International Conference

Successful Educational Experiences and Didactic Guidelines in Science Teaching

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Successful Experiences and Development of Key Competences in Chemistry Education: the Italian Context

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CHEMISTRY IS ALL AROUND NETWORK

Lifelong Learning Programme

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Competences in the European context

As you know:

in 2000, the European Union started a process well known as the Lisbon Strategy, a system of reforms that spans all fields of economic policy, but its main characteristic is that for the first time the themes of knowledge are identified as fundamental.

Subsequently, in 2006, the European Parliament and the Council invited the Member States to develop, as part of their educational policies, strategies aimed to grow in young students the **eight key competences** that may constitute a basis for further learning and a solid preparation for adult and working life

Competences in the European context

1. Communication in the mother tongue
2. Communication in foreign languages
3. Mathematical competence and basic competences in science and technology
4. Digital competence
5. Learning to learn
6. Social and civic competences
7. Sense of initiative and entrepreneurship
8. Cultural awareness and expression

Competence means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

The Italian answer

The concept of competence came in the Italian school from 2000 (Berlinguer - De Mauro reform), and was finally "coded" by DM n. 139 of 22 August 2007, which introduced new guidelines for the second cycle and compulsory education up to sixteen years.

In September 2012 the ***New National Guidelines*** for the first cycle of education expressed more clearly that the Italian school system takes, as reference horizon to work towards, a framework of eight key competences for lifelong learning.

The text of the New National Guidelines expresses a general goal, ***the competence profile of the student*** at the end of the first cycle of education and details role and objectives of different disciplines.

Goals for sciences in the New National Guidelines

In the case of sciences, the goals that the student has to attain at the end of lower secondary school are expressed globally for chemistry, physics, biology, astronomy and earth science :

-the student explores and experiments, in the laboratory and outdoors, the unfolding of the most common phenomena, imagines and tests the causes, researches solutions to problems using the knowledge acquired;

-he develops simple schematization and modeling of facts and phenomena using, when appropriate, to take suitable measures and simple formalization;

-he recognizes in his body structure and operations at macroscopic and microscopic levels, is aware of his potential and limitations;

Goals for sciences in the New National Guidelines

-he has a view of the complexity of the system of the living and of the evolution over time, recognizes their diversity, the basic needs of animals and plants and ways to meet them in specific environmental contexts;

-he is aware of the role of the human community on Earth and adopts environmentally responsible way of life;

-he links the development of science to the development of human history;

- has curiosity and interest towards the main problems related to the use of science in the field of scientific and technological development.

New guidelines also for upper secondary schools

Consistently, MIUR (Ministry of Education, University and Research) worked to conform to the European guidelines also the organization of upper secondary school.
In the school year 2012/2013 the didactic at the lyceum, at the technical and vocational school underwent a change and was focused on the development of key competences.

A new way of teaching and learning

In this new scenario, teachers and educational institutions were asked to change and renew their working method, away from the previous transmissive teaching and focusing on the action in situation of the student.
Now, the keywords are: design, formulate curricula in a lifelong learning perspective and certify competences.

A not easy task to perform!

Successful experiences in chemistry teaching: the ICTs

The Ministry of Education also strongly encourages the use of digital resources in the teaching of disciplines, with the aim of developing a transversal key competence: the digital competence.

Many teachers claim low affinity toward ICT resources.

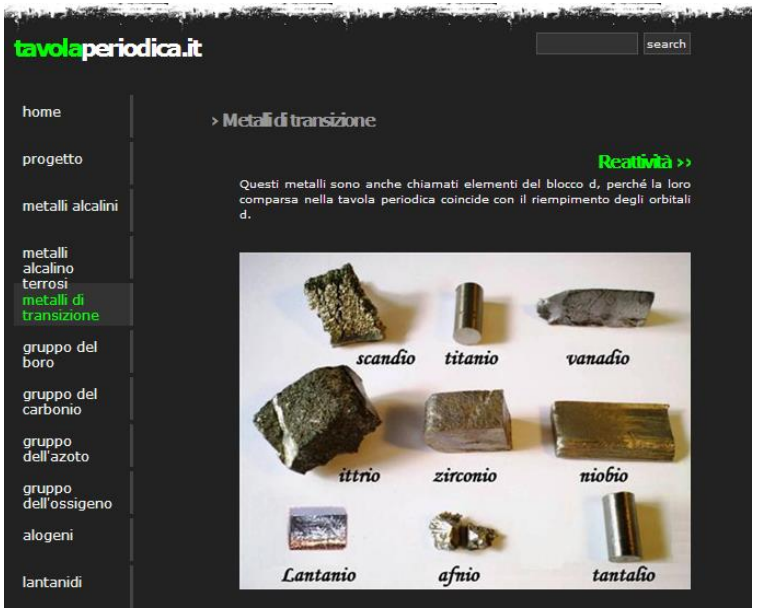
In order to use digital tools as successful experiences, especially in the context of competence development, it is necessary a suitable design that includes:

- interaction between teacher and student and among students themselves
- practical experience, carried out in the classroom or in the laboratory, but, in any case, real.

