

Chemistry Teachers' Training in Europe



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Context

The identified background of the project idea relies on the evidence of common needs within the countries involved and in Europe in general, related to the insufficient diffusion of scientific culture and awareness, that starting from the school level (primary and secondary education) affects all levels of educational and training systems and therefore citizens in general.

Promoting Life Long Learning strategies for scientific issues is much more difficult, if compared to other subject areas (e.g. humanistic subjects, business management, language learning) as when the compulsory educational pathways end up, those that are not specifically interested in science are much more likely to abandon completely the subject.

Moreover teachers, the key actors of the promotion of scientific awareness, have to face a major challenge coming from the fact that the speed of the development of scientific knowledge is constantly increasing.

The scientific background of a teacher who started teaching 10 years ago, without a constant update, risks to become soon completely obsolete. But often the language used by most advanced researches is too complicated even for teachers and the knowledge gap between university and research centres and the teachers themselves tends to become too big to be handled, with the most negative effects falling on the students who exit school unprepared to develop their knowledge in scientific issues.

This phenomenon risks to create concrete and consistent obstacles to the achievement of some of the main objectives of the Europe 2020 strategy aims related to the competitiveness and the excellence of scientific research in Europe and its capacity to answer and anticipate the needs of the market and the promotion of science education and knowledge among European citizens.

The Chemistry Is All Around Network project aims at stimulating the interest of students towards the study of chemistry. It is based on the collaboration of school teachers, scientific experts and university researchers and each year foresees different activities within a specific area of interest: 1. students' motivation; 2. teachers' training; 3. successful experiences and good practices.

The first year of work, dedicated to analyse students' motivation to study chemistry in the Countries involved and to discuss about concrete solutions, was completed in December 2012.

The second year of work, completed in December 2013, was dedicated to analyse the training of teachers in the different countries, with a special focus on science/chemistry teachers.

The material produced during both the years (papers, reports, teaching resources etc.) is available in the project portal.

The main results related to the "Teacher Training" research area will be presented in the following paragraphs.



1. National situation on teacher training

A brief description of the general situation on teacher training is given for each project partner, with special attention to the training of science/chemistry teachers.

Each paragraph is composed by two sections: initial (pre-service) training and in-service (continuous) training.

The detailed description of every national teacher training can be found in the eleven corresponding national reports uploaded on the project portal, while information on the organization of the school systems are included in the Transnational Report On Students Motivation, it also uploaded on the project portal.

1.1 Belgium



In Belgium, education is not a national matter. Belgium is divided in three territorial regions (Brussels, Flanders and Wallonia) and three communities based on the three official languages of the country (Dutch, French and German). Education is the responsibility of communities, in our case the French-speaking Community, officially called "Fédération Wallonie-Bruxelles" (as French is spoken in Wallonia and Brussels). In the Fédération Wallonie-Bruxelles, teacher training depends on the Ministry of Upper Education.

Initial Training

There are two courses of study to become a teacher. They both mix academic knowledge and professional practice in variable proportions:

- the *régendat* (AESI certificate) lasts three years. It takes place in non-university colleges (*hautes écoles*) and trains primary and lower secondary school teachers (12-15 year students);
- the *agrégation* (AESS certificate) is achieved at university after a five (or six)-year training; it is necessary to teach in upper secondary schools (15-18 year students);

It must be noted that chemistry is not taught as a separate subject in primary school and during the first cycle of secondary school (the first cycle includes the first and second years, thus 12 to 14 year old students). Biology and physics are always taught in first and second years although the curricula of most networks (i.e. the authority that organises education) contain generic titles such as "sciences" or "scientific training". Chemistry is taught to all students in general education in the second cycle (third and fourth year) and third cycle (fifth and sixth year) cycle. Therefore, regents in science, who teach during the first three years, would only teach chemistry in the third year (14-15 year old students), at a basic level. For this reason, there are less credits and hours dedicated to chemistry than to the other two sciences in our reference schools. To teach in fourth, fifth and sixth year, a university master is necessary.

Anyone with a secondary school certificate can enter into AESI training. The training is organised in a three-year bachelor's degree with professional orientation. It is divided in sections and sub-sections (ie. sciences). It associates theory and practice as soon as the first year: there is a progressive and continuous interaction between academic knowledge, teaching skills, educational skills and supervised professional practice with the "target audience", that is 12 to 15 year old pupils and field teachers. The training can be divided in three kinds of activities: common courses to all the sections of the school; specific courses for one section; practical activities in small groups. Courses related to the

profession of teacher include educational practices, psychology, sociology, group management, ethics, French language... Science courses are directly related to teaching practices with title such as "Chemistry and didactics"; therefore students simultaneously learn sciences and how to teach sciences. To these courses must be added internships in schools and what is referred to as "practical training workshops" (simulation of a lesson). A final dissertation is foreseen in the third year (BAC 3). At university, the AESS includes at least 300 hours of lessons and teaching internship and is spread on a complete academic year.

The AESS presupposes that the student has mastered the subject and achieved a scientific approach during the disciplinary Master, the great difference with training in AESI (which is centered on pedagogic content). 300 hours are meant to compensate the absence of pedagogic and didactic training from the curriculum of the disciplinary Master.

Since the "Bologna decree" [1] of the 31st of March 2004, pedagogic training has been integrated in the curriculum of the Master (didactic orientation). Thus, there are currently two ways to achieve the AESS: either the Master with a didactic orientation (in two years, following the three-year baccalaureate) or a master (or certification equivalent to the master) with another orientation (disciplinary, for instance) followed by an additional year with 30 AESS credits (therefore six years in total).

When they choose the master with a didactic orientation, students have not only lessons in various branches of chemistry, but also in chemistry didactics. The master also includes courses that are not specific to sciences; such courses are related to education and are common to all the masters with a didactic orientation, whatever the subject. Among these are courses of pedagogy, interdisciplinary approach, professional ethics, education sociology, school institutions. Seminars, on-site observation periods, internships and the final dissertation are also part of the didactic master. Chemistry didactics is taught along with biology, as those two subjects are often taught by a same teacher in secondary school. The future teacher will also take a third discipline as a minor option, which in most cases will be physics. The students are in charge of teaching practicums (40 hours) during which they teach in secondary school classes under the supervision of experienced teachers. In addition to chemistry, they also teach a limited number of biology lessons.

In-service Training

Every secondary school in the Fédération Wallonie-Bruxelles is attached to one of the four networks: the network organised by the FWB, the networks of provinces and municipalities, the so-called denominational free network (mainly Catholic education, the organisation is called SeGEC) and the non-denominational free network (private education). Each network works in its own way but is subsidised by the FWB, provided that it respects a series of injunctions. The institution that provides in-service training depends on the network. There are various possibilities of in-service training for teachers:

- Training. Any staff member has to take three days (only) of training each year, divided between one day organised by a public benefit organisation, IFC (*Institut de Formation en cours de Carrière* – In-service Training Institute, of which INFOREF is a partner recognised as a training organization), two days organised by the network and/or the school. The subject is not imposed; teachers can choose any training offer in a catalogue (disciplinary content, teaching skills, ICT...).
- Asking support from educational advisors. The request can be issued by a team of teachers, the headmaster, or be required after an inspection. Particular attention is paid to new teachers. Several organisations guide them while they are settling in the work.
- Participating in working groups. On the initiative of universities, schools or private individuals, teachers meet and discuss a given topic to share professional practices, ideas and experience.

- Participating in coaching sessions. Universities organise sessions to update knowledge.
- Working together with “Advanced Technology Centres”. These centres offer schools to train teachers and students to use material that is too expensive for schools to purchase (e.g.: industrial material, ICT).
- Consulting the Internet. Agrégations and teachers associations work to create innovative lesson sequences, computer animations, spectacular experiments, and gather their information together on websites known to the teachers.

1.2 Bulgaria



The coordination of the state policy related to the planning, organization and conduction of education and improvement of teachers' qualification is performed by the Qualification and Career Development Directorate at the Ministry of Education and Science. It is responsible for the actions referring to the development and implementation of the state policy regarding the qualification and career development of the teaching staff. The educational and qualification activities are performed by institutions or specialized units accredited by the National Evaluation and Accreditation Agency.

Initial Training

Chemistry teachers in Bulgaria are trained in four universities: Sofia state university, Plovdiv University, Shumen state university and South-west university of Blagoevgrad which offer Bachelor and Master degree courses in chemistry.

Most Bachelor degree courses emphasize on pedagogical aspect of training and qualify graduates in teaching tandem subjects: chemistry and physics, chemistry and informatics, chemistry and biology. Universities of Sofia and Shumen offer degree courses which train only teachers of chemistry.

Successful secondary education graduation is a prerequisite for joining bachelor degree courses. Admission to university degree courses is through compulsory exam in chemistry, mathematics and biology (depending on the degree course to be followed).

Bachelor degree courses are face to face and full-time. Some courses use blended learning, e-learning and face-to-face. Training ends up with state exams in both majors e.g. chemistry and physics, chemistry and informatics or chemistry and biology.

Bachelor degree courses for chemistry teachers include general subjects and core subjects through which prospective teachers acquire knowledge in contemporary chemistry education and skills to work in real school settings. In particular, the training includes specific chemistry courses but also courses of pedagogy, pedagogical psychology, chemistry training didactics, audio-visual and information technology in teaching chemistry plus internship. Training of chemistry teachers necessitates good knowledge in lab experimentation too.

Master's degree courses are intended for in-service teachers however training also is available for candidates who are not involved in active teaching. Courses are full-time and part-time and are subsidized under two schemes: state grant is awarded to candidates who are top performers in a selective exam in chemistry; tuition fee is paid by candidates who are willing to follow the course (in this case the amount of the fee is higher). Students graduate these courses with state practical exam or Master thesis on chemistry education. Successful graduates are awarded “Teacher of chemistry” qualification.

Master's degree courses aim at expanding knowledge and skills of in-service teachers and familiarizing them with the latest trends in chemistry teaching. Students get familiar with the opportunities offered by the use of IT and communication technologies in chemistry education

During their studies some students are actively involved in research projects both in the field of chemistry science and education. Students in Master's degree courses for teachers must conduct their own research in teaching chemistry while preparing their thesis.

In-service Training

Vocational training upgrade is a follow-up of continuous learning which includes various forms of postgraduate training and aims at increasing professional efficiency of teachers, chemistry teachers included.

Three Bulgarian universities, Sofia state university "St.Clement of Okhrid", Plovdiv state university "St.Konstantine of Preslav", and "Tracian University" of Stara Zagora conduct in-service teacher training in various trends and on annual basis. In addition to specialized courses carried out in university departments, teachers may acquire professional qualification levels from one to five on the grounds of studied courses and held exams; levels one and two are acquired following a defense of thesis papers.

