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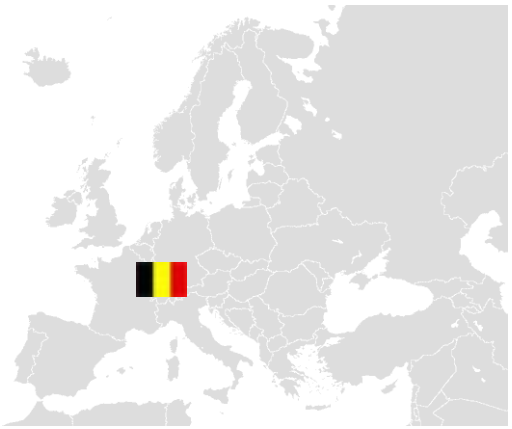
Students' Motivation to Learn Chemistry in Belgium



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Students' Motivation to Learn Chemistry in Belgium

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Abstract

In Belgium the project "Chemistry Is All Around" gathers together seven experts specialised in chemistry who have experience in didactics, teacher initial and continuing training and ICT. Several institutions are officially involved in the project: the Catholic University of Louvain, two normal schools, the SeGEC (General Secretariat of Catholic Education) and the association of chemistry teachers.
Ten schools are involved, nine upper secondary schools and one normal school, in Brussels and the provinces of Liège and Walloon Brabant. The project involves 28 science teachers (who often teach chemistry, physics and biology) and around 500 students.
The experts coordinate groups of teachers to identify and review existing teaching resources, create new lesson sequences associating ICT, experiments and the systemic approach and create a platform with new interactive resources. Indeed it turned out that it is difficult to find teaching tools adapted to the students' level and curriculum in the appropriate language.
Motivation for science is directly linked to the way it is taught and the younger people are confronted to science the more they are interested in it.
Some ideas to increase students' motivation?

- *CLARIFY the etymological and epistemological approach to chemistry (its jargon, its symbols, the reason for things…).*
- *EMPHASISE the contextualised and qualitative approach to the chemical reaction with more experiments in the class.*
- *IMPROVE the quantitative approach to the chemical reaction through modelling and using new means from communication technologies.*
- *IMPROVE teachers' training and change the curriculum, adapting it to modern techniques.*
- Chemistry is a particularly complex science, in which the beginner needs support from an expert to master the scientific jargon, experiments and ICT.

1. Introduction to the National Situation

Young people's disaffection for science in general and for chemistry in particular is widespread in Europe.
The situation is worrying: at the University of Louvain, 120 students graduated in chemistry in 1972 while there are only a dozen of them now.
The causes evoked can be divided in two categories:

Society-related causes:

- Up to the years 70, science and chemistry were considered as factors of progress (remember for instance the space missions). The opinion turned after a period of disillusion, science was no longer considered as a source of progress. Environmental concerns (which are legitimate)

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have taken precedence and the image of chemistry was tarnished. It must be pointed out that sustainable development and chemistry are not mutually exclusive, but this idea is not easily accepted by the public. There is much disinformation such as the opposition between “chemical” and “natural” product.

- It seems that society shows more consideration for a doctor, an economist or a manager, than for a researcher in chemistry or for a science teacher.

Subject-related causes:

- Studying chemistry is considered as difficult.
- In secondary schools, chemistry teaching is too theoretical, little space and time is dedicated to experiments. Yet chemistry is before anything an experimental science.
- This is partly related to the lack of laboratory sessions and equipment in many schools.
- The methods used are little appealing: the nomenclature is often learned “by heart”, teaching lacks of context. Unlike physics or biology, chemistry does not seem to involve a great challenge.
- Experts’ observations:
- Despite all the promotion initiatives (from universities, the industry …), the number of chemistry students in higher education is not increasing.
- In secondary education, many teachers are often helpless:
- There is a same teacher for biology, physics and chemistry
- Security-related worries
- Class-groups of 28 students
- Few experiments
- New ideas for remediation:
- To integrate more experiments in the class, greater means are necessary, in terms of equipment, and infrastructure and in terms of training of the teachers. In this regard, some initiatives are taken (such as continuing training, new frame of reference for skill)
- Specific preparations for higher studies in chemistry should be created. In Belgium, there is no prerequisite to study chemistry at university (unlike, for instance, medicine).
- To associate the use of ICT, experiments and a systemic approach… These are realistic ways to “see” and “make” or, even better, to “build” experiments.

