

# Innovation in Teaching/learning physics in Master IDIFO

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**Abstract.** Implementing Teachers' Professional Development is a challenge, which is based on a consistent amount of physics education research (PER). The innovation in teaching/learning required today to build competence and autonomy for young people represents a strong challenge for teachers. In Italy, there is no institutional program for the professional development of teachers, but the PLS Plan (PLS) offers the opportunity for a qualified professional development by means of cooperative work between school and university and in that framework the Master IDIFO build an original TPD able to integrate PER and praxis in school activities.

## Introduction and aims

Teachers' Professional Development (TPD) require an important innovation in physics education for many reasons: the actual complexity of the society [1], the need of even more autonomy and competence for future citizen [2], the new learning challenges offered by ICT able to put in the hand of the students sensors for measurements, software for modeling and communication tool for sharing data and interpretative ideas. [3]. Physics Education Research (PER) contributes in many ways with studies on conceptual change, tools and methods for teaching strategies, didactic pathways, tools and modalities of learning analysis [4]. However, much of this work does not reach teachers. In fact, teachers do not always have access to research journals and know how to use PER, so they ask for help in this. Depending on the country, this aid takes different forms, such as institutional coaching, annual training periods or projects run in a network by teachers.

In Italy, the situation has been hard for many years (since 2006) both for the initial teacher education in physics [5] and for the in-service TPD [6]. This problem has been the stimulus for the development of an interesting model for the TPD.

This model is called Master IDIFO (Innovation for Didactic In Physics and Guidance) and was born in 2006, promoted by the University of Udine as an initiative shared by several universities (10-20 depending on the edition) for the professional development of in-service secondary school teachers with the contribution of research in physics education, in the framework of a National Degrees Plan - Piano Lauree Scientifiche (PLS) to promote STEM degrees [7]. More than 27 publications report on the research results during the master's life [8]. Here we present the characteristics of IDIFO and some results on the main problems inherent in the TPD.

Selected features make IDIFO an interesting model for TPD. Here are the main ones: 1) Each location offers free modules of 3 credits for a total of 136, to be chosen according to training profiles corresponding to the teacher's needs in 3 possible forms: two-year Master's Degree of 60 credits, Annual Postgraduate Course of 15 credits, with single modules of 3 credits; 2) Research in physics education is a tool and reference for the whole educational offer; 3) Each training profile must include 40% of transversal modules on tools and methods of didactic research, orientation, citizenship education and transversal issues; 4) Each module involves 50% of class time and 50% of students' working time; 5) The impact on classes of the didactic proposals developed by the Master's students after training, is an integral part of the training proposal; 6) A platform guarantees all e-learning training and each location organizes local workshops for those interested; 7) Alongside the Steering Board, the Scientific Council composed of one representative for each

cooperating university site, evaluates the teachers' training plans and the educational offer of the individual locations; (8) IDIFO is offered free of charge to interested teachers; 9) PER is the focus of the initiative, with particular regard to modern physics, the laboratory and the role of ICT in teaching/learning physics.

The main research questions faced by IDIFO are:

- 1) How can the professional development of secondary school teachers be personalized?
- 2) How do create ownership of the main results, tools and methods of PER?
- 3) How is the teacher's training relapse put in place in classes?

## Findings and perspectives

In recent editions, the request to each member to choose a series of Modules that would constitute a coherent professional profile corresponding to personal needs, has been a choice capable of personalizing the training, also because it is implemented with telematic communication tools favoring the interaction (RQ1), though it also proved to be a difficult choice for Master's students, who sometimes made changes to their study plan (20%). About 70% of the Modules correspond to a training offer based on PER. In fact, the training profile of the participants had to compulsory include at least 15% of Modules completely based on didactic research: this proved to be a very effective strategy, since the participants (95%) understood how to use it and indeed made significant use of it (68%) in the final design documents (RQ2). The request for the design, implementation, monitoring of learning and evaluation of a minimum of 12 hours in classroom with students produced an assumption of responsibility for quality educational innovation in 85% of participants with good level of research-action, i.e. where the research results were acted in class practice (20%) (RQ3).

In the framework of international research on TPD the consolidated experience of IDIFO offers solutions to the main relevant RQs posed still matter of studies.

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