

## Initiatives in Chemistry Teacher Training in Italy: Significant Testimonials

**Maria Maddalena Carnasciali, Laura Ricco**

Department of Chemistry and Industrial Chemistry – University of Genoa (Italy)

[marilena@chimica.unige.it](mailto:marilena@chimica.unige.it)

### Abstract

*The paper, after describing the national scenario about training of science/chemistry teachers in Italy, presents activities and successful results of two important projects that offer in-service training to teachers: they both are coordinated by the Department of Chemistry and Industrial Chemistry of Genoa. Finally, in order to produce a more complete analysis of the chemistry teacher training, “senior” and “junior” teachers were interviewed: a summary of their considerations and of their needs is reported.*

### 1. Training of science teachers: national scenario

Science education in Italy [1,2] begins at primary school as a single, general, integrated subject area, where broad themes which are the basis of chemistry and other scientific disciplines (states of matter, vegetable world, human body etc.) are taught. Integrated science subjects promote a questioning and investigative approach to the environment and prepare children for more detailed studies in later grades.

The teaching of science continues as an integrated program at the lower secondary school and splits into separate subjects at the upper secondary school, but not completely. In fact, after the recent reform of the school system (introduced with Law no. 53/2003 and the subsequent decrees), the teaching of science at the lyceum foresees two disciplines, physics and natural sciences: the teaching of natural sciences includes biology, chemistry and earth sciences, grouped in an integrated program. Different and less homogeneous is the situation at technical institutes and vocational schools where chemistry and other scientific disciplines are taught separately: annual timetable and specific name of the courses are function of the kind of school and of its specialization.

In order to be included as science/chemistry teacher in the above school system, the training is different as function of the school grade.

Primary school teachers have to get the degree in “Sciences of Primary Education”. This degree program consists of two addresses: one for the training of nursery teachers and one for primary school teachers. Access is limited and the number of enrolments is established in each region according to the needs of schools; the admission examinations test the knowledge of the main disciplines. The course takes five years and provides both disciplinary teachings (language and literature, math, sciences, history and geography) and didactic-pedagogic teachings; also didactic-pedagogic laboratories are foreseen, and a traineeship carried out in the school alongside an experienced teacher.

For what concerns lower secondary school, chemistry is taught within and integrated program (sciences), including natural sciences and physics, and the teacher is also the math teacher. Accordingly, in order to teach sciences and math at lower secondary school, it is needed to get a generic scientific degree as math, physics, biology, natural sciences, chemistry, informatics etc.

A little more specific is the request at higher secondary school: only people graduated in chemistry, pharmacy or chemical engineering can teach chemistry where it is foreseen as a separate subject. But at the lyceum, natural sciences, as it is an integrated subject, can be taught by people graduated in natural sciences, biology, geology, chemistry, pharmacy and few others.

Before 1999, the degree was the only compulsory requisite to teach at secondary school: after this data, a post-degree two-year master (Training Course for Secondary School Teaching - *Scuola di Specializzazione all’Insegnamento Secondario* – SSIS) was instituted as a pre-service education for secondary school teachers, and was specific for different disciplines, including chemistry. In 2008



518300-LLP-2011-IT-Comenius-CNW

SSIS was interrupted and only in 2012 it was re-established, as one-year course, named TFA (Active Formative Training - *Tirocinio Formativo Attivo*): the first cycle of TFA finished the last July. This course (as SSIS did) gives a teaching qualification, compulsory, even if not sufficient, in order to get a permanent role of teacher at school. Without it, only temporary contracts, can be obtained.

TFA foresees a limited number of attending people for every year, admitted after an examination testing the knowledge of the specific discipline. Didactic-pedagogic courses, together with courses and laboratories about the teaching of the discipline are provided by universities; a period dedicated to practical experience at school, side by side with an expert teacher, the tutor, is foreseen to complete the training.

For what concerns in-service training, they are sporadic and not compulsory. The most significant are national projects financed by the Ministry of Education, University and Research (MIUR) and provided by Universities, or courses provided by INDIRE (National Institute of Documentation for Innovation and Educational Research) [3] with the support of European Structural Funds (FSE).