Access to in-service training depends on school head administrations. Acquisition of professional qualification levels is possible with the consent of school principal and the positive reference on behalf of regional inspectorates of education. Training of in-service chemistry teachers is carried out following a decision of regional inspectorates of education in the trends determined by them and accorded with school principals and teachers (stake holders). During the last few years short-term courses of 8 to 16 hours were done for chemistry teachers in different subjects. Training is conducted by academic lecturers in small groups and/or teams using IT and solving specific tasks and case studies. Teachers participate in them on voluntary basis while payment of tuition is made from the funds of delegated school budgets. Such training courses result in the active involvement of many teachers in subject matter that is of special interest to them. This in turn leads to participation in action research and later becomes prerequisite for acquisition of professional qualification levels.

In addition to these forms of qualification there are various other sources such as special programs, projects (i.e. Qualification of Pedagogical Experts [2], ICT in Education [3]), internet sites (i.e. National Educational Portal, Teachers Innovators Network) and private organizations (i.e. RAABE Ltd) which offer opportunities for enlarging teaching competence in natural sciences.

1.3 Czech Republic



The preparation of students-future teachers is not uniform in the Czech Republic not only in the field of chemistry. Creating a standard teaching profession is a special project of the Ministry of Education, Youth and Sports (MŠMT). According to the Association of Teaching Profession, it is needed to establish the quality standard of the teaching profession, which would guarantee a good and comparable level of competence of graduates (future teachers). Teacher quality and professional standard came into the spotlight in the National Programme for the Development of education in the Czech Republic (so called White Paper). In this paper, the quality teachers are considered as the key players in the transformation of schools.



Initial Training

The preparation of teachers starts at high school. For future chemistry teachers, the most common way of study is to attend high school and then The College of Education with a focus on chemistry and another different (second) field. A requirement for obtaining teaching certification is reaching the master university degree (ISCED 5), focusing on the fields of study and education.

Chemistry teachers should have the Master degree, but the lack of teachers in some areas in the Czech Republic forces headmasters to accept unqualified teachers.

The completion of bachelor study program is given by obtaining credits, that are specified in a study plan (previously approved by an accreditation board) and final bachelor state exam, which consists of a bachelor project defence and an exam of the given field problematic. After completion of the bachelor program and in case of passing the entrance exams, a student can continue in a master program. A master's degree is obtained the same way. The total length of both programs is usually five years in total, (three years of the bachelor program and two years of the master program). Some universities do not have such a division into two programs, yet, the study program is completed by a master's state exam and a master's thesis defence.

There are various ways how to become a certified chemistry teacher during studies at a university. As the system of teachers' preparation is not unified and might seem to be very complicated. Therefore, here is a brief list of various ways how to obtain a teaching certification.

Option 1

Bachelor's degree: Educational-psychological preparation, inspection of classes, science field basics

Master's degree: Builds on the science field basics and develops it. The emphasis is put on teachers' preparation.

Option 2

Bachelor's degree: Only science focus in one or two fields, teaching focus only as an optional subject.

Master's degree: Follows the bachelor's degree, escalates the science field focus, inclusion of teaching focus

Option 3

Bachelor's degree: only of non-teaching character, focused only on the science

Master's degree: follows the bachelor's degree, focused on teaching subjects and teaching experience

Option 4

It is very different from the previous ones. It is dedicated to chemistry school graduates, who decide (during or after completion of the study) to become a chemistry teacher on top of their study program. Therefore firstly there is a non teaching study program terminated by master's exam. It is followed by further bachelor program, focused on chemistry methodology and pedagogical-psychological basics.

Option 5

This is very untypical way, but we demonstrate it to illustrate non-standard of pre-gradual preparation system. Teachers at vocational schools after finishing their secondary chemical school can study bachelor program, where they obtain teaching basics and expand their professional knowledge. They don't follow on master's program and they became so called masters for their apprentices at vocational schools.

These five options are the same in many aspects; on the other hand they vary considerably in many other aspects. An attempt is made to find an intersection of the systems and to find a proposal which could be applicable in every school.

In-service Training

Similarly to the lack of a system in pre-gradual preparation, there is no unified system of a lifelong

education of graduated teachers. During their studies, students are being kept reminded by their teachers about the necessity of a lifelong education. However, an adequate motivation is missing for many of them also because the salary rate is low and the courses of lifelong education are not very popular. The courses vary in many aspects, but they also have plenty in common. It is necessary for the courses to have a certification from Ministry of Education, Youth and Sports, so the people, who leave the course, could obtain a certificate of attendance to prove an improvement of their competencies. The courses are not compulsory, however some headmasters motivate their teachers to attend them, so the schools would improve their reputation. The trainings are mandatory for teachers who work with students handling with dangerous and toxic substance. Also trainings about a new leaving exam are mandatory. They are mainly:

- trainings in Chemistry
- trainings in pedagogical competences
- trainings in new technologies
- trainings in language skills
- conferences oriented on complex teacher's development.

1.4 Greece



Pre-service training is mainly provided by the chemistry and primary education departments of Greek universities and by the obligatory one-year program "EPPAIK" organized by the School of Technological and Pedagogical Education (ASPETE). Regarding in-service training, there exist the obligatory "Initial Training" program and three optional programs ("Major Training", "Project Training", "ICT in Education") all organized by the Institute of Educational Policy, as well as the training initiatives undertaken by the regional Science Laboratory Centers (EKFE). In addition, there exist Masters programs related to science education and the initiatives undertaken by the Association of Greek Chemists, which are addressed to both in-service and pre-service chemistry teachers.

Initial Training

In the Greek primary school (which lasts six years), chemistry is not taught separately but as part of a general science course ("Fysika") and only during the last two years. In order to become a primary school teacher, one needs exclusively to be a holder of an undergraduate degree (B. A.) from a department of primary education. The studies in these departments last four years and all such degree holders are automatically entitled to work as primary school teachers in all of its six levels. In this way, they are also asked to teach the general science course ("Fysika") offered in the last two years of primary education. All holders of a B.A. in Primary Education, need to sit in a national selection exam in order to get a teaching job in a public primary school. Nine universities offer an undergraduate program of Primary Education.

The main route for becoming a science teacher in secondary school is by obtaining an undergraduate degree (B. Sc.) from one of the related university departments, namely Physics, Chemistry, Biology and Geology departments. The studies in these departments last four years and until very recently (2010) all corresponding degree holders (i.e. Physicists, Chemists, Biologists, Geologists) were considered to hold a "teaching-related" first degree and were automatically entitled to work as science teachers in the Greek secondary school system. However, since the available teaching positions in

the public schools are much less than the science graduates, all science degree holders of the four disciplines mentioned above, who are interested in getting such a teaching position need to sit in a national selection exam. This exam usually takes place every two years and the four different specializations are competing separately. However, the successful competitors are entitled to teach all science-related courses when they get their placement in a public secondary school. As a result, it is often the case that the chemistry course is not taught by a chemist.

In May 2010, a new law was voted by the Greek Parliament which established the prerequisite for a "Certificate of Aptitude for Teaching" (CAT) for all science degree holders in order to be entitled to practice the teaching profession of all science-related courses in secondary education. However, this new legislation has not yet been put into practice.

In Greece, there are 5 chemistry departments at the following universities: National and Kapodistrian University of Athens (UOA), Aristotle University of Thessaloniki (AUTH), University of Ioannina (UIO), University of Patras (UPAT) and University of Crete (UOC). The Department of Chemistry at AUTH offers seven courses, directly or indirectly related with chemical education, all in the 4th year of study. It is worth noting, that AUTH is the only Greek university whose chemistry department offers a specialization which is directly related with chemistry education. The Department of Chemistry at the UOA offers four courses in the thematic cycle entitled "Chemistry and Education". However, only one of these courses is taught within the chemistry department of UOA and has been assigned with a specific number of didactic units. The other three courses are offered by other departments of UOA and do not officially count for covering the degree requirements. The grade achieved in these three courses is shown in the official transcript, however it does not count for the calculation of the official GPA (Grade Point Average) of the degree. The Departments of Chemistry at UIO and UPAT follow a route similar to UOA as far as availability of courses related with chemistry education is concerned.

A special note needs to be made on the existence of a pre-service chemistry teacher training program which is obligatory only for prospective secondary school chemistry teachers who hold an undergraduate degree which is not officially considered "teaching-related" (i.e. it is neither Physics or Chemistry or Biology or Geology). Chemical Engineering is an example of such a degree. The respective graduates need to successfully attend this pre-service training program in order to be entitled to find a job as chemistry teachers. This pre-service teacher training program is state-funded and offered by the School of Technological and Pedagogical Education (ASPETE) and it is known with the acronym EPPAIK. It has one-year duration and provides training in psychology, pedagogy, student evaluation methods, teaching methodologies and techniques.

In addition to the undergraduate programs of study of the different chemistry departments and the program EPPAIK organized by ASPETE, there are numerous Masters programs that are offered by different Greek universities and which are related with science education. More specifically, there exist nine Masters programs which are either exclusively dedicated to chemistry education or they are more general programs related with teaching of physical sciences.

Finally, one can refer to the educational initiatives undertaken by the Association of Greek Chemists (EEX). These initiatives usually have the form of one-day training workshops or seminars, they often make use of the experiential teaching approach and they are addressed to both pre-service and in-service chemistry teachers.

In-service Training

The above paragraph has already made reference to two possibilities/initiatives of in-service training, namely the existing Masters Programs related to chemistry education and teaching of physical sciences and the initiatives of the Association of Greek Chemists. These two pre-service teacher training structures are optional and they are also available to in-service chemistry teachers.

The organization of in-service teacher training programs in secondary and primary education is, in the largest part, implemented by the “Organization of Teacher Training” (OEPEK.), in combination with the scientific collaboration and support by the “Institute of Educational Policy”. Both organizations are private legal entities supervised by the Greek Ministry of Education and Religious Affairs. The funding of all training programs run by OEPEK/IEP is in its largest part available by the European Social Fund. Their main in-service teacher training programs are the following: “Initial Training” (“Eisagogiki Epimorfosi”), “Major Training” (“Meizona Epimorfosi”), “ICT in Education”, “Project Training”.

“Initial Training” is an obligatory training program for all newly appointed chemistry (and science) teachers in the Greek public school system. The expected results of this training program involve the following: development of skills for designing the teaching session according to the philosophy of the “New School” (utilization of ICT in education, differentiation of teaching, etc), comprehensive management of all pedagogical issues that may occur, utilization of the suitable evaluation methods, utilization of all available teaching tools for dealing with problems in student behavior and for preventing school failure, management of the uncertainty which is inherent in the teaching profession and requires for the teacher to be constantly open to changes.

