease to deal with numbers, and the influence of the teachers, who [...] fed the idea [...]

As already presented by Nardi et al. [9], the response of this student evidences that the role of the teacher during basic education has a strong influence on the choice of the programme. It is worth mentioning that this student, since the first year in the programme, already participated in activities and projects in the Didactic Observatory of this university, as a monitor, and in construction of low-cost telescopes.

The student's responses each year were:

Table 3. Answers from the third student, year by year

| Year | Answer |
|------|--------|
| 2014 | A way to see what the learner has learned and what has prevented learning, or what the learner has not understood. |
| 2015 | A way to see what the student has learned. |
| 2016 | A way to see what the learner has learned, what was not very clear to him (and somehow manage to come back and explain again to the student). |
| 2017 | Evaluating the content that the learner has learned and what has remained in deficit, the traditional models of evaluation are deferred. |
In the first questionnaire, we detect a summative view of evaluation, since he makes it clear that the function of evaluation is to “measure” what a student has learned, that is, only to rate the student's learning. In the three following questionnaires, the constant use of the word "continuous" in his speech is worthy of attention; he makes the importance of continuous evaluation clear. Because it allows for a procedural follow-up on student development besides being part of the teaching and learning processes.

Still at the time of the third data collection, it can be noted in his speech that evaluation concerns both the student and the teacher, since it allows reflection on the teaching practice.

3. Final Considerations
The results show that the conditions of production of the discourses were the elements that made possible the change in the future physics teachers’ imaginary about learning assessment. In addition, the study also points that the present curricular structure and the way that this undergraduate programme (licensure) has been conducted are two additional factors that have contributed to this process.

Although there is some resistance about the evaluation of learning, a favourable movement has also been identified in the adoption of new methodologies and in the understanding of the future teachers that traditional practices are out of date and need adjustments.

Understanding the university as a social institution, it was in this context that the material conditions of production of students' discourses were constituted. If it were not for these conditions, the imaginary of these students would not change, because the subject of discourse establishes relations with its real conditions of existence, the context, through the imaginary formations that govern it.

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