## 2. Testimonials of in service training for chemistry teachers

As chemistry is concerned, the Scientific Degrees Plan (PLS) is, actually, the most active and widespread project at national level [4,5]. It is addressed to upper secondary school and financed from the Ministry of Education since the first edition, in 2005. The project was born to face the alarming decrease of enrolments to some scientific courses of degree, chemistry included; year by year, it realized a great success in improving the teaching-learning methodology in upper secondary school so as to become a reference point for many teachers.

Our institution, the Department of Chemistry and Industrial Chemistry, has been the local coordinator of PLS-Chemistry for the Liguria region since 2007. The activities that are carried out within the project are designed so as to provide a form of continuous training; in fact, teachers are actively involved in:

- meeting for the production of admission tests for the degree course in chemistry;
- seminars on current topics of chemistry or teaching methodologies;
- meeting to design practical activities to be carried out in the laboratory;
- implementation of laboratory activities with students

The part devoted to the laboratory is usually the most popular, as for the enthusiasm of the students, as because teachers feel not prepared in this area and require help. The collaboration between teachers and university researchers enabled to organize many laboratory activities, carried out both at the Department and at school. In particular, a path on the theme of polymers, called "Fantastic Plastic", had the university as first location, and was then brought in all the schools involved in the project, as a travelling laboratory. In this second case, the aim was to show that the laboratories of schools, even if poorly equipped, can be used without difficulty for practical experiences; the initiative was very useful because allowed teachers to learn in their own work context. The achievement of the aim is proved by the fact that many teachers repeated autonomously, with their students, some of the activities of "Fantastic Plastic".

A path about the topic of carbohydrates and proteins [7] was planned for students of the fourth year and carried out at school: the task of teachers was to introduce biochemistry before the foreseen practical activities. The latter, realized under the guidance of the university staff, were about the bread-making and had an interdisciplinary character, because biology (yeast and cellular breath) and math (realization of graphs) were complementary to chemistry. The discussion of the results, in classroom, and the production of the scientific report completed the work.

This path had a great success, as because students worked with motivation, as because teachers have received support and valuable material to improve itself in a field where they feel weak. Very widely appreciated were also some activities carried out in collaboration with the world of job: the Scientific Police, the Aquarium of Genoa and enterprises of the chemical sector agreed in showing their working reality to students and teachers, while university provided laboratory experiences closely related.

Another project that provides in-service training and in which our Department is deeply involved is "Chemistry Is All Around Network" [8]. Within the project activities, teachers participating can share their experience and discuss about their context of work, each other and with experts of teaching.



518300-LLP-2011-IT-Comenius-CNW

Moreover they contribute to select and validate ICT teaching resources, so learning to use this kind of tool, relatively new and too often rejected by teachers. The cause of the distrust is not only the perception that they have about a limited ability to manipulate ICTs, but, above all, the difficulty to insert them in the traditional teaching, so as to make them real "learning resources" and not time-consuming objects to be used sporadically. The validation of the resources was conducted by choosing those in line with the school *curricolo* and was carried out by the teachers, according to their sensitivity and in order to achieve an appropriate and successful integration with lessons and laboratory activities.

Thus, in example, "Chemistry at Home" one of the educational packages of the portal "Chemistry Is All Around Us" [9], has been used at lower secondary school to study the chemical reactions and the factors that affect their speed. Moreover, because the resource is in English, it has been a good opportunity to use the CLIL (Content and Language Integrated Learning) methodology in order to build scientific and digital skills. The realization of practical experiences about the reaction between vinegar and baking soda, described in the activity section, allowed to integrate the virtual learning with the real practice [10].

Another ICT resource tested as part of a didactic unit about the chemical elements and their behaviour is "Tavolaperiodica.it" [11]. This site provides sections dedicated to groups of elements, with pictures and videos. It was used with benefit, sided by small practical activities and by activities work in groups.

The correct and fruitful use of the resources that were tested and of those that will be tested during the current school year will be described in specific papers, comprehensive of considerations and suggestions from the teachers. Also supporting material, produced as further guide to the use of the resource or to integrate the digital activity with others. The documents will be available on the project portal, in order to provide a training for all portal users that need support in introducing digital tools in the teaching of chemistry.