2. Setting up the network

Since 1998, INFOREF has participated in several European projects within the framework of the use of innovative teaching technologies.
We have a large experience in the Belgian education system and collaborative work between teachers from secondary schools and educational experts from universities or normal schools.
Thanks to that experience we have established this partnership between motivated schools and experts in chemistry with the relevant profile: teacher trainers, university professors and ICT specialists.

2.1 Experts involved in the project

Seven experts are involved, four of them train teachers, two are university professors at UCL (Université Catholique de Louvain) and one is an ICT teacher and Apple Distinguished Educator. They are all specialised in chemistry and have experience in didactics, initial teachers training, continuing training, ICT...

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Teacher trainers

Divna Brajkovic
Specialisation: initial and continuing training of chemistry teachers
Institution: HELMo (Catholic higher education, 6750 students in 13 different sections), Liège
Role in the project: officially granted by her institution time to coordinate the scientific content of the European project. She organises with Inforef free trainings to create new sequences in chemistry: using the interactive whiteboard and modelling in addition to the experimental approach.

Jean-Luc Pieczynski
Specialisation: pedagogical counsellor for chemistry teachers
Institution: SeGEC – General Secretariat of Catholic Education
Role in the project: guidance to create new lesson sequences

Pierre Hautier
Specialisation: trainer for chemistry teachers in ICT and laboratory experiments
Institution: SeGEC, continuing training (at IFC and CECAFOC), honorary professor of chemistry
Role in the project: expert in the use of ICT for new lesson sequences

Nathalie Matthys
Specialisation: initial training of chemistry teachers
Institution: ENCBW normal school (Louvain-la-Neuve)
Role in the project: Catholic higher education, trains future teachers (for 12: 15 year old students). Guidance to create lesson sequences and 3D animations for 15 year old students. These tools are being created on the platform called DIDAC-TIC http://didac-tic.sk1.be/.

University professors

Myriam De Kesel
Specialisation: science and didactics for future teachers
Institution: UCL
Role in the project: responsible for teaching qualification in science and for the supervision of students' internship in secondary schools. Within this framework, the new ICT resources in chemistry will be tested by the interns and pupils in the said schools (10).

Bernard Tinant
Specialisation: chemistry and didactics for future teachers
Institution: UCL
Role in the project: guidance in the sequences created regarding the scientific content and didactic approach

ICT teacher

Dominique Lambert
Specialisation: science teacher using ICT
Institution: Abbaye de Flône (Amay)
Role in the project: expert in ICT (e-book, platforms, tablets, podcasts…), reference person regarding the teaching resources review
Background: coordinator of Comenius European ICT-based projects since 2002. Responsible of a project "École numérique" that aims at integrating and testing the IPad in science classes.

2.2 Schools involved in the project

There are ten schools involved, nine upper secondary schools and one normal school, from Brussels and the Provinces of Liège and Walloon Brabant. The project involves 28 science teachers (there is often a same teacher for biology, physics and chemistry) and around 500 students.

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The experts supervise several professor groups, divided according to:

- the area (Liège or Louvain),
- the education level of the pupils (15 or 18) upon which the teachers' training depend (normal school or university),
- the objective of the working group: analysing existing teaching resources, creating new lesson sequences (see Chapter 5).

Province of Liège: coordinated by Divna Brajkovic, who works with teachers in their own schools to organise the review of existing teaching resources and the trainings to create new sequences in chemistry for the interactive whiteboard.