“Major training”, is an optional training program available for science teachers. It is based in the active participation of the trainee, the discovery of knowledge via ICT approaches and e-learning, the direct application of the training experiences in the classroom, flexibility and social interaction.

“ICT in Education” is a training program which is divided in two phases. The first phase (Level A) aims in the acquisition of basic computer skills, while the second phase (level B) aims, among others, in understanding the requirements and possibilities for utilization of ICT in the teaching process, in getting comprehensive information on the main existing educational software and different internet tools, in the development of communication skills (with students and colleagues) via the use of web-based technologies.

“Project Training” is addressed to upper secondary school teachers of different specializations (chemistry being one of them) who are interested in getting involved in the teaching of the recently (2010) introduced course entitled “Project”. This course aims at involving a small group (ideally less than 10) of interested students in the design, execution and final presentation of a research assignment via collaborative work.

Finally, in-service training is also provided at the Secondary Education Science Laboratory Centers (EKFEs). The EKFE is an educational structure that aims to support all aspects of laboratorial teaching of physical sciences to all in-service science teachers in the school units which are within the specific educational geographical district.

The possibility of receiving a good personal evaluation and bonus points for advancing in a higher rank in the professional hierarchy remain the most obvious motivating factors for a teacher participating in an in-service training program.

1.5 Ireland



The Irish Government Department of Education and Skills [4] established in April of 2004 the Teacher Education Section (TES) [5]. TES was formed to reflect the Department’s view of teacher education as a continuum from initial teacher education (ITE), to induction and continuing professional development (CPD). The work of the Section embraces policy formulation, co-ordination, general direction and

management, quality and financial control in supporting the provision of education and continuing support for teachers and school leaders throughout their careers.

In Ireland, initial teacher education programmes for primary and secondary teachers are facilitated through a range of concurrent (undergraduate) and consecutive (postgraduate) programmes. There are nineteen state-funded and three private providers of initial teacher education, with some forty programmes in primary and post-primary teaching. All of these programmes have undergone revisions in recent times.

Initial Training

There are five state-funded Colleges of Education which offer programmes of teacher education for primary teachers through a concurrent (undergraduate) programme leading to a Bachelor of Education (B.Ed.) degree. In the concurrent model, student pre-service teachers complete a four year B.Ed. degree which includes professional studies in education, teaching practice and science. All students graduate with a competence to teach two subjects to Leaving Certificate level as well as Junior Certificate Science. Post-graduate programmes for primary teaching are currently offered over 18 months, and this will be extended to two years with effect from September 2014.

All pre-service teachers must have some training in science to enable them to connect with the science curriculum at primary level. Chemistry is embedded in the Primary curriculum in a stream of Social Environmental and Scientific Education, which was formally introduced in 2003/4. The curriculum is presented in two sections: a skills section and a content section. The skills section supports children in working scientifically and in developing their designing and making skills, encouraging them to learn by investigating: observing, asking questions, suggesting explanations, predicting outcomes, planning investigations or experiments to test ideas and drawing conclusions. Chemistry is inherent in the Materials and Environmental Awareness and Care strands. The word 'Chemistry' is not evident in any of the curriculum booklet sections [6].

Post primary teachers are normally required to teach at least one subject which they have studied to degree level. They may also be required to teach other subjects which they have not studied to degree level but in which they have developed expertise. Qualification is usually achieved by gaining a primary degree from a recognised third level institution and the degree must include at least one subject from the curriculum for post-primary schools for the Leaving Certificate Programme. The primary degree is followed by a postgraduate qualification in education. Another path to qualification is gaining a degree which is awarded by a recognised third-level institution on the basis of a concurrent course of academic study and teacher training.

The consecutive route to a teaching qualification is offered for a wide range of programmes, typically those with practical, laboratory and workshop elements. The secondary consecutive route is the newly renamed Professional Masters in Education (PME), previously called the Postgraduate Diploma in Education (PDE). This was formerly known as the Higher Diploma in Education (H.Dip.Ed.) and entry requirements include a degree in at least one subject which meets the criteria for registration with The Teaching Council [7]. At the moment, PDE programmes are one year in duration, although this will be extended to two years, with effect from September 2014. The courses include pedagogical studies as well as approximately 100 hours of teaching practice over the year, but no further science. The teaching practice is now being renamed Student Placement. The majority of approximately 100 graduates specialize in Biology, which reflects the demand for Biology at second level. There is no real shortage of Chemistry teachers at secondary level but the reality is that in many schools, because of cutbacks, Chemistry may be taught by a teacher who has not majored in Chemistry.

All initial teacher education programmes, be they undergraduate or postgraduate, are in demand and there is a high level of competition for places. The majority of undergraduate entrants apply for their

place through the Central Applications Office [8] and they are awarded courses depending on their results in the Leaving Certificate examination

In-service Training

In its document, "The Continuum of Teacher Education", the Teaching Council refers specifically to Continuing Professional Development (CPD), stating that 'Continuing professional development (CPD) refers to life-long teacher learning and comprises the full range of educational experiences designed to enrich teachers' professional knowledge, understanding and capabilities throughout their careers'[9]. Accordingly, many organizations and institutions provide in-service training; below, the most representative examples are briefly described.

The aim of the Professional Development Service for Teachers (PDST) is to provide high quality professional development and support that empowers teachers and schools to provide the best possible education for all pupils/students. The mission is to support teachers as reflective practitioners by promoting teacher learning, collaboration and evidence-based practice. PDST operates under the remit of Teacher Education Section (TES) and is hosted by Dublin West Education Centre (DWECC).

The principal activity of the nationwide network of Education Centres (originally Teachers' Centres) is to organise the local delivery of national programmes of teacher professional development on behalf of the Department of Education and Skills [10]. Centres also organise a varied local programme of activities for teachers, school management and parents in response to demand. Among their activities is the delivery of the National Induction Programme for Newly Qualified Teachers [11]. The National Induction Programme for Teachers (NIPT) supports the induction of newly qualified teachers (NQTs), both primary and post-primary, into the teaching profession in Ireland.

The Irish Science Teachers' Association (ISTA), Eol Oidí na hÉireann, is the Professional Association for the Teachers of Science in the Republic of Ireland [12]. It is one of the largest voluntary subject associations in the country. The Association works to develop co-operation between teachers of science at all levels. It aims to keep members up to date with changes in their subjects and with new ideas in teaching, learning and assessment. The ISTA helps members to promote a positive attitude amongst their students towards science and technology in society.

The Royal Society of Chemistry (RSC) education team aims to support chemistry teachers and enable them to inspire their students into pursuing a future in the chemical sciences [13].

Finally, the National Centre for Excellence in Maths and Science Teaching and Learning, based at the University of Limerick, is strongly focused on translating research into practice so that research findings impact on science and mathematics teaching in Irish classrooms.

The Chemistry is All Around Us Network project has not as yet had any impact on teacher training provision. However, some of the teachers, experts and associates of the Irish team are involved in both pre-service and in-service teacher training and as such they have been supportive of the promotion of the project portal and the resources therein. The report of the conference on Initiatives in Chemistry Teacher Training is available. This was a fruitful day of information sharing among all European partners as well as dissemination of Irish initiatives to enhance Chemistry teaching and teacher training.

1.6 Italy



Initial teacher training is actually under the control of the Ministry of Education, University and Research (MIUR) for both primary and secondary school teachers. Related selections, courses and final examinations are organized and carried out by universities.

For what concerns in-service training, it is sporadic and not compulsory. The most significant are national projects financed by the MIUR and provided by Universities, or courses provided by INDIRE (National Institute of Documentation for Innovation and Educational Research).

Initial Training

Science education in Italy [14,15] begins at primary school as a single, general, integrated subject area, continues as an integrated program at the lower secondary school and splits into separate subjects at the upper secondary school, but only at technical institutes and vocational schools. At the lyceum, the teaching of natural sciences includes biology, chemistry and earth sciences, grouped in an integrated program

Primary school teachers have to get the degree in “Sciences of Primary Education”. 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 an 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 school grade and discipline, including chemistry. In 2008 SSIS was interrupted and only in 2012 it was re-established, as one-year course: TFA. TFA foresees a limited number of attending people for every year, admitted after an examination testing the knowledge of the specific discipline.

It provides didactic-pedagogic courses, together with courses and laboratories about the teaching of the discipline, organized by the universities. More specifically:

- courses about special pedagogy to apply in presence of students with different problems (learning disorders, handicap, social disease ...)
- courses about general aspects of the education at school: communication, didactic mediation and relation
- courses about the instructional design and some teaching methodologies such as cooperative learning and problem based learning

- specific courses about the didactic of chemistry, including the laboratorial approach
- courses about the use of ICTs at school

Finally, a period dedicated to practical experience at school, side by side with an expert teacher, the tutor, is foreseen to complete the training.

An examination is foreseen at the end of each course and the final TFA score is the addition of the single votes. This score influences the position in the list of new teachers.

In-service Training

The in-service training of teachers, as above mentioned, is sporadic and not compulsory. There is not a regulation of the training and courses, more or less lasting, are offered by Regional School Offices on the basis of regional funds or by INDIRE, a National Institution that has the task of accompanying the evolution of the Italian school system by investing in research, experimentation and innovation. An example of training for science teachers is the national program PON Science Education [16]: The training model is blended, meaning that it integrates activities in presence and activities on-line. It is based on the 'situated knowledge', in order to accompany teachers from theory to practice, and on the 'cooperative learning' through a continuous dialogue between teachers, experts in education and e-tutors, in order to encourage the building of communities of teachers.

In service training is also provided as activity within national projects funded by the MIUR, as the Scientific Degrees Plan (PLS) [17,18] or "Teaching Experimental Sciences" (ISS) [19] (recently expired for lack of funds). The training within these projects is provided through different activities, autonomously organized by the many universities involved. For example:

- meetings among teachers and university researchers;
- 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.

At the end of the projects, no examination is foreseen and a certificate of attendance is given to teachers.

1.7 Poland



Polish higher education has been undergoing a series of reforms and modifications so that it becomes more compatible with the European higher education sector.

Curricula of all the programmes have been restructured especially those which involve teaching and training of prospective teachers. The Ordinance of the Minister of Science and Higher Education from 17 January 2012, which was also signed by the Minister of Education is currently in force. The standards of training leading to the teaching profession are defined in this ordinance. The ordinance regulations specify:

- a) the learning outcomes across the range of expertise and methodology (cross curricular), pedagogy and psychology, application of information technology and foreign language proficiency,
- b) the duration of studies and postgraduate studies,
- c) the size and organization of practical training for teachers.

The Regulation leads to increase of the role of practical training, in particular in the areas of competence of the care, education and diagnosis of individual student's needs.

