



Strategy for the Promotion of Lifelong Learning of Scientific Subjects



Lifelong Learning Programme

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The strategy has been identified thanks to the joint work of::

Milena Koleva, Angel Anchev,
Technical University of Gabrovo,
Bulgaria

Anna Mittnerova, Hana Stepankova, Petra Kinzlova,
Institute of Chemical Technology in Prague,
Czech Republic

Susan Präsel,
DAA,
Germany

Dionysios Koulouglotis, Katerina Salta, Evangelos Ntararas, Irene Petsimeri, Mihail Gekos,
Anastasios Kalimeris,
Technological Educational Institute (TEI) of Ionian Islands – Department of Environmental
Technology and Ecology,
Greece

Aldo Borsese, Marilena Carnasciali, Irene Parrachino, Laura Ricco
Dipartimento di Chimica e Chimica Industriale – University of Genoa,
Italy

Murat Demirbaş,
Kırıkkale University Education Faculty
Turkey

Mustafa Bayrakcı,
Sakarya University
Turkey

The editing of the strategy was made by:

Marilena Carnasciali,
Dipartimento di Chimica e Chimica Industriale
University of Genoa
Italy

The identified background of the Chemistry is All Around Us project idea relies on the evidence related to the lack and insufficient diffusion of scientific culture and awareness within all countries involved and in Europe in general. This phenomenon starts at school level (primary and secondary education) and subsequently affects all levels of educational and training systems and therefore citizens in general.

Insufficient diffusion of scientific culture and awareness in Europe

Promoting Life Long Learning strategies for scientific issues is much more difficult, compared to other subject areas (e.g. humanistic subjects, business management, language learning) since when compulsory education ends (at around age 15-16), those that are not interested in science are much more likely to completely abandon the subject.

To address this situation, the “Chemistry Is All Around Us” Project intends to identify the existing successful strategies for the promotion of Life Long Learning in scientific issues and spread them through the potential of ICT. In addition, the project aims at providing a method and related educational tools which can practically and efficiently help learners (starting from school level) develop and cultivate the skills required to informally learn about science throughout their lives.

Among all scientific fields, Chemistry is identified as an exemplary Case Study as it is recognized as one of the most problematic subjects. One of the reasons is related to its public image: Chemistry often suffers from a growing unpopularity due to the fact that the media frequently makes improper connections between Chemistry and notions like pollution, health threats, manipulation of natural structures etc.

The “Chemistry Is All Around Us” Project initially made a comparison between the strategies implemented in the 6 countries involved (Bulgaria, Czech Republic, Germany, Greece, Italy, and Turkey) for the promotion of public awareness and the diffusion of a more interesting approach towards Chemistry (chosen as exemplary case studies for scientific subjects) at all levels of the Educational and training Systems.

Each country involved in the present project produced a national report dealing with school and adult educational systems, with particular focus on scientific subjects. The transnational report, produced by the Italian coordinator with feedback from all partners, is a comparative summary about the educational systems, the image of chemistry and the problems related to the teaching-learning methodology. The main points discussed in the transnational report are reported below.

The educational systems of the countries involved are basically similar in the organization of educational levels, but different depending on the history of the single country and the ideas that inspired the development of the school system.

The educational system consists of pre-primary, primary (or elementary) and secondary school. As mentioned above, the National Reports describe very similar organizations and small differences are related to the subdivision of secondary school. Moreover, secondary schools can be divided in terms of educational contents and two main categories can be identified: the first one provides a preparation suitable for pursuing studies at university, while a second category provides professional studies.

The educational system of five out of the six examined countries is mainly entrusted to a central government, apart from Germany that has a different system. Indeed German policy is not uniform because education and culture is focused on the ‘Länder’, the states of the federal organised Germany, while the central government has a secondary role.

In all countries education is compulsory for children between 5-6 and 14-16 years old.

For what adult education is concerned, it consists mostly of courses for people that need to acquire a degree of education or a degree of professional qualification and courses for people in possession of a secondary diploma or degree that wish to enrich their knowledge in different topics or get continuing professional training.

Part of the education supply is controlled by the national governments and part by enterprises, private centers and agencies, non-profit associations and similar structures. It is possible to monitor activities and results only when courses are carried out by state bodies, while the other numerous private centers are often autonomous and, therefore, out of control, especially for what concerns teacher competence.