Collège du Sartay (Embourg)
Type of school: Upper secondary school
Students involved: 40 (17 – 18 years old)
Teachers: Sabine Jacquemin (chemistry, biology, physics), Nadia Bechoux (chemistry, biology, physics)

Collège Saint-Louis (Waremme)
Type of school: Upper secondary school
Students involved: 40 to 50 (15 – 18 years old)
Teachers: Divna Brajkovic (chemistry), Anne Minet (chemistry, biology, physics), Céline Cherdon (chemistry)

Collège Sainte-Véronique (Liège)
Type of school: Upper secondary English immersion school
Students involved: 80 (4 classrooms) (15 – 18 years old)
Teachers: Elizabeth Jantsky (science), Véronique Bollinne (science), Françoise Derwa (chemistry)

Institut de la Providence (Herve)
Type of school: Upper secondary school
Students involved: 120 (15 – 18 years old)
Teachers: Simonne Liégeois (physics, chemistry), Yanick Lejeune (chemistry), Michaël Warnier (chemistry, biology, physics), Gaëlle Kroonen (science), Caroline Gillen (science), Josiane Lehane (chemistry), Christel Nyssen (chemistry, biology, physics)

Province of Walloon Brabant and Brussels: coordinated by Jean-Luc Pieczynski and Myriam De Kesel. Creation of new sequences associating the use of ICT, experiments and a systemic approach. An innovative approach the first step of which, consisting in gathering themes among internship supervisors, is completed. Structuring of the standard lesson sequences has been established and the construction of the first theme will begin in 2013. Testing will then be carried out in the schools.

Collège Notre-Dame de Basse Wavre (Wavre)
Type of school: Upper secondary school
Students involved: 40 (16 – 18 years old)
Teachers: Geneviève Delire (chemistry, biology, physics), Bertrand Droulez (chemistry, biology, physics)

Institut de la Vallée Bailly (Braine L'Alleud)
Type of school: Upper secondary school
Students involved: 40 (12 – 18 years old)
Teachers: Stéphanie Wilmet (chemistry, biology, physics), Géraldine Verstaen (chemistry, biology, physics)

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Institut des Sœurs de Notre-Dame (Brussels)
Type of school: Upper secondary school
Students involved: 40 (15 – 19 years old)
Teachers: Marie-Françoise Couvreur (science), Serge Bontemps (science)

Institut Saint-Jean-Baptiste (Wavre)
Type of school: Upper secondary school
Students involved: 40 (15 – 18 years old)
Teachers: Catherine Marlier (chemistry, biology, physics), Michèle Lepoutre (chemistry, biology, physics)

Lycée Martin V (Ottignies-Louvain-la-Neuve)
Type of school: Upper secondary school
Students involved: 40 (15 – 17 years old)
Teachers: Guy Wansard (science, geography), Raphaëlle Buxant (science)

Louvain-la-Neuve: coordinated by Nathalie Matthys. Creation of a platform with new interactive resources in chemistry (3D animations with the free open source software BLENDER) addressed to 15 year old pupils.

École Normale Catholique du Brabant Wallon (Louvain-la-Neuve)
Type of school: Normal school
Students involved: 20 (18 – 30 years old)
Teachers: Nathalie Matthys (chemistry), Laurent Gruber (science), Antoine Guillaume (science), Tiffany Vanbever (science)

3 Main obstacles to Students' Motivation to learn Chemistry

3.1 Reviewed national publications

Eight publications are available online:

a) Three publications originally in French and translated into English for the portal

- Internet to restore scientific vocations: the site Médiachimie (Paul Rigny)
- Findings: young people today in the U.S. and Europe are less attracted to science and there is a lack of motivation.
- Two solutions are proposed:
- -Changing programs for the teaching of chemistry (to start from objectives, from concrete reasons to learn chemistry) and adapting them to students, who speak and live "computer".
- -They must therefore be addressed differently using ICT and the Internet, to build a site, designed for teachers so they can find the supports to define the path from the objectives to disciplines and enhance it with articles or videos - in technical terms, with modern "resources".
- The disaffection of young people for scientific and technological fields - Diagnosis & remedies (A. Belleflamme, S. Graillon & M. Romainville)

Science has lost its aura and is now associated with health risks, mass destruction and environmental degradation. Moreover, young people choose their higher education based on two main factors: first, their interest in a particular discipline and, secondly, the idea they have about career prospects in this field. Therefore they prefer more fashionable course of studies. Young students still face negative stereotypes, such as "science is not for girls". It was observed that motivation for science is directly linked to the way it is taught and that the younger people are confronted with science the more interested they are; it is therefore suggested to rethink science education from top to bottom. A

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suggested idea to get young people interested in sciences is using current issues such as global warming and explaining how science and technologies can be a solution to the problem.