Initial Training

Universities provide programmes which prepare students for the teaching profession in academic education and post-graduate studies in the relevant training modules. They can be divided into two major paths:

I cycle programme (Undergraduate courses)

II cycle programme (post-graduate courses)

Currently after the new reforms Chemistry teacher training takes place during the second-cycle of studies and includes mandatory training in the following areas:

- 1) substantive education for teaching of first subject (preparation to conduct the course) – first module;
- 2) psychological and pedagogical education – second module;
- 3) didactic education – third module.

The preparation to work as a teacher during the academic education can be extended to optional preparation for teaching of another subject (to conduct the course) – fourth module.

However, the preparation to work as a chemistry teacher at postgraduate studies may be conducted in the following areas:

- 1) preparation for teaching of another subject (to conduct the course) – fourth module;
- 2) psycho-pedagogical and didactic preparation for graduates with substantial preparation for teaching (to conduct the course) and without psycho-pedagogical and didactic preparation – second and third module. The implementation of each module, both in academic education and post-graduate studies, should lead to the attainment of the same learning outcomes.

Post Diploma studies are designed for teachers who wish to improve their qualifications by updating of their knowledge and practical skills necessary for chemistry teaching in lower secondary and upper secondary schools. Recruitment for the study includes people who have completed their master's degree in chemistry or engineering or related fields of chemistry (among others biology, physics). A graduate of postgraduate studies can obtain the most up-to date knowledge of general chemistry and inorganic, organic and physical chemistry necessary for teaching in lower- and upper-secondary schools and implement the information technology resources to support the teaching of the subject. They usually constitute a part of the professional development process of in-service teachers.

In-service Training

The majority of the in-service training for teachers of Chemistry in Poland is organized on the voluntary basis. There are no obligatory requirements for teachers meet and courses to complete in order to teach chemistry in Polish schools. Their university education expanded with practical teaching component is the only must have. Teachers engage in the development of their careers on their own and they care about their professional improvement due to the general directives of teacher training. Trainings, workshops and seminars participation and attendance are only a part of their professional activity. In order to advance and climb their professional ladder they must follow general 4 level teacher development path from novice teachers to the diploma ones.

A series of regional and local institutions offer trainings of various kinds for practising teachers, which is a great opportunity to comply with Ministerial requirements and hold a higher teaching degree. For example the Regional In-Service Teacher Training Centre in Lodz is a public educational institution. The main aim of the centre's work is to support the education environment in achieving aims of the educational reform and in aspiration for proqualitative changes.

The main subjects of their training courses concern: quality in education, teaching problems, planning and documentation of professional development and advancement of teachers, information technology, European education, pedagogical skills and languages. The Regional In-service Teacher

Training Centre is engaged in application of new pedagogical methods with the use of IT. It edits methodological materials for teachers and quarterly The Educational Review. Each region of Poland has a similar institution dedicated to teacher development.

Teachers can also select from many high quality offers among which is the one of the Centre for Education Development (CED).

Many universities of polytechnics organize Post-Diploma Trainings for teachers. Among others the institute of Didactics of Chemistry in Siedlce offers an interesting course for Chemistry and Maths teachers.

Another example of good practice in terms of chemistry teacher development is WCIES. It is a self-government teacher development facility – an institution providing knowledge and education, whose tasks perfectly illustrate the motto “Warsaw – the City of Education”. The main objectives of the Centre include supporting the Warsaw educational environment and improving the quality of work of schools and educational facilities in the City of Warsaw through different supporting forms for teachers, include biology and chemistry teachers.

1.8 Portugal



According to the Portuguese legislation [20], teachers' training is organized in three different categories: (i) Initial training, (ii) Specialized training, and (iii) In-service training. ITE corresponds to level 7 of the European Qualifications Framework (master degree). It is a career-long professional development, where research-based and in context practice are important features. Specialized training is intended to provide qualification in complementary education functions, such as special education, school administration and inspection activities, socio-cultural animation and basic education for adults. In-service training or continuous training allows teachers to complement, deepen and update their knowledge and professional competences.

Initial Training

Presently, and following the Bologna process, ITE programmes in Portugal have been restructured and a Master degree is required to ingress teacher profession (since 2007). ITE curriculum is presently driven to learning outcomes and the valorisation of teacher practice (supervised practice and internship). ITE formation can be provided by public (Universities and Polytechnics) and non-public Higher Education Institutions (HEIs). Public HEIs receive governmental funding but students have to pay a fee that varies from 631-1066 euros.

In general terms, ITE organization comprises a first cycle, typically of 3 years (180 ECTS) characterized by a broad training in basic education for class teachers and a field of knowledge oriented training for subject teachers (e.g. chemistry, mathematics, biology etc.). Following this first cycle, a master degree is required. The duration of this second cycle is of 1-2 years for class teachers. Class teacher's education follows a concurrent model being subject and pedagogical subjects taught simultaneously, whereas subject teacher's education follows a consecutive model [21]. For this last case, a second cycle with a typical duration of 1.5-2 years (90-120 ECTS), where professional qualifications are acquired, is needed. The access to the first cycle is made at national level whereas for the second cycle it is made at HEIs level. Requirements for each cycle can be consulted on the website of NARIC (National Academic Recognition Information Centre) [22].

In what concerns chemistry teachers, the formation pattern corresponds to a subject oriented first cycle followed by a second cycle (master) mainly focussed on professional qualifications. The second cycle entitled "Education in Physical-chemistry Sciences" (2 years, 120 ECTS) aims to qualify teachers, both in physics and chemistry sciences, to teach basic (3th cycle) and secondary education levels [23]. To access this second cycle the applicants need to have 120 ECTS in the two subject areas (physics and chemistry) including no less than 50 ECTS in each of them. Examples of the first cycle are Chemistry, Physical-Chemistry Sciences and Biochemistry, among others. The second cycle provides training in physics and chemistry didactics, as well as, in educational psychology being only provided by Universities.

In-service Training

The contents of this section are based on Portuguese legislation/regulations [20, 24-31]. Accordingly, in-service training actions are conducted by training bodies accredited by the CCPFC-Conselho Científico-Pedagógico da Formação Contínua (Scientific and Pedagogical Council of in-service training), headquartered at the University of Minho (Braga, Portugal). Examples of these training bodies are the Training centers associated with school associations (CFAE) and Higher education institutions. The formation plans can be drawn by schools considering their own training needs diagnosis or might simply result from an individual initiative of the teacher. Given the current economic situation there is at present no governmental funding to support in-service training. Although several HEIs are able to offer a wide range of paid formation packages, the search for these actions is decreasing, partly justified by the CFAEs work trying to address the most urgent needs of their associated schools. In this context, free training is being offered thanks to: (i) Endogenous school resources (some accredited teachers make themselves available to provide training to their colleagues); and (ii) The existence of protocols and partnerships with other entities within the framework of training programs.

Most of the training actions correspond to face-to-face classes; however there is a progressive change of paradigm due the progressive consolidation of ICT use. As so, the online format through e-learning and b-learning modalities is becoming a current practice, not only because of its effectiveness but also as a way to address financial, distance and time constraints. The evaluation of the actions is compulsory and must be accredited by the CCPFC. The final classification is expressed qualitatively (insufficient to excellent) corresponding to a final ranking on a scale comprised between 1 and 10 values. The evaluation accounts with the teacher performance but also with assiduity.

Among other factors, to access progression, teachers must attend, with success, in-service training or specialized training actions during the cycle under evaluation. Specifically, they need to have accredited 25 hours in the fifth step of the teaching career (= 1 credit) and 50 hours in the others (= 2 credits). As so, to access progression, teachers have obligatorily to attend in-service training actions, accredited by CCPFC, up to the required number of hours, irrespective of attending other non-accredited training actions such as colloquia, conferences, seminars or workshops. Moreover, it is mandatory that part (at least 50%) of the attended training lies in actions within the appropriate scientific area.

In the past years a strong effort was made by the Portuguese Ministry of Education to modernize schools and reinforce the role of ICT as a basic tool for teaching and learning. Examples of programs at national level are the "Minerva project" (1985-1994), the "Nonio-21st Century" (1996-2004), and more recently the "Technological Plan for Education" (approved in September 2007) with the following objectives [32]: (i) Provide technological infrastructures to schools; (ii) Make available online contents and services; and (iii) Promote the ICT skills of the schools' community.

According to this financed program in-service ICT training was provided to the teachers. As a result of

this investment, a very recent work making a survey in 2011 (over 190 000 online questionnaires posed to students, teachers and head teachers) in several schools across Europe (EU27, Croatia, Iceland, Norway and Turkey) [33] pointed out that the percentage of students that are taught by “digitally confident and supportive teachers” reached 20–25% for the EU average. In Portugal, the values were 30 to 50% for students at 4 and/or 8 grades and more than 45% in grade 11.

1.9 Slovakia



Future teachers are provided by Universities. There are 11 universities in Slovakia, which prepare future teachers at the bachelor level BSc. and master level Mgr. From those 7 universities prepare future teachers of chemistry for ISCED 2 and ISCED 3 mainly at scientific faculties (UK Bratislava, UKF Nitra, UMB Banská Bystrica, UPJŠ Košic) and pedagogical faculties (TU Trnava, KU Ružomberok, UJŠ Komárno – only BSc. level). Study programs of each university differ even though there are perennial efforts for an uniform attitude in preparation of the scientific teachers.

Initial Training

As main representative example of initial training, the activities of the Department of Natural Sciences, Psychology and Education at the Faculty of Natural Sciences of UK in Bratislava are described. The Department is the creator and leader in many national and international projects since 1999, for example Infovek (www.infovek.sk), COMENIUS, RAFT, MVP ZŠ and MVP SŠ (www.modernizaciavzdelavania.sk). In these projects are applied experiences and results from researches and are used in innovative preparation of teachers of Chemistry, Biology, Geography and Environmental Education. The department gradually offers students new optional subjects in which they can spread their portfolio of knowledge but also can gain new competences in teaching.

On the basis of years of experiences from the work on the national projects, it was decided to work out the project for identification of innovative teachers of scientific subjects in Slovakia and connect the work of innovative teachers with preparation of future teachers of scientific subjects at the Faculty of Natural Sciences UK, Department of Education. That is how triennial project KEGA “Incubator of innovative teachers of scientific subjects at elementary and high schools” was created. The aim of this project was to create a database of teachers who create the basis of innovative teachers with whose help the reform of education “from below” will be implemented (new methods and forms of education with support of digital technologies) and also teachers education for improvement of creativity at schools. It is also needed to implement inevitable change in preparation of future teachers of scientific subjects at the universities.

The selection of innovative teachers of scientific subjects started in 2012 at the basis of cooperation with teachers during many national projects and also at the basis of analyzing the performances of teachers from various projects and competitions focused on modernization of education. The database is continuously renewed.

