The influence of high school teachers on the representations of the role of an "exemplary teacher" according to future physics teachers

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Abstract. We highlight here part of a longitudinal study, which sought to follow a group of future physics teachers and explain how research has been introduced in or affected their initial training. We seek to analyse their representations of the role of an 'exemplary teacher', considering that some of the graduates affirmed to have chosen a career as a teacher because of the influence of their high school teachers. The data were collected through questionnaires administered at the beginning of the study to students enrolled in the teacher education programme and treated by Discourse Analysis. We compare students' representations with five dimensions that characterize an "exemplary teacher". The results show that the characteristics of their high school teachers appear in the discourse of the students when they refer to an "exemplary teacher".

1. Introduction
Studies on the initial training of physics teachers have been increasingly present in research in Science Education, providing a considerable amount of publications that point at trends and gaps [1]. These results have shown promising paths in the search for solutions to the main problems in the area. Among them, the need has been highlighted to approximate the results of academic research and teaching practice in the classroom or other learning spaces [2]. One way to reduce this gap is to get prospective teachers, at as early a stage as in-service, to interact with research findings.

We highlight here part of a longitudinal study, which sought to follow a group of future physics teachers in a public university, from the beginning of the training programme (called licensure, in Brazil), until its completion, in order to explain both how the results of research are introduced in, and how research affects the initial training of these students. In the data collection, questionnaires were used to verify the alteration of their imaginaries about science and its teaching along the 4-year licensure programme.

The study began with a survey of the profile of the group of future physics teachers at a Brazilian public university. We found that one of the main reasons that led several of the students in the sample to choose the physics licensure programme was the contact with their high school physics teachers [3]. It is important to highlight that one of the questions in the initial questionnaires used with these future teachers asked their opinion about what they considered an “exemplary teacher”, and about the role of the teacher in the classroom [4].

The research took French Discourse Analysis as a theoretical-methodological reference [5–6]. Thus, the analytical device took into account the studies by Mesquita [7], in which the author identifies and outlines five dimensions with the characteristics of an "exemplary teacher":

...
a) Dimension of Knowledge: gathers the specific knowledge necessary for teaching performance. In this dimension three sets of knowledge are highlighted - scientific knowledge, curricular knowledge and pedagogical knowledge.

b) Strategic Dimension: this dimension brings together the techniques that will guide the teacher's work, that is, mastery of teaching strategies and equipment, learning resources, assessment methods and others.

c) Relational Dimension: This dimension refers to the relationship between teacher and student, where the teacher must recognize the characteristics and contexts of students, in order to establish a favourably learning environment, which encourages the exchange of experiences.

d) Motivational Dimension: related to the satisfaction and involvement of the teacher with his/her profession, feeling responsible for the students' performance. For the student, the teacher arouses and maintains their interest in learning.

e) Professional Dimension: Here we gather the formative elements, the bureaucratic issues of training and acting and working conditions. This refers to the continuing education of the teacher in search for updates and the relationship between his/her projects and proposals with the school administration.

Thus, in this paper, we seek to analyse the representations of the future teachers of the role of an 'exemplary teacher' of Physics. We justify the choice for this qualitative research question by considering that some of the sample graduates claimed to have chosen the Physics teachers' training programme because of the influence of their high school physics teachers.

2. Methodology

This research followed a qualitative approach, in the sense defined by André [8] and Flick [9]. Data collection took place at the beginning of each academic year through questionnaires, which were applied in matters related to the pedagogical axis of the licensure curriculum.

In total, four data collections were carried out, in which questionnaires contained questions about the students' personal and academic profile, which are important for the construction of the analysis, and questions about science and its teaching – these questions were maintained in all questionnaires in order to observe the changes in their interpretations over the four years.

The first data collection included 49 future teachers; in the second year, that number decreased to 11 students; the third data collection involved eight students; and, in the last questionnaire only three participants in the initial sample took part. At the end of the training programme, only one of these undergraduate students graduated on time. This drop in the number of undergraduates matches data in previous research [10], which investigated dropout in the last two decades of this licensure programme.

Elements of French Discourse Analysis, developed by Michel Pêcheux [11] in France, and Orlandi and others [6] in Brazil, constituted a theoretical-methodological framework for the elaboration of the analysis. Discourse analysis, in this approach, has as a main characteristic to promote the reflection on interpretation, that is, it shows the impossibility of having a direct access to meanings.