- The image of physical and chemical sciences in French upper secondary schools (François Alluin)

This publication addresses the image of science among French students, particularly in the last two years of secondary education, and among science teachers. It emerges that chemistry is considered as more entertaining and useful than physics, physics as difficult. According to students, chemistry is used to make experiments and physics is used to understand the world. Students like doing experiments, but not learning formulas. Most students consider that what they have learnt in science classes is useful in everyday life, but few keep themselves informed about science outside school. According to students, scientific studies require motivation, then seriousness and autonomy; for the teachers it requires motivation, rigour and curiosity.

b) Five publications originally in English and translated into French for the teachers:

- Nuffield Foundation's report on Science Education in Europe: "science education in Europe" (Conference article by Jonathan Osborne, Justin Dillon)

The main argument of the report is that schools' science education has never provided a satisfactory education for the majority, and that it should be re-imagined, among other to make it fit for the modern world and meet the needs of all students. Science education should be both about the major explanations of the material world and about the way science works. Students should be informed about careers in science and an emphasis must be put in science education before 14. Evidence suggests that this is best achieved through opportunities for extended investigative work and "hands-on" experimentation and not through a stress on the acquisition on canonical concepts. Teachers with appropriate up-to-date knowledge and skills are the foundation of any system of formal science education.

- Popularity and Relevance of Science Education Literacy: Using a Context-based Approach (newspaper/magazine article by Miia Rannikmäe, Moonika Teppo, Jack Holbrook)
- Promoting science and motivating students in the 21st century (web article by Marilyn Brodie)

These two articles address the importance of relevance for motivation and note that for many students science education is irrelevant, disconnected from everyday life. The first article considers that relevance is part of intrinsic motivation, motivation coming from the students themselves, and suggests using examples from everyday life to improve relevance and motivation.
The second article notes the absence of role models in science and suggests using the help of experts and PhD students to put science into context, mentioning two projects: "Researchers in Residence" and the "Express yourself conferences".

- Science Education in Europe: National Policies, Practices and Research (report by the Education, Audiovisual and Culture Executive Agency [EACEA P9 Eurydice])

This report compares strategies in European countries to raise interest and motivation. It analyses organizational features and the kinds of support available to teachers and schools to raise students' attitudes and interest for science and collects information on existing practices in the initial education of science teachers.

Some conclusions of the report:

Countries support many separate initiatives but overall strategies to improve science education are rare.

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The experimental approach in laboratory should be improved.
How to transform teaching to become more inquiry-oriented?
In teacher education, there are many national initiatives to help improve teachers' skills.
In initial teacher education, the curriculum should be adapted.
The different interests of boys and girls should be taken in to account.
Knowledge of the scientific world is inadequate.
School partnerships, science centres and similar institutions all contribute to teachers' informal learning and may give them valuable advice.

- S-Team: Firing up science education. What is enquiry-based science teaching? Changing the way science is taught (three web articles by S-Team)

These three articles focus on the importance of improving pupils' motivation, learning and attitudes, to increase science literacy and recruitment in science-based careers. They suggest doing it by enabling a large number of teachers to adopt inquiry-based and other effective teaching methods and by supporting teachers with innovative methods and research-based knowledge. These objectives can be summarized as pupil engagement, teacher empowerment and teacher education.
Europe must develop a common terminology and a common understanding of its basic ideas. There is no common definition of inquiry-based science teaching or any appropriate translations of the term in the national language of the participating countries.
The wide range of existing knowledge about how to teach science effectively must be used. This knowledge needs to be shared between teachers, schools, national systems and researchers.