During the winter semester of the academic year 2012/2013 was realized “1. Innovative Semester of Teaching Science Education in Chemistry, Biology and Geography for future teachers as well as for teaching subjects and psychology”. During the summer semester took place “2. Innovative Semester of Teaching Science Education in Chemistry, Biology and Geography for future teachers as well as for teaching subjects and psychology”. “3. Innovative Semester” will be realized during the winter



semester of the academic year 2013/2014.

In-service Training

Slovakia has a system of professional development of pedagogical and vocational employees in the career system (Law n.390/2011 Z. z., which is changed and supplemented by Law n 317/2009 Z. z. about pedagogical and vocational employees).

Teachers educate themselves at various accredited courses, they gain points followed by an increased salary. Educative courses can be organized by the universities and by methodological and pedagogical centers, educational institutions (state or private) etc., but the quality of these courses is questionable. In 2013 teachers could attend dozens of accredited courses (refresher, specialized, innovative, etc.) but the predominant are courses focused on coping with the work with digital technologies.

National projects such as “Modernization of Education System at Elementary Schools” (MVP ZŠ) and “Modernization of Education System at High Schools” (MVP SŠ) were mentioned in the previous report. Aim of those projects is to change form of teaching at schools, which will lead to modernization by incorporating modern technologies into teaching connected with preparation of the teachers for active realization of the school reform by adapting educational system to the needs of the society. Projects are focused on innovation and modernization of the content of education and methods in teaching, but mainly on the preparation of teachers with new competences for a work in the Modern school of the 21. century.

Target groups of those projects were teachers of elementary schools and high schools from Slovak Republic, who teach at least one of these subjects: Math, Physics, Chemistry, Biology, Slovak Language, History, Geography, Music and Art.

Teachers who successfully completed the educational project graduated in the specialized education. National projects MVP ZŠ and MVP SŠ belong to the biggest educational projects which have been realized in the last 5 years in Slovakia and affected thousands of teachers. Department of Education plans to ask graduates of those projects in the subject of chemistry for the feedback – how they perceive the training after some time, what they use in the lessons from the trainings, which technologies they use.

1.10 Spain



Initial Training

From 70's to 2009, in Spain the teacher training was carried out through the CAP (certificate of pedagogical aptitude), an Educational Certificate with serious deficiencies in its structure and organization, and just an administrative procedure for students who wanted to access to the secondary education teachers' group.

From the academic course 2009/2010 the CAP has been replaced by a Master of a year-long (60 credits-1500 hours), organized by the Spanish public and private universities. To being part of the Master it is necessary to be in possession of an official Spanish university degree, or if any other declared expressly equivalent or one issued by an institution of the European area of higher education (EEES). To access to any specialty applied must possess a university degree in that specialty, have completed 60 credits in matters inherent to the specialty or exceeding a theoretical-practical

knowledge test. The allocation of seats is done according to the academic record.

Main features of the Master are: the need for coherence between the orientation of the courses and the strategies to be applied by future teachers with their students, the evaluation of the work done by the students and courses received during their training and the importance of a close collaboration between the practicum teachers and the specific contents of the master.

The master is structured in three modules.

The first one, called generic, is subdivided into the following themes:

- learning and development of personality;
- processes and educational contexts;
- society, family and education.

The second one, called specific is subdivided in turn into three themes:

- accessories for training discipline;
- learning and teaching of the corresponding matters;
- teaching innovation and introduction to educational research.

The third module is the practicum, which looks for future teachers to acquire experience in planning, teaching and evaluation materials from their specialty. In this module they must prove a suitable domain of the speaking and writing in teaching practice and master appropriate skills to facilitate the learning and living together.

The first part consists of the completion of 100 hours of teaching practices in the specialty chosen in a school of secondary education. These one hundred hours are spread over a period ranging from four to six weeks under the guidance of a teacher at the Centre that guides the work of the student practices and issues a report on competencies and skills displayed by the student during this period. During the practicum, a supervisor of practices carries out seminars of tracking which students must attend. This part ends with the delivery of a final report that includes a self-evaluation of the student, corrected by the supervisor of practices.

In a second part, the student must be a work of Master thesis which should reflect the competencies acquired throughout the training process and which must be defended publicly.

In-service Training

The training of teachers practicing in Spain is organized by the Ministry of education through the INTEF (National Institute of educational technology and teacher training), the ministries of education of the communities autonomous through the CEP (teacher training centres), the universities continuing education centres, and by trade unions, employers, associations of teachers or private institutions such as CECE or Catholic schools that offer training through agreements with administrations educational.

A brief look at the offer of training comprises the majority of training courses in one of the following sections:

- Generic training courses on organization and management of schools or educational guidance and tutorial action.
- Courses to improve knowledge of the subject that is taught. Although there are few which offer is the majority of these courses they depart from the CEP and the universities and show teachers the latest advances in related fields to your stuff. This type of courses promotes the gathering between teachers and experts.
- Courses on new methodologies and teaching practices: most destined to develop teaching methods, constructivist and more collaborative teaching practices.
- Courses of adaptation to new technologies: the majority of these courses are aimed at the creation and implementation of teaching resources based on new information and communication

technologies.

- Courses aimed and promoting multilingualism. In the majority of cases are English courses to accredit training in the knowledge of English among teachers that allows to carry out successfully the implementation of an educational model with presence of more than one language.

In general, permanent training of the teaching staff in Spain are voluntary. Most of the courses are face to face, although you can find distance learning courses, especially in the area of ICT learning.

Most of the training courses are offered during the school year except for some summer courses.

The process of change in the permanent teacher training remains open, in particular aiming at generating training linked to the needs of schools.

1.11 Turkey



Teacher education programme is actually regulated by the National Education Development Project (NEDP), collaboratively prepared by YOK and MEB. The project which was put into effect in 1998, introduced new concepts and important changes to the teacher education system in Turkey. These changes included the revision and restructuring of the partnership between schools and universities, developing an accreditation programme for the teacher education courses and defining standards expected from intending teachers. In addition, at the school level, for the first time, the quality of classroom teaching has started to be questioned and a need for a shift from traditional teacher-centered classrooms to more pupil-centered ones has been emphasized. Classroom learning has been intended to be 'active, purposeful and goal oriented' and teachers would be educated accordingly (Odabaşı Çimer and Çimer, 2012).

Initial Training

The student teachers first attend the classes and observe the experienced teacher during their university education. The students are assessed according to the rules of their own university assessment and evaluation conditions. They are assessed by the course teachers. After attending to the classes as observers for a certain period, the student teachers can teach in the classes under the guidance of the class teacher or the lecturer from the university. The teacher candidates, who successfully attend a four-year initial teacher training program, get a Primary Teacher Diploma. After the students graduate, they have to pass the Examination for the Selection and Placement of Candidates for Professional Posts in Public Organizations (KPSS) and get a certain grade in order to be appointed. Those who are appointed have to work for a year and be assessed again before they are called professional teacher (Kilimci, 2009).

In-service Training

According to the Civil Servants' Law and the National Education Principal Law, Turkish teachers should attend in-service training programs in order to continue their professional development (Devlet Memurları Kanunu, 1965; Milli Eğitim Temel Kanunu, 1973)

The in-service Teacher Training Department at The Ministry of National Education is responsible for all the training events. This department prepares an annual teacher training program every year, which includes training events for all teachers - not only English teachers - for the whole academic year. The teachers apply for the training or refreshing events on line and the Teacher Training

Department approves or refuses the applications. The teacher training system in Turkey is centralized and managed from the capital city, although there are teacher training departments in every national education liaisons. Once the teachers' applications are accepted, all the expenses are funded by the Ministry of Education (Köyalan, 2011).

In-service training activities used to be conducted solely at the national level until 1993. But these courses were very inadequate in terms of quality and quantity. The Ministry decided to share its authority with local educational directorates in order to enhance the in-service training programs and professional development of teachers. An expert from the Department of In-Service Training notes that (Bayrakçı, 2009):

There is virtually no systematic in-service training program for teachers according to their years of experience. The only such program is internship training (Bayrakçı, 2009). As part of the teacher training programme, trainee teachers are required to undertake a practical placement within a school every semester. The first semester is spent observing the teachers and students in the classroom. During the second, they begin to assist teachers with lesson planning and marking assignments. Trainee teachers cover other aspects of teaching during this year, such as school administration and teaching legislation and regulations. Practical training normally ends at the end of one year by the evaluation of the tutor and an inspector coming from Ministry of Education (www.webcache.googleusercontent.com).

In the first year of the profession, all teachers are considered intern teachers and they take three different training programs: basic training, preparatory training and practical training. These training programs are conducted by the local National Education Directorates. After these programs there aren't any systematic training activities that teachers must participate in. However, they can apply for the grants provided by EU Comenius teacher training program and attend conferences, seminars, workshops if they want.

2. Assessment of the National Training of Science Teachers

A brief assessment about science teacher training is given for each country. The assessment was made by partners considering:

- relevant national publications
- teachers' opinion, collected during the national workshops but also, in some cases, interviewing teachers not involved in the project.

2.1 Belgium

A number of strengths and weaknesses are pointed out by teacher trainers of the courses of study. As AESI strength we cite the permanent and progressive interaction between academic knowledge and professional reality and the closeness between trainers and students and multidisciplinary team work. As weakness, the organisational and institutional difficulties and the strains between trainers, students and internship supervisors because of different demands.

Regarding the AESS, it has to be said that the Belgian university is not vocational. It provides knowledge but does not aim to offer masters with professional orientation, which the didactic orientation should be. The articulation of activities and the lack of coordination within the programmes of masters with a didactic orientation is very difficult, particularly regarding the internships and the dissertation that take place in parallel, which causes some problem of time management. Students in the post-master AESS are particular and heterogeneous. They include many people who resume studies and often do not master subjects among other because their Master, or even Licence (as the Master was called before the Bologna reform), dates from a long time. As strength, several collaborations between the actors concerned (experienced field teachers, inspectors, educational advisors...) have been established. Moreover, the audience of AESS has become varied: students in Master mix with more mature people who are resuming studies sometimes after fifteen years in a profession of the private sector; their second cycle training are varied: chemists, biologists interact with bio-engineers, graduates in biomedical sciences or in pharmacy for instance. There is a great variety, but it is also the source of difficulties precisely related to the heterogeneity of the group.

The division of teacher training in AESI and AESS is the source of several problems: it would seem useful that all the teachers who teach sciences in any six years of secondary school had a same training. A project of structural reform of teachers' initial training is currently under consideration to change the composition of the upper education landscape. The project intends to extend the non-university training cycle in order to harmonise it with university training and to build new frames of reference of skills. All secondary school teachers would therefore be trained in the same way. This approach has to redefine the profession of teacher in its multiple missions: pedagogic, didactic and as a social and cultural partner.