Successful experiences in chemistry teaching: the ICTs

As first step is to break down teachers' distrust, by encouraging the use of simple digital tools that meet the favor of students and not embarrass teachers

The site tavolaperiodica.it seemed to us the most suitable digital resource to present at schools for demonstration purposes.



In this way, teachers could have an example of how a digital resource, although very simple, can be used to enhance learning of curricular chemistry contents.

Testing of digital resources: tavolaperiodica.it

A short two-hour path was designed around tavolaperiodica.it and proposed to 8 classes of upper secondary school who had started to study the periodic table of elements.

The path was carried out entirely in the computer lab; during the first thirty minutes students, in small groups, surfed autonomously within the site, while, for the remaining time, they were involved in a non-traditional lesson.

During the lesson, the virtual laboratory was joined to practice, observation and guided discussion, in order to connect previous knowledge to the new context, to consolidate and deepen.

tavolaperiodica.it: few moments of the "lesson"

The videos of some chemical reactions, dangerous to be really carried out, were used to guide students to the construction of the corresponding equations.

What did you see?

Which are the reactants?

And the products?

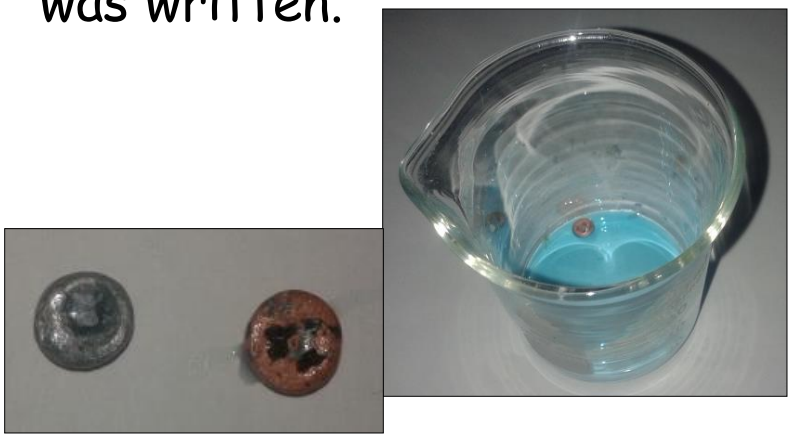
What is burning?

$$2K + 2H_2O \rightarrow 2KOH + H_2$$

tavolaperiodica.it: few moments of the "lesson"

Practical activity

A piece of zinc was dipped in a solution of $CuSO_4$. The change of color, from gray to red, was used to deduce the reaction products, then the corresponding equation was written.



$$CuSO_4 + Zn \rightarrow ZnSO_4 + Cu$$

Virtual activity

A solution of $CuSO_4$ reacts with an iron nail and, in time, decolorizes completely in correspondence to the deposition of metallic copper on the nail.

$$CuSO_4 + Fe \rightarrow FeSO_4 + Cu$$

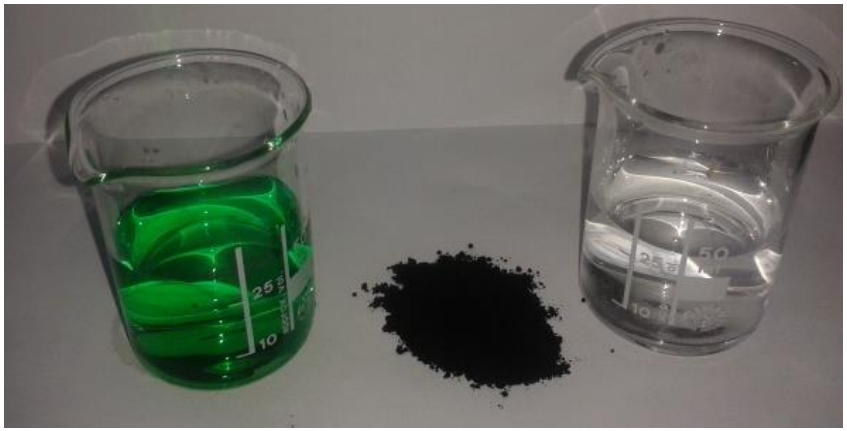
tavolaperiodica.it: few moments of the "lesson"

Virtual activity

Talking about carbon…

Practical activity

A sample of charcoal was shown and its bleaching properties were demonstrated by filtering water containing food dye. Charcoal is widely used in filtering carafes, filters for pools, purifiers, deodorizers and is also sold in pharmacies.



tavolaperiodica.it: few moments of the "lesson"