According to Orlandi [6], this type of analysis has the objective of explaining how an object produces meanings for subjects, what its relevance is and how it occurs. It is also based on this framework that we emphasise that language is not something transparent, being thus necessary to consider the conditions of production of meanings. According to Pêcheux [11], we must suppose that in every discursive process there are imaginary formations, in which the subject of discourse establishes relations with his/her real conditions of existence, the context, through the imaginary formations that govern him/her.

We highlight and relate here in this paper the answers given by the future teachers to two questions in the questionnaires:

- How do you rate the performance of the physics teachers you had in high school? What methods did they use to teach physics? Did you consider these methods good? Why?
- The literature on science education research speaks of “exemplary teachers”. What would be an “exemplary teacher” for you?
3. Data analysis

In this part of the research, the analyst makes a bridge between the identification of the subject and his place of speech, that is, he looks for meanings in his speech, considering who this subject is, and what he says, to whom and where he speaks. Thus, identifying meaning connections in the discourses of the analysed subjects.

According to discourse analysis, in this context, there is a power relationship, because the student ends up assuming the role of author of discourse, and the researcher the role of reader, the analyst. Even though the researchers made it clear that the answers given to the questionnaires would not be considered in the subject’s evaluations, the students, by means of an anticipation mechanism, try to meet the researchers' expectations. Thus, this analysis corresponds only to the answers given by these subjects to the first questionnaire as soon as they entered the physics teachers’ licensure programme. Out of the total number of students who answered this questionnaire, we selected and present here only the answers of some students who attributed the influence of the choice for the physics teachers’ programme to their high school physics teachers or to the classes taught by them.

3.1. First Student

Regarding the question about the performance of his high school physics teachers, this student brings the following statements about the classes of one of his teachers:

[... he was able to conquer the room by the explanatory method [by] using the people themselves within the room as daily examples of his explanations. [...] I think his method interacts with the classroom, removing the idea of hierarchy, becoming more friend and teacher at the same time. (student’s response excerpt)]

It is observed that the student concentrates his answer on a teacher. In the discursive fragment above we note that he highlights the way the teacher interacts with the students (relational dimension), 'removing the idea of hierarchy' and considering their daily experiences. The meanings in this discourse point to the teacher-student relationship as important in motivating learning (motivational dimension). Motivation also appears when he qualifies the “exemplary teacher”:

One who motivates the student to know (student response excerpt)

Thus, the motivational dimension seems to support his definition of an "exemplary teacher.”

3.2. Second Student

Regarding his high school teacher, the second student makes the following statements:

Our teacher was an undergraduate in mathematics, so her performance in physics teaching left something to be desired (which obviously did not happen in mathematics), she just gave the formula, explained little about it and dictated exercises [...] (student response clipping)

By highlighting the fact that his teacher has not completed a degree training in physics, the student points to the importance of the knowledge dimension. The strategic and motivational dimensions are also valued, when the student relates the teaching method employed by the teacher with the demotivation of students as regards their lack of interest in the classes.

When asked about the qualities of the “exemplary teacher,” the student makes the following statements:

[...] that teacher who can explain clearly, substantiate what he is teaching, shows willingness and patience with students because each one has their way of learning and their doubts, always willingly shows with the lessons, etc. (student response excerpt)

It is observed that the definition of the "exemplary teacher" conflicts with the qualities of his high school teacher, that is, the student points out practices that were not experienced by him in the classroom. Thus, his speech reproduces the opposite of the classes he had during high school. His image of the “exemplary teacher” contemplates the dimensions of knowledge, motivation and relation.
3.3. Third Student

The third student argues that:

The performance of my physics teachers in high school was terrible; they did not use any specific method, all because they were not physics teachers, but substitutes. (student’s response excerpt)

In this discursive passage, it is possible to identify a reference to the dimensions of knowledge and strategy, since the teachers had no specific training in the area, and also because “they did not use any specific method”, that is, no specific teaching method. We can see that the student does not make evident the relational dimension, probably because the teachers are substitutes, the relational dimension was impaired.

The student gives the “exemplary teacher” the role of guiding students, which brings us the relational dimension, since the interaction between teacher and student needs to be close for him to play this role.

An exemplary teacher is one who, besides teaching, guides the student in certain directions. (student’s response excerpt)

The proximity between teacher and student was an important factor for him, and the lack of physics teachers on public schools undermines this relationship. In this case, there was no permanent teacher and the alternation of substitute teachers hinders the strengthening of the relationship.

