Lights and shadows in Physics teaching using laboratory-based practice. Approaches to educational research

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Abstract. The aim of this paper is to find a teacher's concerns, difficulties and knowledge construction when he begins to be part of the field of science education research. Based on an experience carried out for the teaching of spectroscopy in secondary school level Physics lessons, a reflection is raised on the practice itself aimed at transforming the teaching task into an object of action - research for the teacher. The processes involved in the selection of the topic, the basis for the design and implementation of the practical activity and the observations of the teacher are described.

1 Introduction & Theoretical Framework

Science Education has had its scholarship recognition all around the world supported by several Ph.D. university programs. Thus, research in this domain of knowledge expands and permeates the particular classrooms of those who have committed themselves to the mission of becoming researchers. However, the process of transforming a teacher into a researcher of his own practice, although it has often been claimed and promoted, is still a pending issue.

This work aims to expose the processes through which a professor of secondary school level Physics begins to rethink his own practice, from the perspective of research in Science Education. When we ask ourselves about the teacher's motivation to carry out a new practical activity for his students, his difficulties in planning it, his considerations when carrying it out and the knowledge that he builds along that process, we are taking into account the processes that are part of the development of the pedagogical content knowledge (PCK) [1,2] of that teacher.

As of an experience carried out for the teaching of spectroscopy in secondary school level Physics lessons, from the construction of a homemade spectroscope, a reflection on the practice itself is proposed here to transform the teaching task into an object of investigation for the teacher. The processes involved in the selection of the topic, the basis for the design and implementation of the practical activity and the teacher's observations are described. For the design of the didactic proposal, two complementary aspects were taken into account. On the one hand, the role of practical laboratory activities for the teaching and learning of Physics [3]; and on the other, the need to incorporate new technologies such as the use of mobile devices as experimental tools in experimental Physics lessons [4]. The wide selected topic was *the light* (Optical Physics) because it is a very known physical phenomenon and it admits a broad diversity of teaching proposals.

2. Methodology

Andy is a Physics teacher at a secondary school with 6 year of teaching experience. He is, besides, a Ph.D. student. His students were 5 boys and girls of around 17 years-old of a public secondary school of a small town of Argentine.

In order to promote the self-reflection about the involved processes during the creation and planning of his lesson, we design a questionnaire inspired on the classic Content Representation (CoRe) [5] because it is a holistic reflective tool to make knowledge and conception about a particular topic explicit [6]. Corpus of data was constituted by the enacting of the innovative class, the report of that experience and the written responses to the specially designed questionnaire. In this first approach, a qualitative methodology was employed in order to detect plausible categories for further analysis.

3. Results, Discussion & Conclusions.

The answers to the questionnaire revealed the declarative knowledge of the teacher. Andy showed a big interest to improve his lessons according to his students' motivations and their socioeconomical context. He gave a starting role to his pupils in the lab. He also showed his knowledge and passion for teaching Physics and diverse ways to assess the students' understandings. However, his answers exposed some difficulties when explaining the rationale of the innovation and inconsistencies between the teaching proposal and learning expectations. In the same way he could be able to reflect about his technical new learnings, but not about other wider thoughts and knowledge carried out throughout the completed process.

Nevertheless, PCK model suggests that Andy's knowledge was modified and enriched with new strategies for searching information, for designing innovative practices and, mainly, in order to transform personal experience in an object to be analysed. Succession of questions and answers, and the participation of Andy in the research team, offered him the opportunity to revisit his experience including new analytical tools. In this way, our results begin to lighten the *shadows* on the needed knowledge and process to become in a science education researcher.

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