2.1 Bulgaria

Concerning general educational policy of teacher training and qualification there are some problems which are worth noting. First, the problem with young teachers - inadequate methodological support at the start of young teachers' career was accounted for as one of the major problems at the National workshop of the project work group on training and qualification issues faced by chemistry teachers, which was held in May 2013. Bulgaria is among European countries which do not have specialized

programs for introduction of newly appointed teachers.

The next problem relates to continuous qualification of teachers. Pedagogical training that is offered at university level is insufficient for their successful professional realization. The widespread application of high technology demands adequate qualification of teachers to meet the ever expanding range of students' needs in their formation as prospective highly qualified experts [34]. Material incentives for professional upgrading are low and inadequate so teachers are not interested in professional qualification.

A major problem in the teachers' qualification policy appears to be the lack of present day analysis on the specific types of in-service courses needed by teachers. The usual practice is to offer a list of courses which, as is often the case, are selected by the school principal [35].

It emerges the need of further qualification of in-service teachers which is to be targeted at the application of constructivistic approaches and methods such as problem-based approach, team work, work in small groups, collaborative and joint learning in a classroom; in few words, the need of innovative approaches and methods for teaching and learning chemistry which are student centered, aiming at enhancing his motivation and scientific awareness. A serious need of competence upgrade in IT and communication technologies in learning is also claimed.

2.3 Czech Republic

The Czech school system builds on basics set by Comenius (who is also called the Teacher of the Nations). Czech education system used to be known for its excellent quality and competitiveness. The latest OECD report deals with the decrease in this trend and with problems in quality of education. An example of these problems could be the non-uniformity of the chemistry teachers' pre-gradual education system. Similarly, there is no unified system of lifelong education for graduated teachers. The teachers' work is demanding and the salary rate is low. There are problems in chemistry teaching too: especially the lack of chemical experiments, lack of time for teaching and low motivation of students. Based on these facts, excellent teachers leave their schools to pursue a career in the commercial sector. Czech school system is undergoing changes (sometimes unsystematic because of political instability). There are new projects and courses to improve the actual state. The courses are not compulsory, but some headmasters motivate their teachers to attend, for the schools to improve their reputation.

The current state is not perfect. Clear vision and better support for Czech teachers is needed.

2.4 Greece

On the basis of teachers' opinion, training in Greece is treated with a "light" and "superficial" manner. This opinion is based on the fact that in Greece there is no officially established system for providing accreditation for entering the teaching profession. It is also related with their assessment of the in-service teacher training and the fact that the chemistry course is degraded in the Greek educational system as evidenced by the little time allocated to chemistry teaching.

In relation with pre-service training, teachers state that they received intensive and in-depth academic training in the subject of their specialization (chemistry, physics, biology, chemical engineering) but very limited training related to psychology, pedagogy or chemistry education. The courses related to these latter subjects were few and always belonged to the category of elective or elective-obligatory in the best case. Some teachers have exposure to teaching methodologies by attending some seminars on a voluntary basis, however most of them enter the teaching profession by considering their own

science (physics/chemistry/biology) teachers as a prototype.

Recent research conducted for primary school teachers provided evidence that pre-service teacher university education is usually characterized by the fragmentary nature of the courses offered and by the rather large differences among the pedagogies of different course categories, namely content-specific courses (eg. General chemistry) and education-related courses (eg. Methodologies for teaching physical sciences). As a result, student teachers end up rather “confused” and often claim that their undergraduate education is insufficient in helping them to choose and implement a specific teaching strategy by following clear criteria. The lack of a satisfactory level of knowledge of basic chemical concepts among primary school teachers’ and the existence of several misconceptions despite their age and experience, which are subsequently passed on to the students, have also been pointed out.

A special note needs to be made on the usefulness of the one-year pre-service training course, referred to as EPPAIK, which is obligatory for all college graduates not holding a “teaching-related” degree (for example engineering majors) in order to be entitled to work as chemistry teachers. This training course seems to be useful for facing the challenge of the teaching praxis, even though it provides general knowledge and not directly related to chemistry education. It is important to note however that only a limited number of such college graduates gets accepted in this training program every year and in addition that the typical science college graduates do not have the possibility to attend it, even on a voluntary basis.

In relation with in-service training, the practical courses organized by the different regional EKFE have to be mentioned positively due to the possibility of attending “live” experiments by more experienced teachers. A special note also needs to be made to the Masters’ program in “Chemical Education and New Educational Technologies” (DIXINET) organized jointly by three Greek Universities, which is considered a very useful and rewarding experience by the teachers. This Masters program is the only one in Greece which is dedicated to chemistry education by providing high level theoretical knowledge and practical training. Its unique drawback seems to be the limited number of teachers it can serve (currently ca. 20 teachers every year), due to limited available funding by the Greek State.

2.5 Ireland

Pre-service teacher training in Ireland has undergone a review and institutions are currently implementing new schedules for training, especially with regard to length. The dichotomy that exists between consecutive and concurrent training continues to be a point of contention. In the case of the concurrent training, there is always a question mark over the subject content knowledge of the pre-service teachers. In one research study it has been shown that a cohort of Chemistry teacher trainees carried a number of chemical misconceptions through the whole period of their degree. One would have expected that the misconceptions would decrease as the subject content knowledge increased.

All teachers must complete a period of probation and induction, and can only be employed in a school if they are registered with the Teaching Council. The Teaching Council’s regulatory requirements have also been reviewed and updated. The two main routes to registration are:

The completion of an undergraduate degree, which enables the holder to teach at least one approved curricular subject AND the completion of a postgraduate programme of initial teacher education (such as the Professional Diploma in Education - PDE) geared towards the post-primary age range (typically 12-18 years) OR The completion of a concurrent degree qualification in post-primary initial teacher education, which combines the study of one or more approved curricular subjects with teacher education studies encompassing professional studies, foundation studies and school placement, all

geared towards the post-primary age range (typically 12-18 years). The requirements for registration as a Chemistry teacher have become more stringent, which should surely have a knock-on effect on the training of the pre-service teacher, and in particular the issue of subject content knowledge is addressed in very explicit requirements for qualification as a Chemistry teacher.

Having consulted with other European partners, Ireland appears to have an exemplary set of initiatives for in-service support. The network of Education Centres throughout the country works closely with providers of in-service training. The Professional Development Service for Teachers (PDST) has subject specific teams of trainers who are bringing classroom and laboratory experience to their colleagues. While the fiscal situation has had some effect on provision, the supply of Continuous Professional Development activities, including many which are ICT-based, has increased in recent times. The model has positive feedback from in-service teachers and is to be commended. Teachers are also offered Continuous Professional Development opportunities through their subject associations, in the case of Chemistry teachers the Irish Science Teachers Association. The reality is that while in-service teachers have to deal on a daily basis with lack of financial, technical and other supports, they have many opportunities to discuss, share and learn from their colleagues through a selection of different formal and semi-formal settings.

2.6 Italy

Italy provides a insufficient training to its science teachers, both with regard to initial training, that with regard to in-service training. Initial training appears to be well structured as regards to primary school teachers, that, since 2008, are requested to obtain the degree in Science of Primary Education. Initial training of secondary school teachers got a good implementation in 1999, with the institution of a 2 year postgraduate course, specific for the different disciplines. Unfortunately this training, actually called TFA, has been declassified to a 6 month course and this is not the definitive structure yet. In-service training is not mandatory and absolutely not governed by precise rules: the result is low attendance and a lack of real continuous training.

Teachers themselves feel of not having good teaching, organizational, interpersonal and communication skills. Another, not negligible, problem is linked to the school organization: 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.

Finally, in-service training does not influence the career of teachers. In fact, despite the issuance of certificates of attendance (sometimes after taking a final exam/test), courses and projects do not provides credits for carrier advancements or higher salaries. An acknowledgment is requested, because also teachers, not only students, need to find motivation to do their work better and better every day.

2.7 Poland

Polish student of Chemistry at University or Polytechnic is better prepared for teaching in theory than practice. He/ she has access to equipment and chemical experiments when at University and then lacks the opportunity to experiment when starts proper teaching at schools, which do not even have

properly equipped chemistry laboratories. Another downside is the educational reform in Poland itself which according to some experts interfered with the core curriculum development - for the last few years it got changed few times which results in disorientation and lack of cohesion of ministerial requirements and the factual learning outcomes and teaching objectives. What is more, according to ministerial regulations, a Chemistry teacher is supposed to develop professionally, but during the process his/her chemical knowledge is not much verified. Their pedagogical skills are verified, however chemistry experimentation and core chemistry issues lack monitoring. There is an offer at few institutions of some professional development, refresher training available for in-service teachers but courses, workshop, conference and training organized by them are not mandatory, and usually if of higher quality, also quite expensive. The goals of this development program are to expose teachers to the research environment, to reinforce each teacher's sense of science as a process, to deepen each teacher's understanding of the achievements and potential of chemistry, and to apply lessons learned from the content class to a research setting a scientific discovery. The Polish chemistry teacher has to cater for his/ her professional development on the individual basis which may result in the lack of motivation and loss of quality of teaching. Last, but not least, the Polish Chemistry teacher lacks good English language skills which is very limiting and can slow down self-teaching and restrict use of teaching solutions applied by foreign chemistry market.

2.8 Portugal

One of the positive aspects arising from the Bologna process implementation seems to be the valorization of the teachers' socio-professional status based on the assumption of a higher professional qualifications (master degree), a curriculum driven to learning outcomes, and the valorization of teacher practice. Nevertheless, the teaching profession in Portugal is nowadays characterized by a surplus and unemployment among the new teachers. As a consequence, recruiting of student teachers in ITE programs is becoming difficult and a lack of motivation to pursue teaching careers is generally noticed [33]. In what concerns chemistry teachers ITE programs, one negative aspect was the creation of a common 2nd cycle, Education in Physical-chemistry Sciences aiming to support both chemistry and physics professionals. As so, chemistry teachers for basic (3th cycle) and secondary education levels can nowadays proceed from quite different 1st cycles. In this context, in-service training becomes more crucial for teaching in the current Portuguese education context, ensuring teacher's knowledge update and skills development.

Regardless of career progression, the importance of in-service training must be perceived by all teachers, who need to face training as an intrinsic and essential need. ITE formation by itself is no more enough to support a teaching career. Today, quality standards claim for updated professionals strongly committed with independent learning in a "lifelong learning" concept. Be updated through in-service training participation is an efficient way to respond to the requests of the actual educational system.