### 3. What teachers think

As it can be evinced by the first paragraph, Italy provides a insufficient training to its science teachers, both with regard to initial training, that with regard to in-service training. In order to add more concrete considerations about this situation, some teachers were interviewed about their past and present training and about what they need to improve their skills. In particular, two categories of teachers were consulted:

- "junior teachers", meaning people that attended the TFA for chemistry (upper secondary school) and got the qualification in July 2013. They have few years of experience in chemistry/science teaching, but only with temporary contracts
- "senior teachers", meaning upper secondary school science/chemistry teachers with many years of experience.

Junior teachers think that a deep knowledge of chemistry is necessary but not sufficient to be a good teacher. Therefore, they appreciated the contribute of the TFA to their training, in particular for what concerns the courses about pedagogy and science of education and about special teaching methodologies such as the teamwork or the use of ICTs; much appreciated was also that part of the course dedicated to the laboratorial approach. Some critics were addressed to the poorness of practical activities within the courses and to few aspects of the general organization.

In synthesis the evaluation was globally positive: they state that *"the experience will be the real motor of the improvement in teaching, but the experience is not sufficient without a suitable training, initial but also continuous"*.

Senior teachers did not have initial training, apart the degree in a scientific discipline. Most of them teach science at the lyceum and have the degree in biology or in natural sciences. First of all they declare a low chemistry knowledge so feeling not adequate to teach this part of the *curricolo*. This situation is very diffused in Italy so to seriously threaten the survival of chemistry at the lyceum. Secondly, they recognize that the lack of an initial training made more difficult their work and they had to count on the experience only, day by day. But experience is not sufficient, so they feel the need of attending courses to improve the approach with students and to apply an efficacious educational

518300-LLP-2011-IT-Comenius-CNW

mediation between students and chemistry. They thank the contribution that projects as PLS-Chemistry gave to their skills, and state that courses or events for teacher training should deal with the laboratorial approach, the chemistry of everyday life, the update of the knowledge with the state of the research and the new technologies. Finally they would like to have the possibility of belonging to teams composed by teachers and teacher trainers, that discuss the usual problems of teaching, that test solutions and produce materials to use with students.

## Conclusions

As it can be evinced from the above paragraphs, Italy provides a insufficient training to its science teachers, both with regard to initial training, that with regard to in-service training. Teachers themselves feel of not having good teaching , organizational, interpersonal and communication skills. Another, not negligible, problem is linked to the school organization: as explained in the first paragraph, chemistry is often taught by teacher graduated in other, even if scientific, disciplines. In the light of this situation, the system of teacher education is evolving, but with great difficulty: a functional and well structured system seems to be very far from the reality, also due to the lack of funds. it is worth to be mentioned that activities addressed to teachers exist and are increasing because the need of teachers to be continuously trained is increasing too, but their are not sufficient to guarantee a well planned training.

## Acknowledgements

The authors thank the Lifelong Learning Programme – Comenius Sub Programme, of the European Union for financial assistance.

## References

- [1] From Eurypedia  
[https://webgate.ec.europa.eu/fpfis/mwikis/eurydice/index.php/Italy:Organisation\\_of\\_the\\_Education\\_System\\_and\\_of\\_its\\_Structure](https://webgate.ec.europa.eu/fpfis/mwikis/eurydice/index.php/Italy:Organisation_of_the_Education_System_and_of_its_Structure)
- [2] EACEA 2011. *Science Education in Europe: National Policies, Practices and Research*. Brussels, Education, Audiovisual and Culture Executive Agency (EACEA P9 Eurydice)
- [3] <http://www.indire.it/>
- [4] MIUR, Ministero dell'Istruzione, dell'Università e della Ricerca 2007. Il progetto 'Lauree Scientifiche'. *Annali della Pubblica Istruzione*. Florence, Le Monnier
- [5] <http://www.progettolaureescientifiche.eu/>
- [6] <http://www.chimica.unige.it/pls/it/>
- [7] Carnasciali M.M, Ricco L., Minguzzi A. (2011) . Introduzione ai carboidrati nella scuola secondaria di II grado: 1.un percorso laboratoriale ispirato alla vita quotidiana. *CnS La Chimica nella Scuola* 5: 195-208
- [8] <http://www.chemistryisnetwork.eu>
- [9] <http://www.chemistry-is.eu/>
- [10] <http://is.pearson.it/espresso/imparare-la-chimica-in-inglese-con-il-metodo-clil/>
- [11] <http://www.tavolaperiodica.it>

