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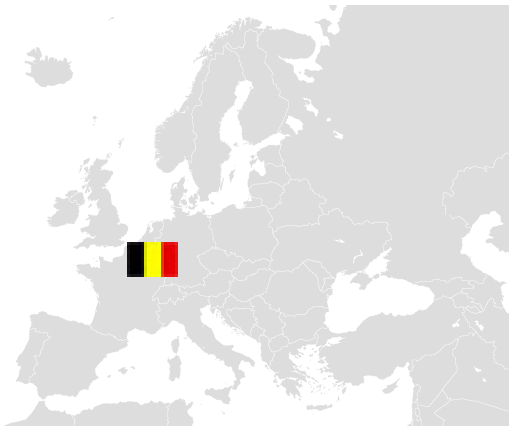
Chemistry teachers' training in the Fédération Wallonie-Bruxelles (Belgium)



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CHEMISTRY TEACHERS' TRAINING IN THE FÉDÉRATION WALLONIE-BRUXELLES (BELGIUM)

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Abstract

In French-speaking Belgium, teachers' initial training is organised in two ways. In both, academic knowledge and professional practice are mixed in variable proportions.
The initial training of primary school (for pupils between 6 and 12 years old) and lower secondary school (12 to 15) teachers is organised in non-university colleges, called in Belgium Hautes Écoles *(HE), in a three-year cycle and lead to a bachelor's degree with a professional orientation.*
The initial training of upper secondary school teachers (for 15 to 18 year old students) is organised in universities in a five-year cycle and leads to an academic master with a didactic orientation, or in a six-year specialised academic master with extra training.
This division is the source of several problems. 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.

1. National Situation on Teacher Training

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.

1.1 Initial Teacher 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* (AESE 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).

1.1.1 Lower secondary school teachers' initial training (AESI)

A. Current organisation

This initial training is the result of the decree [1] "initial training of primary school teachers and *régents*" of the 12th of December 2000, adapted after the decree [2] "standardisation of upper education in the *Fédération Wallonie Bruxelles*", commonly called the "Bologna decree", of the 31st of March 2004.

Access to initial training is not governed by a competitive exam or by the introduction of a personal dossier; anyone with a secondary school certificate can enter.

The training is organised in a three-year bachelor's degree with professional orientation. It is divided in sections (in our case, pedagogy) and sub-sections (sciences). It associates theory and practice as soon as the

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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.

B. Curriculum

This description is mainly based on the curricula of two of our partner schools that train teachers; HELMo [3] in Liège and ENCBW [4] in Louvain-la-Neuve. Although there may be some variations in other schools, they can be considered as representative of teacher training in French-speaking Belgium.

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).

At ENCBW, practical training is organised like this: 2 weeks of observation in class and 108 hours of practical training workshop in the first year (BAC 1); 4 weeks of internship and 102 hours of practical training workshop in the second year (BAC 2); 10 weeks of internship, 45 hours of practical training workshop and the final dissertation in the third year (BAC 3). By the end of their training, ENCBW students are supposed to have achieved thirteen skills described by the school organisation as follows:

1. Knowledge in social sciences to interpret situations lived in and around the classroom and to better adapt to the school audience.
2. Efficient partner relationships with the institution, colleagues and parents.
3. Being informed on one’s role as a teacher.
4. (Inter)Disciplinary knowledge that justifies the educational action.
5. Disciplinary didactic that guides the educational action.
6. General knowledge to make pupils aware of the cultural world.
7. Relation skills related to the profession requirements.
8. Ethical aspects related to one’s daily practice.
9. Team work at school.
10. Designing testing, assessing and regulating teaching strategies.
11. Critical and autonomous relation to past and future scientific knowledge.
12. Planning, managing and assessing various learning situations.
13. Reflexive view on one’s practice and organising one’s continuing training.

