

Professional Development Programs in Physics in Tuscany

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Abstract. Since 2000 we have been engaged in professional development programmes to improve the cultural knowledge and skills of pre-service and in-service teachers. All activities focus on promoting active learning in laboratories. After testing different training modalities for in-service teachers, in recent years a series of national summer school has been organised to explore a single general topic from an interdisciplinary point of view. In addition, in collaboration with an interdisciplinary inter-university team, we have developed and tested a training course for tutors for newly recruited teachers in Tuscany, with the aim of promoting the acquisition of professional skills.

Introduction

Designing professional development programs for physics teachers that can lead to fundamental changes in their practice is a challenge in physics education. Over the last few decades, we have implemented several professional development programs for teachers of physics and mathematics, both pre-service and in-service. These programs have been designed to enhance the cultural knowledge and skills of teachers. All activities aim to promote active learning [1-3] in laboratories. After testing various modalities [4-7], the analysis of the results indicates that a residential summer school could be one of the most effective ways for in-service professional development. In the following, we summarise the most significant editions of the summer school *Science in 4D*, discussing the strengths and weaknesses of this training method.

The latest research aims to identify effective actions to foster active learning, with a focus on laboratory practice, in current school teaching. In collaboration with the regional school office, an interdisciplinary team developed and tested a training course for tutoring newly hired teachers. The goal of the course was to promote the assessment and acquisition of professional skills [8]. A new version of the tutor training course is being tested because of changes in the legislation that regulate the confirmation process of newly hired teachers.

The interdisciplinary summer school *Science in 4D*

As part of the National Plan for Scientific Degrees (PLS) innovative paths, laboratory experiences and teaching materials have been developed which, following and developing the most recent indications emerging from physics education research, have allowed us to develop a series of actions that have proven effective in the classroom. From this experience tested directly with students and teachers in the laboratory, in summer orientation schools and in curricular teaching practice, the interdisciplinary summer school *Science in 4D* is born in 2016 with the aim of sharing and disseminating. *Science in 4D* proposes a theme that is significant for the citizen's scientific literacy, with important scientific aspects that can be studied with specific methodologies of each discipline, but which also require interdisciplinary skills and allow the development of transversal skills such as the ability to model complex phenomena, to observe and correlate very different phenomena, to use adequate mathematical tools. The school theme changes every year to offer teachers a wide choice of workshops (Hidden harmonies: time in science 2016, Science for sustainability. Sustainability for Science 2017, A World of Colours 2018, Discovering Materials in Science 2019, Space Sciences 2021, Radioactivity: Yesterday, Today, Tomorrow 2022, Time Rediscovered 2023, Energy for Life. Energy for Society 2024). In the seven editions

held so far, 174 secondary school teachers of scientific disciplines (mathematics, physics, natural sciences) have participated.

Despite the great satisfaction of the participants with the tools provided by the school for their professional development, the number of participants is decreasing. The critical points of this type of training are mainly: the summer period in which the school can take place is compressed between the final exams of the high school and the summer holidays, and the difficulty of involving colleagues from other disciplines in interdisciplinary courses after returning to school. Furthermore, the possibility of disseminating innovative teaching actions in school practice has been much lower than expected over time, due to several problems related to the organizational dynamics of schools.

A wide collaboration for an innovative in-service professional development program

Three years ago, the Tuscan Schools Office involved the main universities in the region (Universities of Florence, Pisa and Siena) in a collaboration for the professional development of teachers. The first action was to develop, in a large inter-university interdisciplinary team, tools that would be useful for tutors in the first year of training of newly hired teachers and for the evaluation of professional skills along all professional life. In collaboration with the school office, the team designed the second module of the training course for secondary school tutors, where the developed materials were proposed as the principal tool for measuring skills in the probationary year (observation sheets and guidelines to support the training action of tutor teachers).

In the last year, the Ministry has defined the observation methods by focusing on the results achieved in the classroom rather than on the professional skills used to achieve them. The course was therefore redesigned by proposing materials as tools for continuous professional development. We carried out the training on the disciplinary and transversal skills needed to create effective active laboratories. This part involved 520 participants, ensuring a wide dissemination. However, the methods used to manage the courses required the development of a new way of measuring results, different from those used in the other PLS actions. In previous years, the focus group method was used before the end of the course but in this way, we have no information on the effectiveness in teaching practice.

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