One of the positive aspects of in-service training relies on its centralized coordination by CCPFC - Conselho Científico-Pedagógico da Formação Contínua (Scientific and Pedagogical Council of in-service training). CCPFC is responsible for the accreditation system in what concerns the institutions involved, training actions and evaluation process; guarantying homogeneity of criteria at national level. Also a positive point was the creation of the CFAEs – Centros de Formação de Associações de Escolas (Training centers associated with school associations) that work directly with their associated schools trying to solve the most urgent formation needs. Moreover, and facing the present economic situation, where a lack of funding for in-service actions exists, CFAEs still offer some free actions due

endogenous school resources and the establishment of protocols and partnerships with other institutions.

Following the past national financed actions, e.g. the program dedicated to information and communication technologies (ICT) [36] and the national program focused on the teaching of experimental sciences for primary school [37], the situation is nowadays quite distinct. Teachers have to financially support their in-service formation, e.g. by attending the paid formation offered by some HEIs or other accredited bodies, or take advantage from the CFAEs proposals, which can be limited in some scientific areas.

2.9 Slovakia

Presence of good teachers at schools depends on two factors: good selection of applicants who possess an interest for a job in education and their preparation before starting working along with providing opportunities for further improvement while teaching. From those factors, the need of changing the training system results, meaning to provide a good selection and preparation for the work in education. Preparation of future teachers for elementary schools has to have different pedagogical – psychological preparation than the preparation of teachers for high schools. It is advisable to provide more practical teaching in preparation of future teachers and higher difficulty for studying teaching. After completing the graduating preparation, it is also needed to provide another professional development and growth. For improving the professional growth it is needed to toughen the process of accreditation of continuous education programs, to provide feedback from the previous participants, to toughen the requirements for professional grants and to provide the control of quality and progress of the continuous education programs. From TALIS 2008 study, it results that Slovakia belongs to countries with the highest amount of highly qualified teachers who do not continue in another continual education.

The main problems in preparation of future teachers are the following:

- there is not a unified way of preparation despite the big amount of faculties, which prepare future teachers;
- little amount of practical education (pedagogical practice);
- small connection between practice and theory;
- disinterest in studying teaching and not enough applicants.

Finally, the credit system should be implemented, because teachers want to gain credits but they are not interested in professional growth and in improving educative process.

2.10 Spain

Initial teacher training, shows many weak points:

- Haste and precipitation in the implementation of the master.
- Criteria economic to design the curriculum of some universities.
- The absence of coordination between the institutions and the Faculty involved.
- The erroneous allocation of teaching in some subjects of the master.
- The time allotted for the completion of the master's degree is considered insufficient or not suitable to the degree of demand.
- Lack of consistency between teaching models that are used and which is intended to be the future teachers to use in the classroom.
- Lack of control of results in the evaluation of the teachings.

Among the strengths they are noteworthy:

- The high degree of involvement of teachers and students who participate.
- Can become an instrument of permanent training of tutors at the same time that initial training for future teachers. (Vilches)
- Strengthens relations between the University and secondary school teachers.
- The use of virtual environments.

The opinion of the participants in the seminar on training of teachers held in Granada is quite critical of the process of initial training of teachers and found several deficiencies in the generic module since it does not seem to be coordinated with the specific module and just is connection between the two. Although everyone considers necessary the change that took place in 2009, most considered that insufficient change.

In the section on permanent training, strengths seem to be:

- The wide range of courses available to teachers through numerous institutions.
- The motivation shown by teachers who perform permanent training courses.
- Free of many of the courses offered by the administration.

And weak points include:

- Not mandatory training courses.
- The majority of the courses do not have a practical part of application in the classroom.
- The lack of final evaluation in many of these courses.

The Faculty Assistant for the teacher training seminar highlights the importance of training courses related to the use of ICT in education, that actually are of low quality. Courses on teaching are often theoretical and not connected with problems real encountered in the classroom: in many cases they are taught by teachers who do not have direct contact with schools. Furthermore it has to be claimed the difficulty of attending training courses due to the high number of teaching hours and the lack of time available for further activities.

2.11 Turkey

When we examine the in-service teacher training (IST) in Turkey, we can say that there are some problems and needs in the system. Some of the major problems can be presented as follows:

- In-service training activities are so limited for great number of teaching staff in schools.
- The finance for in-service training is definitely not enough.
- It is costly and it is not given those administration and travel fees to joiner teachers.
- There is no award or diploma for teachers who successfully finished course.
- Consequently, generally theoretically-based and it is insufficient for development of professional skills and education for teachers.

3. The Impact of the Project on Teacher Training

Each country built a national network composed by at least 10 teachers and 5 experts in teaching of scientific disciplines, directly involved in the project activities; moreover, several associated schools and partners are joining the project with the aim of supporting objectives and results.

Countries (11)	Experts (71)	Schools/ Teachers (79/163)	Associated Schools (32)	Associated Partners (50)
Belgium	7	11/37	2	4
Bulgaria	5	5/10	7	3
Czech Republic	5	6/11	4	5
Greece	7	10/12	5	6
Ireland	5	8/11	3	6
Italy	6	6/10	7	6
Poland	7	8/14	3	3
Portugal	6	7/18	1	4
Slovak Republic	7	5/10	<i>in progress</i>	3
Spain	10	6/14	<i>in progress</i>	6
Turkey	6	7/16	<i>in progress</i>	4

The research activities and the discussions carried out within the project by people involved, together with the good visibility of the portal and the intense activity of dissemination and exploitation, are producing positive results. In particular, the project is giving a valuable contribution to the training of teachers because:

- allows experts involved to deal with the international reality and increase their knowledge in the field of training;
- allows experts involved to discuss with teachers of schools of all levels and degree, thus establishing a solid contact with the school, its problems and its needs;
- allows teachers involved to have people to refer to for advice and improving their teaching methodology;
- allows teachers users of the portal to update on the teaching of chemistry in Europe and find ideas for new teaching methodologies;
- provides to teacher trainers, users of the portal, selected information in order to decrease the gap between university and the world of school
- encourages the creation of new collaborations, not only among people involved in the project, but also with colleagues and teachers reached by dissemination activities;
- sensitizes people involved in the field of education to the need of improving the training of teachers to have students better prepared and motivated

In the following sections we will present the main activities that demonstrated to have a good impact on teacher training:

- the national workshops
- the transnational Conferences
- the providing of selected ICTs

The last section is devoted to a brief presentation of the associated partners and their role in the project.

3.1 The National workshops

The most important opportunity to meet for teachers and experts is during the annual workshop. In this case the attendance is large and the discussion is engaging. The workshop is fundamental part of the project because it allows to:

- share and integrate the work that experts and teachers make for the project
- discuss and compare problems and experiences in order to improve everyone skills

The last workshops, held in May 2013, dealt with teacher training, following six issues:

- 1) Methodologies to teach a specific topic: analysis and comparison between positive and negative experiences
- 2) Consequences of lack of opportunities to experiment different approaches and methods for teaching and learning chemistry
- 3) Importance of training science teacher keeping them updated with the continuous progress of the research
- 4) Use of simulations: pros and cons
- 5) Identification of recommendations, guidelines for teachers
- 6) Discussion about international papers and publications

All partners expressed positive opinions about the results of the workshops, described in detail in both National reports on teacher training and minutes, uploaded on the project portal. The meetings allowed to gather valuable information on the situation of teacher training, directly from the individual testimonies. In fact, teachers discussed with experts, highlighting strengths and weaknesses of their training; on the basis of their experience, they also stressed the need to acquire or improve specific skills related to the organization of the school system and to the current needs of students. In some cases, teachers would like to acquire more skills in chemistry because, as described in previous chapters, it is not always required a degree in chemistry to teach this discipline at school. But, above all, the workshop participants proposed that a chemistry teacher training program should include the following topics:

- laboratory techniques and active learning methods
- use of ICTs in the teaching process
- pedagogical dimension of teaching based on findings of educational research
- psychological dimension of teaching
- update on new scientific knowledge and general current trends in science



Belgian Workshop



Bulgarian Workshop





3.2 Transnational Conferences

Two Transnational Conferences were organized in order to present and disseminate the main results of the second year of project.

The International Conference on Training Issues of Chemistry Teachers was held on 26th June 2013 in Gabrovo. The conference was organized by Technical University of Gabrovo in close collaboration with Research Laboratory on Chemistry Education and History and Philosophy of Chemistry – Faculty of chemistry and pharmacy, Sofia University, and Aprilov National High School – Gabrovo . A primary goal of the conference was to turn it into a wide forum of discussing issues as: the methods of teaching the subject at school; the difficulties of chemistry teachers to keep update to the continuous progresses of the research; competences of chemistry teachers in using ICT as a mean to communicate with students and enhance their interest towards Chemistry lessons; opportunities and space within the institutional programmes for experimenting different approaches and methods for teaching and learning Chemistry; development of active partnership between university chemistry professors and researchers and secondary school science teachers so as to identify a common approach and a strategy to allow the better exploitation also at secondary school level of the most recent findings in the field of chemistry science and chemistry teaching. To reach this goal the main topics of the conference were defined to be “Policy for teacher professional development”, “Modern pedagogical approaches for student-centered teaching”, “Curriculum and assessment of advanced skills development”, “Teachers’ ICT competency”, Implementation of ICT in teacher training”, “Good practices in teacher training”.



518300-LLP-2011-IT-COMENIUS-CNW



Papers content dealt with 3 thematic areas. National policy, good experience and practical solutions in organization of chemistry teachers training in the 11 European countries were shared under the thematic area “Training of Chemistry Teachers – European Realities” by the foreign participants. Other 5 papers have been presented under the thematic area “Teachers competences: modern student oriented pedagogical approaches” by Bulgarian experts in Chemistry Teacher Training in close collaboration with young chemistry teachers. The 3th thematic

In this aspect, the conference correlates with the project aim to develop collaboration between university professors and researchers and secondary school teachers so as to identify a common approach and a strategy to allow the better exploitation also at secondary school level of the most recent findings in the field of chemistry science and chemistry teaching. It also creates a bridge to the final Project's thematic area dedicated to Successful experiences and Good Practices for teaching Chemistry. Summarizing the conference results and participants' opinion it could be said that the conference became really a forum where the most important issues related to chemistry teachers competences and qualification as prerequisite to enhance the student's interest in learning chemistry were discussed. Despite differences in educational systems the presentations of both foreign speakers and Bulgarian participants showed common problems also. The participants came to the common conclusions that although there is some practice in teachers training established in the different countries, there is a common need of clear policy and regular activity in science teachers' training to guarantee their permanent professional development and, thus, the high quality of the educational process

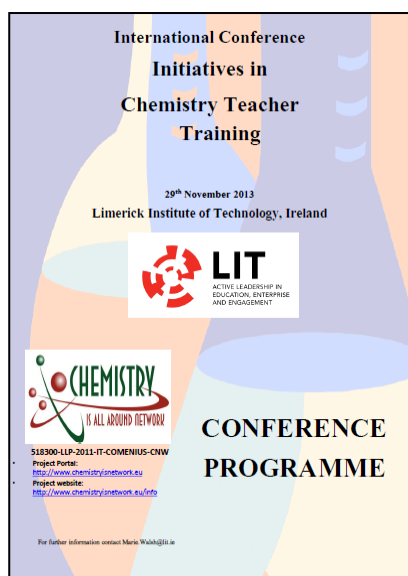
The International Conference Initiatives in Chemistry Teacher Training took place in Limerick on 29th November 2013 in Limerick Institute of Technology City Campus at George's Quay. The aim of the conference was to share European experiences and initiatives for pre-service and in-service training of chemistry teachers and then to focus on initiatives to enhance chemistry teacher training from an Irish perspective.