These thirteen skills are divided and organised in six distinct and complementary axes:

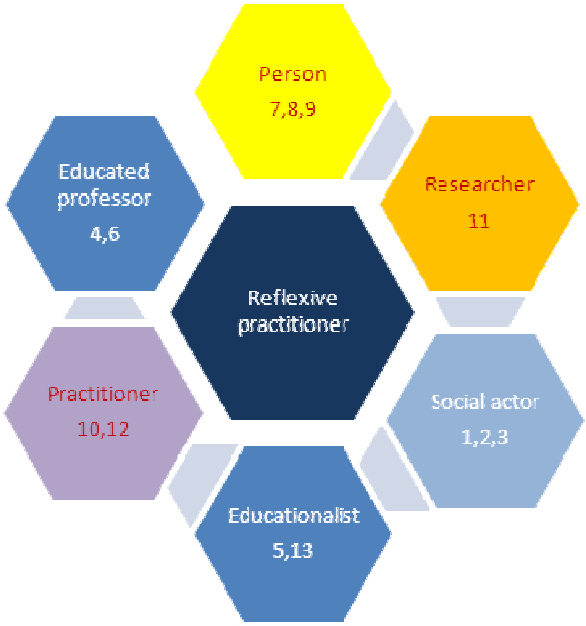

Figure 1: Axes and diagram created after the work of Léopold Paquay

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Person: to develop relation skills and be able to work in team
Researcher: to be informed and stay up to date with scientific knowledge
Social actor: to adapt to one's audience and develop good relations with the institution and parents
Educationalist: to have didactic skills
Practitioner: to plan, carry out and test teaching methods
Educated professor: to provide disciplinary and general knowledge
All these skills should lead to a reflexive practitioner.
At HELMo, the number of hours dedicated to practical training workshops is even higher: 161 in BAC1, 120 in BAC2 and 60 in BAC3. The objectives are described as such: "progressively developing, all along the three years, teaching professionalisation by achieving specific skills, professional autonomy and individual and collective responsibility. This professionalisation will be progressively built through various interdisciplinary activities integrating in the training." The targeted skills are the following:
Observing various practices, situations and partners in their interactions;
Conceiving an activity or sequence aiming at one or more skills related to the curriculum;
Animating and **organising** learning activities;
Analysing the components of a situation and identifying the right and wrong conditions for learning;
Justifying with objective arguments one's educational choices;
Assessing through relevant criteria the learning carried out.
Computer technologies are not included in the official curriculum of initial training. However, specific initiatives are taken by schools, including HELMo and ENCBW, to train future teachers to use ICT in class. For instance students can be asked to create a lesson on one given subject using ICT.
Certification is based on assessments by trainers each year during (written, oral and practical) examinations and throughout the year (for internships for instance). At the end of the cycle, an end-of-studies project (the dissertation) is produced and defended by the student.
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.

1.1.2 Upper secondary school teachers' initial training (AESS)

A. Current organisation

The universities organise the initial training of upper secondary school teachers according to modes defined by the decree of the 8th of February 2001 [5]. The AESS includes at least 300 hours of lessons and teaching internship and is spread on a complete academic year. In reference to the decree called "Missions" [6], it is intended that students have to achieve 13 skills through teaching contents organised on 4 axes:
1) achieving sociocultural knowledge;
2) achieving socio-affective knowledge;
3) achieving pedagogic knowledge with a scientific approach in 2 parts: integrated didactic transposition and pedagogic training;
4) theory and practice (or know-how) articulation achieved during internships.
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 centred 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" [2] 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). It must be pointed out that the proportion of students in either way varies a lot according to the subjects but most programme managers agree that

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masters with a didactic orientation are not as successful as expected regarding the number and quality of students.

B. Curriculum

The future chemistry teacher starts with three-year bachelor studies in chemical sciences. The first year includes lessons of general chemistry along with other sciences (biology, mathematics…). During the next two years, the chemistry lessons are divided in several sub-sections (physical chemistry, organic chemistry, environmental chemistry…). Computer lessons may be taken as an option.

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… Their importance varies according to the university; courses of this kind are more numerous at the University of Liège than at the Catholic University of Louvain (the two most important universities in Wallonia and our partners in this project). 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.

During the AESS, students are trained to create interdisciplinary lesson sequences in natural sciences using active learning and centred on the acquisition of skills. These sequences are created by small groups (three or four students), are based on secondary school curricula and aim to be as close as possible to the reality they will experience as teachers. The chosen topic is related to daily life so as to be motivating. The future teacher will also devise experiments and the prerequisites, produce documents for students and teachers and create concept maps. During such activities, at the University of Louvain, students make two posters, one to present the problem situation and one to restructure the workshop. This workshop is presented during the yearly science event "*Printemps des Sciences*" [7]. Each group thus has to think about how sciences are built and experiment the teaching sequence they created. These teaching sequences are presented to upper secondary school classes. Around sixty sequences have been created so far, all of them tested before around a hundred students. Most of them can be applied in class, with simple material.