In Greece, adult education is mostly focused on the work of centres and institutes belonging to networks with a common regulation, such as 'Second Chance' Schools and Vocational Training Institutes.

Also Turkey describes a simpler and more uniform system for adult education as the courses are mostly carried out by public education institutions.

The Governments of the partner countries are really interested in implementing life long learning and entrust this task to their Ministry of Education.

The Ministry of Education acts by establishing Centers and Agencies aimed to improve life long learning and by coordinating their several activities. Annually, it provides or modifies the National Program for life long learning and funds national and regional projects.

Unfortunately, none of the national reports mentions a specific care toward scientific subjects: the efforts of Ministry of Education are devoted to improve adult education in all disciplines.

In addition to the Ministry of Education a few other bodies are responsible for improving life long learning: for example, Turkey names Ministries of health care, house economics, education of citizens, while Bulgaria has the Ministry of Labour and Social Policy and the National Agency for Vocational Education and Training.

Moreover the role of alternative universities, such as Hellenic Open University (Greece) or Unitre (Italy) has to be mentioned. Italy praises the work of the Italian Society of Chemistry (SCI), the national association really devoted to popularization, and dissemination of scientific subjects, with particular focus on chemistry.

There are policies to promote lifelong learning in general, however for scientific disciplines, a well defined policy is missing.

The policy to promote lifelong learning is similar for the different countries. Its main objectives are focused on giving a 'second chance' to people who have prematurely dropped out of the education system and on facilitating access to the job market by the acquisition of suitable qualifications.

In the European partner countries involved in the project there are policies promoting lifelong learning in general, however, for the specific field of scientific disciplines, a well defined policy is missing from the examination of the National Reports. Indeed the actions are often fragmentary and last for a limited time period. In total, the lack of a long-term common strategy can be evidenced.

The most important actions are addressed mainly to secondary schools and consist of activities to monitor the educational system and improve the teaching methodology. They aim to attract

students to scientific disciplines by stimulating their curiosity and by making the teaching-learning process more attractive.

The establishment of a new and more adequate educational system for scientific disciplines is expected to be the fundamental step to build a continuity between school and permanent education.

Despite the supply of numerous different courses devoted to adult education and the efforts of the governments, the national reports evidence that not so many people are interested in improving their knowledge in general and the scientific knowledge in particular. Statistics reported by Partners show different numbers but they all evidence the same problem: adults attend LLL courses only when it is really necessary, this means when they need a diploma or when they want to reach a higher professional qualification, not because they wish to improve their educational level.

In order to face this crisis of interest, some countries (Germany, Turkey, Greece), are making steps for changing the science curriculum and teaching methodology in both primary and secondary school. The expected result is to train young adults to being more scientifically literate, more curious about discovering new knowledge and aware of the fact that learning is a life long process.

With the aim of getting further information about the failure of the adult educational system, especially when scientific disciplines are involved, a careful investigation of the main obstacles to lifelong learning of scientific subjects has been carried out. Namely, twenty interviews with teachers and adults were performed by each project partner and the answers were analysed to produce twenty case studies. Besides, several national documents and articles were reviewed to support and integrate the results of the interviews.

Interviews and reviewed papers show the disastrous relationship between students and chemistry. This subject is unpopular also among adult people that associate chemistry with negative concepts such as pollution, anti-natural actions and products, poison and who do not wish to improve their poor, and often incorrect, knowledge.

More specifically, partners describe very similar obstacles to lifelong learning of chemistry, which can be summarized as follows:

- Chemistry has a bad image. Chemistry is associated with negative aspects of life and is considered as the opposite of what is natural.
- Chemistry is considered a difficult subject with high conceptual demands: it makes use of difficult and abstract language, it possesses a triple nature (macroscopic, microscopic and symbolic), it is considered the most visual of all sciences, it requires memory and mathematical skills.
- Chemistry teachers are not adequate. Many of them do not hold a degree in Chemistry and most of them have never attended a specific training course necessary to 'learn to teach' .
- Text books are too difficult.
- Laboratory activities are absent or, in the best cases, sporadic or inadequate.
- There is a lack of motivation. Students and

MAIN OBSTACLES TO LLL OF CHEMISTRY

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adults think that chemistry is an abstract subject and do not manage to see its connection with everyday life. Moreover they do not know at all the job opportunities of a chemist.