Practical activity

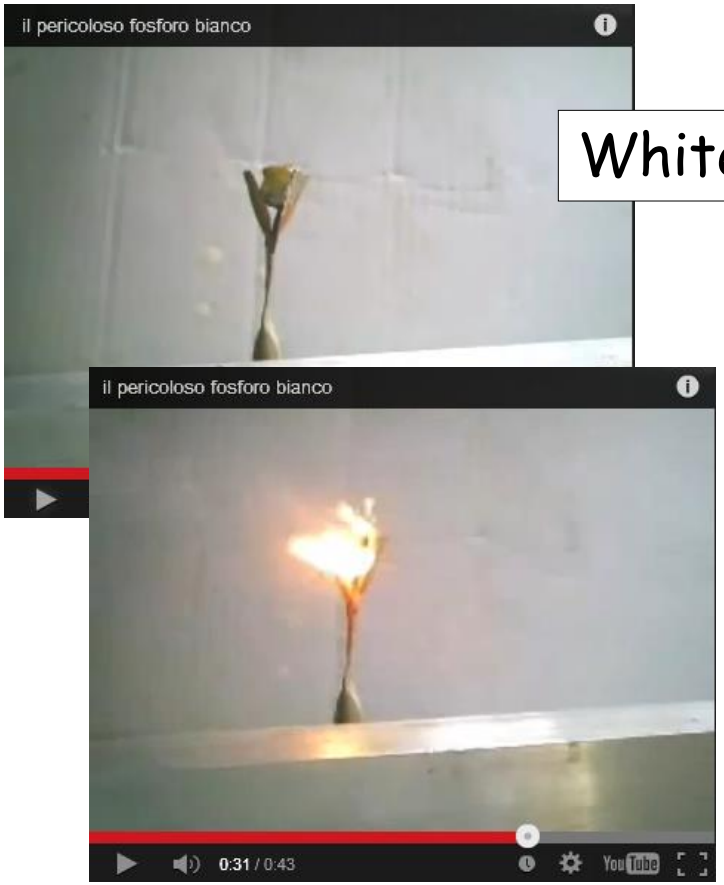
Numerous samples of simple substances (lead, zinc, copper, mercury, gallium, silicon, sulfur, tin, tungsten, iodine, etc.) were given to students for the purpose of identifying them by using personal experience…

Virtual activity

….but also photos and information from the site.

tavolaperiodica.it: few moments of the "lesson"

The site also provides historical notes, anecdotes and references to specific applications



White phosphorus → Chemical weapons

↓

Red phosphorus

↓

Matches

In few words…

The didactic path was designed aiming to competence development: the active role of students was stimulated as much as possible, referring to their life experience and scientific knowledge.

The structure of the lesson has been the same for all classes, but without excessive stiffness: we took care to leave enough space to changes / insights due to curiosity or perplexities, different from time to time.

Assessment

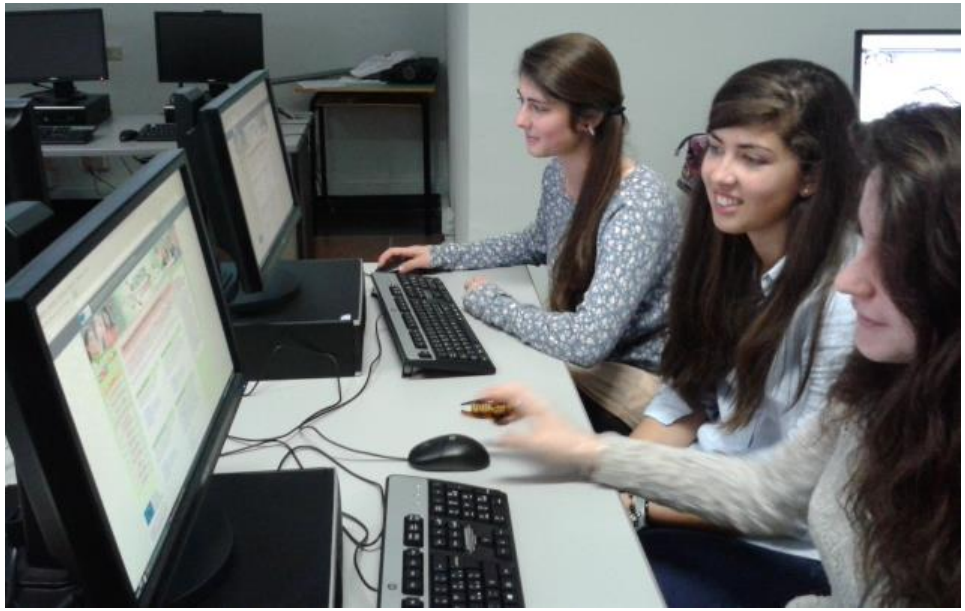
The experience was appreciated by both students and teachers.
The assessment was made in the following way:

-Investigating students' opinion, by a questionnaire with one open-ended question

-Investigating teachers opinion involving them in a focus group

The results of this survey will be presented by Andrea Traverso, researcher at the Department of Education

To be continued…



Thank you for the attention