Concretely, the underlying concepts and skills worked on are the following:

- Analysing and mastering secondary school curriculum contents.
- Comparatively analysing textbooks in terms of methodology and contents.
- Competences, interdisciplinarity, prerequisites, preconceptions, problem situations and concept maps.
- Preparing a lesson in a constructivist way.
- Producing didactic documents for various audiences (students and teachers).
- Making posters.
- Devising and preparing a laboratory (experimental protocol, material…) that brings a solution to the problem.
- Learning how to work in group.
- Public presentation, young people groups animation and management.

Along with the theoretical and practical lessons, the AESS includes seminars, conferences and internships. Together, they aim to 1) understand and analyse the school institution, its framework and actors; 2) conceive, structure, plan, manage and assess teaching-learning situations; 3) think about one's teaching practices and their context. The internship is assessed according to four axes: mastering the disciplinary content and the French language; teaching skills, related to the disciplines taught; educational skills; metacognitive skills.

At the University of Liège, a strong emphasis (15 ECTS out of the total number of 30 ECTS) has been put on the didactics of the specialisation field, in our case, chemistry. The other courses are the following: General didactics (4 ECTS); Analysis of scholar institutions and key-players, educational policies (1 ECTS); Elements of sociology of education (1 ECTS); Media education (1 ECTS); Interdisciplinary seminar (1 ECTS); Professional ethics and training to neutrality and citizenship (2 ECTS); Educational Psychology of adolescents and young adults (2 ECTS); Understanding and managing the diversity of public schools (3 ECTS).

The major aspects emphasised in the specialised chemistry didactics course (including practical exercises) are described below. Most of this information has been borrowed from the website of the University of Liège [8], where additional details are available. This course strongly favours an active participation of the students. Some of the teaching activities are organised in common for the future chemistry, biology and physics teachers to encourage a team-oriented attitude among the science professors. The main activities organised within the framework of the "Didactics of chemistry" course are as follows.

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- Presentation of the legal framework of secondary school education in French-speaking Belgium: competence-based pedagogy;
- Presentation of the organisation of the secondary school educational system in French-speaking Belgium; the future teachers have the opportunity to meet science inspectors and secondary school directors;
- Analysis of secondary school chemistry curricula;
- Elements of didactics: students' motivation and preconceptions, teaching and learning approaches, didactical transposition ...;
- Preparation for the teaching practicums: organisation of small-scale teaching exercises;
- Safety and hygiene in science classrooms and laboratories;
- Development of an experiment-based teaching approach: 4th, 5th, and 6th year's curriculum of the secondary school, electrochemistry, organic chemistry;
- Didactical analysis of selected aspects of the curriculum: The discovery of the atomic structure – The chemical bond – Redox reactions and electrochemistry – Organic Chemistry;
- Methods for the assessment of competences;
- Efficient use of computer tools in a chemistry classroom, including interactive whiteboards;
- Numerical problem-solving methodology;
- Introduction to epistemology: understanding the characteristics of the scientific method, the relationships with other disciplines, promoting ethical aspects.

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. 8 hours must be taught in technical qualification classes or in professional classes. Reflexive practices are organised on an individual basis when the members of the chemistry didactics group come to assess a lesson in a school, and for the whole group of students at the end of each practicum period. The critical analysis included in the practicum report is an important part of the reflexive practices. The future chemistry teachers must also participate in a few school activities taking place outside the traditional classroom environment: accompanying pupils to scientific events, meeting the parents.

1.2 In-service Teacher 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 organisation), 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.

More specifically for chemistry teachers, the following initiatives can be mentioned:

The biology and chemistry didactics groups at the University of Liège organise in 2013-2014, within the framework of the IFC Institute, a common two-day training session for experienced science teachers focussing on how to optimise the supervision of the practicums of future teachers during their pre-service training.