In order to promote a better image of chemistry as a subject, national governments organize numerous national and local initiatives. They consist mainly of projects funded by the Government, but initiatives are also found in permanent centers for scientific expositions (i.e. museums), temporary expositions, seminars, festivals proposing a wide variety of activities as well as a 'hands on' approach allowing for the active participation of the public.

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Many projects are entrusted to universities and aim to attract the interest of secondary school students by showing topical but also amusing and, sometimes, spectacular aspects of chemistry. A common point of the projects is the care in showing the link between chemistry, an apparently abstract discipline, and everyday life.

Other projects worth mentioning are devoted to research in the field of methodology of teaching. They aim to improve the teaching/learning of chemistry and provide training for teachers and useful material for both teachers and students.

These strategies are very positive because they involve students and adult people in practical activities and are able to show the positive and topical aspects of chemistry.

Other fundamental actions consist of improving the teaching-learning process in the following ways:

- involving students in scientific activities at school with their teachers, but also outside school (i.e. at universities or companies and organized by researchers and experts)
- developing tools and alternative teaching material to be used by teachers.

Concerning educational tools and alternative teaching methods, the interdisciplinary teaching approach helps the ability of 'learning to learn' is effective in showing either the interconnections between different scientific fields or the concrete aspects of chemistry.

Furthermore the use of science textbooks which do not follow the traditional teaching method (teacher-centered and the student treated as 'blank paper'), but make use of either guided inquiry or of constructivism seems to be also an effective initiative.

Finally, the constructivist methodological approach is considered very effective because it assigns students an active role in the teaching-learning process, develops their critical and conscious attitude and is able to correct common misconceptions.

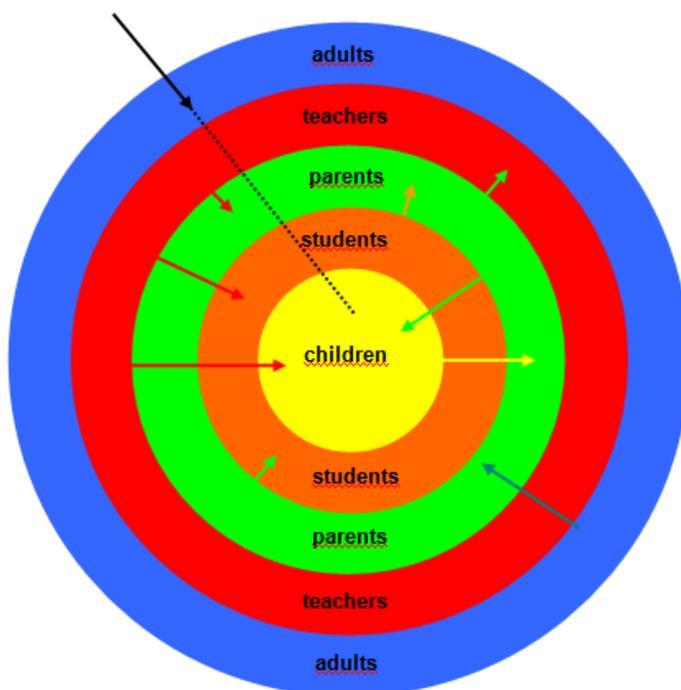
However, the above activities do not seem to be sufficient and really effective in fighting adult distrust towards Chemistry. They are rather sporadic and do not have wide diffusion. A different and long term strategy needs to be implemented.

At the second Partner's Meeting (Berlin 6-7 September 2010) each partner presented detailed conclusions on the basis of information derived from the activities carried out (interviews and reviews of papers and strategies) and proposed a strategy to implement Life Long Learning of scientific subjects, chemistry in particular.

A very stimulating discussion among partners resulted in the common and concrete approach that is described below.

Since the events and actions that are carried out in the six countries have not achieved the result of making Science appealing to both students and adults, it seems that the problem has to be analyzed in a different way and dissected in all its components.

It is possible to represent, the possible interaction among children, students, parents, teachers and adults in general, by using the following diagram where the arrows show the direction of interaction.