3.4. Fourth Student

In this discursive passage, we observed that the student had more than one teacher and makes comparisons between them:

The performance of the teachers that I liked was good for high school because they used examples whenever they could, they took subjects and so on; while the other teacher did not approach the theory, but brought in a lot of exercises without finishing them, he wanted to “run” with the subject, perhaps because he was pushed by the school principal who only thought of “approval”, but this brought difficulties in learning and undermined interest in the subject. (student’s response excerpt)

As for the strategic dimension, the teachers that this student considers to be the best performers used “examples” and “subjects”; the other teacher just "filled lessons with exercises". He also mentions the motivational dimension when he talks about the pressure that the “school principal” exerts on teachers. As Mesquita [12] points out, the factors that influence the performance of ‘good teachers’ include the healthy relationship with managers and colleagues. In this case, the possible pressure exerted by administration on the teachers made the work difficult and, consequently, learning and interest in the subject went down.

According to this student, the “exemplary teacher” is the one who:

[…] wants to form a bond with the student, who wants to see him (the student) become a great professional one day […] then it goes beyond the traditional method in which the teacher passes exercises and students test them later. (student’s response excerpt)

The student brings again the two previous dimensions: when he speaks of the motivational dimension, in which the teacher should feel responsible for the students' education, and the strategic dimension, in which the teacher should use not only the “traditional method” of teaching. In this case the student also highlights positive aspects in the “exemplary” teachers, compared to those who, on the contrary, present aspects that he considers problematic.

4. Conclusions

The study shows the influence of the role of the former teachers, especially in High School, on the discursive formation of the undergraduates. In describing the performance of - and methods used by - their former high school physics teachers, undergraduates highlight the strengths and weaknesses. When
asked what they consider to be an “exemplary teacher”, we observe that the teachers described above are present, even if discreetly, in their discourses.

It was also found that positions that reflect the professional dimension, perhaps because it is a trait of the individual teacher, of his/her own education, do not appear in undergraduates' discourse. This dimension ends up reflecting on other actions. Another point to highlight is the lack of physics teachers, or teachers in general, with training in other areas teaching Physics. This fact seems to limit the teacher-student relationship and discourage them. The studies by Kussuda [13] on the professional choice of undergraduate physics students point out to the gravity of this problem, even in states where the number of undergraduate degrees is adequate. Although, due to space limitation, we brought here only the speeches of some students, we signal that similar speeches also appear in other students; the fact that we are using qualitative research and qualitative research and discourse analysis in the Peuchetian line, also clarify this choice.

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5. References
[1] Santos N F 2004 The initial training of physics teachers in federal technological education centers: contributions and criticisms (Master’s Thesis in Education, State University of Rio de Janeiro, Rio de Janeiro, Brazil) p 140
[2] Nardi R and Almeida M J P M 2009 Science Education research and its impact in the school science: last decades’ in-service teachers’ memories Proc. ESERA 2009 Conf. - European Science Education Research Association (İstanbul, Turkey) Book 4 p 99
[3] Nardi R, Almeida M J P M, Parma F W and Belíssimo J R 2016 A longitudinal study on the imaginary of Physics graduates Proc. XVI Encontro de Pesquisa em Ensino de Física (Natal, Brazil) pp 1-8
[4] Parma F W, Belíssimo J R and Nardi R 2018 A longitudinal study on the imaginary of undergraduates in Physics Proc. XVII Encontro de Pesquisa em Ensino de Física (Campos do Jordão, Brazil) pp 1-8
[5] Pêcheux M 1990 The discourse: structure or event vol 3 (Campinas, Brazil: Pontes Editors) p 68
[6] Orlandi E P 2015 Discourse Analysis: principles and procedures vol 12 (Campinas, Brazil: Pontes Editores) p 100
[7] Mesquita S S A 2018 Benchmarks of the “good high school teacher”: a theoretical discussion exercise Cadernos de Pesquisa 48 506
[8] André M E D A 1995 Ethnography of school practice vol 1 (Campinas, Brazil: Papirus) p 191
[9] Flick U 2009 Qualitative Research Design. Qualitative Research Collection vol 3 (São Paulo, Brazil: Editora Penso) p 164
[10] Kussuda S R 2017 A study on dropout in a Physics Degree course: discourses by alumni and professors (Master’s Thesis in Science Education, State University of São Paulo, Bauru, Brazil) p 308
[11] Pêcheux M 2010 Por uma análise automática do discurso vol 4 (Campinas, Brazil: Editora UNICAMP) p 315
[12] Mesquita S S A 2016 Teaching in high school: the central role of the teacher in working with young people from the periphery (PhD in Education, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil) p 286
[13] Kussuda S R 2012 Professional Choice of Physics Graduates from a public university (PhD Thesis in Science Education, State University of São Paulo, Bauru, Brazil ) p 184