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One introductory conference to the "*Printemps des Sciences*" is organised on a yearly basis on a Wednesday afternoon (when schools are closed) in February. It is intended for secondary school teachers and for students in science didactics. It consists of two or three lectures given by university specialists but at an adapted level, on themes that can be addressed in secondary school classes and that favour an interdisciplinary approach. Themes of the previous years include: "heavy rain and flood: how can we limit the damage?", "rare-earth metals", "the evolution of matter", "extreme temperatures" etc.
The "*Groupe transition*" of the University of Liège, in which the chemistry didactics group participates, has developed a website [9] covering basic chemistry knowledge. Its purpose is to help students make a smooth transition from secondary school to higher education.

2. Assessment of the National Training of Science Teachers

A number of strengths and weaknesses are pointed out by teacher trainers of the courses of study.

Strengths and weaknesses of AESI

The analysis of the organisation of AESI comes from two studies [10] [11]

Strengths

- Permanent and progressive interaction between academic knowledge and professional reality (professional training workshops, internships, practical training professor);
- closeness between trainers and students and multidisciplinary team work;
- accessibility to training for a great number of applicants with a CESS (or equivalent);
- recognition of a teacher identity through common lessons between courses of study and identical titles in program schedules.
- A partner commenting on the Belgian paper on teacher training [12] pointed out this course of study is better suited than the AESS, as it is more focussed on teaching.

Weaknesses

- Organisational and institutional difficulties: recruitment of practical training supervisors and their observation in the classroom, recruitment of trainers with experience in compulsory education; recruitment of internship supervisors;
- Strains between trainers, students and internship supervisors because of different demands;
- Students that are too quickly considered to be in a professional situation during internships while they are still in training;
- Very dense training programmes that leave little room for students' hindsight (around a third more load than other teachings in HE);
- Certain new lessons given in a lecture hall do not make the theory-practice articulation easy;
- Applicants who join the training with a low level in basic subjects and motivations that are unsuited to the requirements of the profession of teacher;
- The establishment of residual credits (credits failed in the previous year) seems to make students' participation to the classes more difficult and merely delay failure or leaving.

Strengths and weaknesses of AESS

Weaknesses

- In Belgium, the university is not vocational. It provides knowledge but does not aim to offer masters with professional orientation, which the didactic orientation should be.
- The time dedicated to training compared to the number of credits (30) is greatly insufficient.
- 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 hesitate to choose the didactic orientation because it is considered as more demanding, and because they fear they would have gaps in scientific content in case they turned afterwards towards the PhD.
- The didactic dissertation is not always recognised as a "real dissertation", which, some consider, should be oriented towards research.
- Connecting theory and practice is difficult for certain lessons given in large lecture halls.
- 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.

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Strengths

- Students in the Master as well as people who resume studies can obtain the *agrégation* in one year. For these, there is a certain flexibility regarding their second cycle degree allowing their dossier to be accepted by the faculty (civil engineers may start the *agrégation* in physics or graduate veterinaries start the AESS in biology for instance).
- Certain universities used the freedom left in the programmes to propose major/minor forms (major in the same subject as the master, minor in a related subject or of particular interest for the student). This opening has been introduced to take the field reality into account, namely that many science teachers have to teach the three subjects: biology, chemistry and physics, including sometimes in the third cycle (16 to 18).
- Several collaborations between the actors concerned (experienced field teachers, inspectors, educational advisors…) have been established thanks to the Bologna reform.
- 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.

Considered ideas for improvement: a common initial training with a professional orientation based on scientific, educational and teaching components.

It would seem useful that all the teachers who teach sciences in any six years of secondary school had a same training. It would involve a common training during the first three years (subject-based bachelor's degree) based on the learning of one major science and other minor ones. The two years of master would be based on the educational and teaching aspects of the training (with variations according to the audience the student intends to teach to). Therefore, current AESI students would better master the subjects they will teach and current master students be better trained in educational aspects.

An evaluation of teachers' initial training was carried out in 2011-2012 (inserted in the publication database [13]). It is the base of a reform that should be applied next year. The harmonisation of teacher training will be one of the results of this reform. Continuing training will also take place in a stricter framework than it does now (see Chapter 1.2). Here are the latest (June 2013) details we have about the reform. They come from guidelines [14] of the Ministry of Education.

The project decree intends to create an Academy of Research and Upper Education. This academy would oversee five poles, centred on the five French-speaking universities (Brussels, Liège, Louvain, Mons and Namur) around which would gravitate the other upper schools ("*hautes écoles*"). The organisation of the studies and the status of the student will also be modified.