The Conference was a one-day event, with the morning session centred around the European experiences collated through the Chemistry is All Around us Network Project, and the afternoon devoted to various aspects of chemistry teacher training in Ireland, and beyond, since some of the



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initiatives were instigated as part of European collaborations. Some of the experts attending this Conference presented the outcomes/results of their research on a poster. Therefore, in addition to the conference talks, 20 in total, poster presentations were displayed, giving the participants the opportunity to examine the posters presented and to discuss their contents with authors during the breaks midway through the morning and afternoon sessions. The conference programme is available on the conference web site (<http://www.lit.ie/ICTT/default.aspx>). Forty participants were registered from a number of European countries, with the largest representation from Ireland. These included representatives from universities, schools, educational companies and public authorities.

As conclusion of the 11 Partners presentation and before starting the afternoon sessions focused on Irish initiatives, Maria Maddalena Carnasciali presented an overview of the Chemistry Is All Around Network Project: The Transnational Report on

Teacher Training. The report showed how the project network is expanding internationally. She concluded that the project is making a valuable contribution to the training of teachers because it allows the experts to deal with the international reality and increase their knowledge in the field of training and to discuss with teachers of all levels, establishing a solid contact with schools, their problems and needs. It also allowed the teachers involved to have people to contact for improving their teaching methodology and for all users of the portal to update on teaching chemistry in Europe and find ideas for new teaching methodologies.

The conference was an opportunity to consolidate the work of the Chemistry is All Around Us Network Project. Furthermore, it allowed associate partners and experts from Ireland to meet the European partners. The presentations not only highlighted common issues but also described initiatives in some countries that are attempting to resolve problems with pre-service and in-service teacher training. It begs the question that given the commonalities in shortfalls and reforms should the education systems of Europe not have a more uniform and streamlined approach to training provision?

3.3 Providing of ICTs

During the first year of project, each partner selected about 20 ICT teaching resources to teach chemistry/science, available on internet and, when possible, in national language. The review of each resource, together with the related link, has been uploaded on the project portal in the section "Teaching Resources".

Teachers involved in the project, as well as few colleagues of them, are appreciating more and more



every day the contribute that the database of ICT teaching resources is giving to their teaching methodology. Many of them were initially distrustful toward these tools, mainly for the lack of training in this field, secondly because of the poor availability of computers at school. But the discussions with experts and the increasing confidence, due to workshops and to the work of portal assessment, improved their feelings and led some teachers to use at least one ICT with students.

On the basis of student positive reaction, teachers think that ICTs can be effectively included in the teaching-learning process, but few words of caution: ICTs have to be included in a significant way in a wider learning path, because if they are used as detached objects they can produce negative effects (loss of time, distractions of the class, transmission of misconceptions...). In this way ICTs can be real teaching resources and not simple tools.

For this reason, following the promoter proposal, during the partners' meeting held in Limerick (27-28 November 2013) it was decided to involve many teachers as possible in the testing of ICT teaching resources and to produce guidelines for the use of ICTs that were tested and that will be tested during the last year of project. These documents will contain testimonials and suggestions for educational paths that can be followed and supported by the above tools, tips and considerations from teachers and experts. For this aim the form to be filled in by teachers with the results of the testing was produced by the promoter and approved by partners.

The guidelines will be uploaded on the project portal in a special section and will constitute a useful training for portal users.

 <p>UNIVERSITÀ DEGLI STUDI DI GENOVA</p>	 <p>518300-LLP-2011-IT-COMENIUS-CNW</p>
WP2.B – Guidelines to Report the Results of Teaching Resources Testing	
<p><i>Please fill in this form in cooperation with the person who tested the teaching resource.</i></p>	
<p><i>Please, insert the following information relating to persons involved in the testing (excluding students)</i></p> <p>Name and Surname:</p> <p>Affiliation:</p> <p>Role in the project:</p>	
<p>Teaching Resource</p> <p><i>Please, insert the name of the teaching resource and the link</i></p>	
<p>Topics related to the resource</p> <p><i>Please, insert the topics that can be taught by this resource</i></p>	
<p>Examples of learning objectives</p> <p><i>Please describe which objectives can be reached by using the resource</i></p>	
<p>Practical information regarding the use of the site/simulation...</p> <p><i>Only if needed, insert practical instructions to use the resource (i.e. if it has to be downloaded, how to reach a special section...) (not compulsory)</i></p>	
<p>Information about the class</p> <p><i>Please insert some details of the class where the resource was tested (school, year, number of students...)</i></p>	
<p>Suggestion for use</p> <ul style="list-style-type: none"> - Please describe, by points, how the resource was used - Please add possible alternatives about how the resource can be used (not compulsory) 	
<p>Considerations about the resource</p> <ul style="list-style-type: none"> - Insights into student use / thinking <p><i>Please describe students' reaction, their difficulties, benefits ... If you wish, you can use the questionnaire WP2.C to collect more information</i></p>	
<p>Teacher's conclusions</p> <p><i>Please insert teacher's considerations after testing the resource with students</i></p>	
<p>Supporting info</p> <p><i>Please, if available, list the supporting material produced by the authors to use with the resource (i.e. laboratory experiences, worksheets, power point presentations...)</i></p>	

3.4 Associated Partners

The project, in order to realize efficacious impact on teacher training, also needs to be supported and divulgated by associated partners, better if they are close to the world of school and to government bodies. The system of teacher education is evolving everywhere, in some countries with great difficulty, and this evolution cannot be entrusted to the good will of a few persons, but it must be

supported and guided in the right direction by an appropriate policy.

For this reason, each partner is working also to increase the number of associated partners involved in the project.

As few examples:

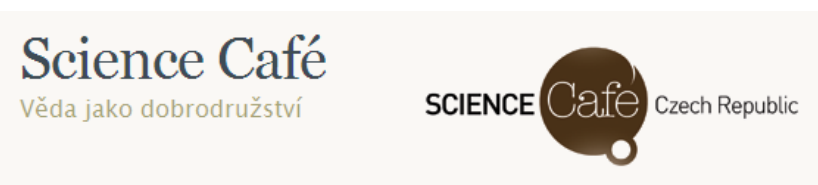
Belgium involved the University of Liege (ULg), that is the only public, pluralist and complete university institution of the French Walloon-Brussels community. It is fully integrated in the Bologna process and aims at maintaining a fair balance between teaching, research and community service activities.



Bulgaria involved the Regional Inspectorate of Education of Gabrovo, a territorial administration within the Ministry of Education, Youth and Science that manages and monitors the system of national educational policy and ensures the implementation of the national educational policy in the territorial district of Gabrovo.



Czech Republic involved Otevírame, o.s. ("We are opening") - project Science Café. It is a citizens association, organizer of the project Science Café in the Czech Republic. Science Café is a successful concept of science popularization based on meeting of scientists and public at informal places of cafés.



Greece involved Secondary Education Science Laboratory Center of Laconia (EKFE Laconias), a public education supporting structure. It is an institution of research, technical and organisational support of experimental teaching of Science related courses.



Ireland involved the Irish Science Teachers' Association – ISTA, the largest and most active subject association in Ireland



Italy involved Liguria Region, a public body, with administrative skills and legislative power within the limits established by the Italian constitution.



Poland involved Łódzkie Centrum Doskonalenia Nauczycieli i Kształcenia Praktycznego, that provides pre and in-Service training of teachers of different subjects, chemistry included.



Portugal involved Centro de Formação da Associação de Escolas Bragança Norte, a Public teachers' training centre, located in Bragança, integrating several schools from the Northeast region of Portugal, reaching approximately 1376 teachers.



Spain involved Ángel Martínez Fuertes Foundation, that aims to provide specific training and development of competencies for students and teachers in several education areas: IT, Scientific knowledge, entrepreneurship, etc.



ÁNGEL MARTÍNEZ FUERTES



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Turkey involved Directorate of National Education, Research and Development Department, a public authority responsible of all of the schools in Kırıkkale city. It has also responsibilities on the Lifelong Learning of the people living in Kırıkkale.



4. Conclusions

The first part of the present report, dedicated to a brief but exhaustive description of teacher training system in the different countries participant in the project, underlines different situations.

How common note we can say that the attention of governments to the need to take care of the teacher training, in addition to a degree in a specific discipline, has recently increased. Lifelong learning is evolving, increasingly linked to needs and structure of the contemporary society.

Teachers cannot be trivial dispensers of information but must become professionals with specific and synergic skills:

- Disciplinary skills. This is a necessary, but not sufficient condition.
- Educational skills related to their discipline. These skills are needed because they make teachers able to plan and cope with learning situations.
- Pedagogic skills. In order to face the complex social and psychological problems that arise within the class.

The main difficulty of training trainers is to identify, fund and organize the most appropriate structures to provide different skills, differentiating the training according to the specific discipline. Science teachers, for example, should attend specific courses on the teaching of scientific disciplines, besides transversal courses in common with the teachers of Italian, or foreign language.

Currently, the initial training is more cared and structured than continuous education. The government attention to the continuous education is limited: courses provided are sporadic, often organized at local level, non-binding and often not recognized for the purposes of the career.

The political authorities should be more aware that continuing education is important for teachers with many years of experience, because it helps them to evolve their approach according to the changes of students, and it is important for younger teachers because training is a continuous process and not just the initial.

In order to make more efficacious the impact of the project at national level it is necessary to dedicate many efforts, during the third and last year, to enlarge the network of people involved or using material uploaded on the portal. In order to reach this objective, the quality of the material dedicated to successful experiences will be fundamental, as well as the dissemination carried out by schools and associated partners involved in the project.

All project partners are trying to involve associated partners at national and international level in supporting the activities and the aims of the project even after the European funding will be expired.

We hope that their aid will be not only in terms of dissemination but also as political influence, in order to make aware the government bodies to address more attention to the teaching of chemistry at school and to the training of teachers.

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