We believe that children must be introduced to Science by using a phenomenological approach. In this way not only is it possible to stimulate their curiosity but at the same time work is done at a level adequate to their cognitive structure.

By allowing children to observe phenomena, describe their observations in sequence, work systematically to understand the significance of terminology and construct a shared definition are

activities which, carried out individually or in groups, aid in the acquisition of transferable skills.

These are skills that are acquired gradually in the successive educational levels and lead to the development of the logical and cognitive capacities that allow cognitive independence and a critical spirit.

Children, shown in the center of the diagram, are the most important category. If children are helped to approach science, chemistry in particular, as a part of their everyday life, they will be able to gradually understand all rules and laws that belong to our knowledge, also understanding that science needs to use models that may possibly change when better ones are discovered.

Children must be introduced to science by using a phenomenological approach

The motivation of children will subsequently be transmitted to their parents, who will be stimulated to share the scientific growth of their sons and daughters. We think that all activities involving both parents and children are very effective, but only if carried out by teachers able to involve both generations in a guided learning path. Organisers specialized in education are not always involved in the events.

If parents change their ideas about Science, they will be able to fight prejudices that characterize their society and will be able to influence the adults close to them: in this way it will be possible to effect a change of the general perception of the sciences.

The diagram can be summarized as follows:

- children feel the influence of their parents and their teachers, but are less influenced by the adult population in general;

- parents influence children and teachers and are in turn influenced of them both

- teachers influence parents and children, but are conditioned by the expectations of parents

- adults, in general, can influence parents but are not influenced by the categories reported in the inner circles, but by other entities, such as mass media and popular beliefs (even if mass media influence everybody, we think that their worst effects are on less learning people).

- students are a case in particular: they are influenced by all adults and have little possibility of change, in fact it is very difficult to modify their thoughts. This is well known by teachers that have more difficulty to revise wrong concept than introduce a new one; students grow fond of these mistakes also during their higher studies, as it is possible to verify even in teacher training trials.

What can be concluded?

The only possibility of modifying the way of thinking of our European society is to train expert teachers and follow them throughout their professional lives according to a lifelong learning approach to in service teachers training. For this reason, the presence of an organisation generously funded by government for carrying out didactic research is fundamental. The best organisation capable of this are the Universities: not only the Faculty of Education, but all scientific faculties should have research teams, collaborating with their colleagues of the Science of Education to study the best ways of teaching scientific subjects at all the age levels. To the same end, it is necessary to address scientific dissemination in order to avoid misleading information diffused by the mass media.

On top of that we need more interaction, especially in the training of science teachers, between universities and schools. University lecturers and experts must go into schools and accompany/watch/ask teachers and students at school to know what's going on

CONCLUSIONS

There should be a cooperation between Universities' faculties of education and faculties of scientific subjects and the result of this cooperation should be an adequate offer of continuous in-service science teacher training according to a LLL approach.

There should be a better integration between Universities and schools.

Scientific research – and science teaching - should have a better consideration in the European society

Events (e.g. science fairs, exhibitions etc) should be organized so as to make sciences more friendly for both children and their parents.

there and what is required. On the other hand, teachers in school need the interaction with the university to exchange experience with experts and get access to research in subject-specific didactics and methods. There used to be such an exchange in northern Germany, it was a teacher training trial that went on for a couple of years. And even when it stopped, teachers and university experts kept working together. In Italy, on the contrary, aspiring teachers are waiting for three years the activation of special courses for teaching qualification.

We think that if all children of the next generations have capable teachers, they will become good students and could become good teachers, good journalists or good researchers in didactics, but they certainly will be parents able to transmit the right approach to science, chemistry in particular, to their children. All of them will be adults able to understand the importance of science and technology and to distinguish the difference between the right and wrong application of chemistry.

We ask the European Commission to sustain the necessity to have in Europe a greater consideration of didactic research, such as occurs in the USA.

Events should be prepared by teachers and didactic researchers and designed to involve primarily children and parents.

Science teaching at all educational levels has to receive more consideration from society, both the perception and in remuneration.

A great challenge is that not only adults in general, but even nowadays students are a lost generation. It is very difficult to change their already formed mindsets. The process will be slow and it will be concluded only when all students will think that TO UNDERSTAND SCIENCE IS AMUSING AND USEFUL, independently from their subsequent choice of study.