To meet the requirements of the profession, the initial training of primary and lower secondary school teachers will be extended to five years. Their cooperation with practicing teachers will be reinforced. The reform will be carried out following three axes:

1. **Progressive reinforcement** of the initial training of all teachers and of the initial and continuing training of teacher trainers.
2. **Updating or even redefining the contents** of the initial training in order to contribute to a fairer and more democratic school and to better take into account the social and institutional context and the working conditions in schools and training centres.
3. **A new organisation** of the initial training that associates the initial training of teachers and the initial and continuing training of their trainers in coherence with the education system and the reform of upper education.

The measures that will be carried out will be based on one or more of the following transversal principles:

Principle 1: More information for a better guidance. Informing on the profession of teacher, highlighting it in order to bring students to train as teachers.

Principle 2: A more demanding initial training. Improving the training making it more demanding, with reviewed contents in order to contain all the necessary elements of a basic training, whatever the path chosen by the student.

Principle 3: A stronger continuity between the initial training and in-service training. The initial training and continuing training should be connected as soon as the teacher starts working.

Principle 4: Federating existing resources. Taking advantage of the specific expertise and skills of people, productions, scientific research, common tools and supports.

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Principle 5: Supporting collaborations between all the actors. Developing and institutionalising all the places where actors of every – action and decision – level meet and share questions, difficulties, practices and good experiences. Developing the idea of co-training between all the trainers and practising teachers concerned by the same future teachers.
Principle 6: Developing a "mirroring" reform. Applying the reform to teacher trainers.
There are several categories of concrete measures, originating among other from the participative evaluation of the initial training [13]. Those measures concern:

1. The organisations and path of initial training;
2. The contents of the initial training;
3. The audience of the initial training;
4. The trainers in initial training;
5. The occupation(s) of education;
6. The possibilities of cooperation and co-training in initial training;
7. The beginning of new teachers;
8. The funding;
9. The management.

Some of the measures can be carried out within a short delay (2014) while others will be planned in the middle or long term.

3. The Impact of the Project on Teacher Training

The project made it possible to gather together teachers from various backgrounds: secondary school teachers, university teachers, teacher trainers and experts. They could share experience and ideas, evoke possibilities of improvement in teacher training. The latest workshop provided the chance to introduce the reform of initial training to the teachers.
The papers and publications on the portal gave ideas to the teachers; the section on teacher training was of greater interest for teacher trainers as initial training is about to be reformed. Secondary teachers were more interested in the teaching resources, although these apply to students' motivation more than to teacher training.
Within the framework of the project, one of our experts in collaboration with Inforef created a lesson sequence on the chemical reaction using ICT and the interactive whiteboard. As part of continuing training at IFC (see section on in-career training), teachers are trained to use this resource (included in the portal database) and to integrate it in their lessons.
Within the framework of the project, Inforef took contact with a teacher trainer at the University of Liège (which has since then become an associated partner) who is involved in another European project on chemistry education. He will provide expertise during the third year of the project and will involve his students (future chemistry teachers).

4. Conclusions

The project made it possible to gather together teachers from different countries and various backgrounds: secondary school teachers, university teachers, teacher trainers and experts. They could share experience and ideas, evoke the strengths and weaknesses of teacher initial training and the possibilities of improvement thereof.
The workshop provided the chance to introduce the reform of initial training to the teachers in the French-speaking Community "*Fédération Wallonie-Bruxelles"*. The project reform intends to extend the training cycle in colleges 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.
Teaching resources: existing resources have been tested by chemistry teachers and future teachers. The project has also provided the chance to create and test new sequences using ICT and the interactive whiteboard. These new resources correspond to the curricula of chemistry courses in secondary schools. Actually, computer technologies are not included in the official curriculum of initial training and this explains the greater interest for teachers in the section of the database of "teaching resources".
During the third year of the project, teachers from different level will be involved in the exploitation and testing of the resources in their classroom.

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Within the framework of the project, some experts and students from universities and in collaboration with Inforef will create new lesson sequence on the chemical reaction using ICT and the interactive whiteboard. As part of continuing training at IFC, teachers are trained to use this resource and to integrate it in their lesson.
Within the framework of the project we have given chemistry teachers the possibility to work in group at the local and European level and to use and build new e-learning sequences with the assistance of experts in ICT and chemistry didactics. This supervised self-learning through ICT and with experts will go on throughout the last year of the project.

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