3.2 Comments posted by Belgian teachers to non-national publications and papers

For lack of correct translation in French, the teachers had problems understanding papers and publications and using the teaching resources. The papers on the national situations were translated into French, which explains why the Belgian teachers only commented on papers.
They posted eight comments on four papers:

- Students' Motivation to Learn Chemistry: The Greek Case (Katerina Salta, Dionysios Koulougliotis, Technological Educational Institute [TEI] of Ionian Islands [Greece])

Belgian comments (3) consider the factors for (de)motivation are relevant and observe the same situation in Belgium regarding the complexity of the lessons, the demanding programme compared to the allocated time and the need for experimental approaches. The various suggestions to increase motivation are considered as relevant, although doubts are raised about the possibility to use interdisciplinarity (which would require a whole new organisation of the science courses).

- Current and Future Methodologies for Improving Teacher and Student Experiences of Chemistry in Schools: an Irish Perspective (Marie Walsh, Limerick Institute of Technology - Limerick ROI)

Belgian comments (2) disagree about the article. One regrets that the causes for demotivation are not clearly addressed and notes that the suggestions for solutions are aimed at decision-makers rather than to teachers. The other one notes similarities with the Belgian situation (lack of interest and awareness despite initiatives) and consider as relevant the difficulties encountered by the students (level of abstraction necessary to grasp the concepts). The initiative to make experiments mandatory is considered as interesting, it is noted that in Belgium several courses of study have a time slot for experiments but that experiments are not always possible due to the number of students per class and the lack of equipment. However, a maximum number of students was set. The results of this measure should be assessed in years to come.

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- X_Science: Communicating Science through Cinema and Science Fiction (Paolo Piccardo, Marilena Carnasciali, Piotr Swiątek, Karlheinz Steinmüller, Faculty of Sciences, University of Genoa [Italy]; FP7 National Contact Point Energy, PTJ/FZJ; Z_punkt GmbH The Foresight Company [Germany])

Belgian comments (2) observe the gap between science and society and the chance to fill this gap with films. This gap and the scientists' isolation are also seen as reasons for students' lack of motivation to study chemistry, and the films and TV series mentioned in the paper as an opportunity for an interdisciplinary approach and good suggestions to prepare a lesson based on them.

- The Problems of Chemistry and Science Teaching in Spain (Antonio Jesús Torres Gil, Colegio Santo Tomás de Villanueva, CECE [Spain])

The Belgian comment notes similarities between Spain and Belgium regarding teaching and most causes for demotivation. The causes for demotivation are relevant and the ideas for solution feasible, but no successful experiences are reported.

3.3 Comments posted by non-national teachers to Belgian publications and papers

The paper "*State of Art in Belgium: Students' Motivation*" was commented by three partners (from Greece, Ireland and Turkey).
The comments agree with the causes for demotivation (teaching methods, negative stereotypes, perceived lack of career prospects) and the ideas to make science more appealing, sometimes noting similarities with their own country.
The comments regret the lack of details and of concrete experiences to improve motivation; the fact that difficulties of the teachers to keep up to date are not addressed; the fact that the paper addresses science in general rather than chemistry.
The paper is seen as a summary of the situation and a starting point for further research.

Three publications received two comments each. Two of the publications address the link between relevance and motivation, and the irrelevance of science studies for the young.
The comments agree that science lessons should be made more relevant to increase their motivation (making links with the students' everyday life, using the help of scientists). The need to make science lessons less theoretical and more experimental and to improve the image of science and scientists (for instance using movies) are also agreed upon.

4 Analysis of Teaching Resources

Belgian teachers have not commented yet on non-national teaching resources because:

- Most resources are in English, which makes them difficult to understand and use.
- They are not related to the programme.
- They need to be judiciously integrated within a learning sequence.
- Testing in schools started in September 2012 and will go on throughout the school year.

4.1 Existing Teaching Resources

So far fifteen resources have been identified by Belgian experts. They have been on the database since September 2012. The analysis and testing in schools are being made by the teachers. The results will be relevant at the end of the school year, in June 2013.
The identified resources are divided into three categories:
I. Online animations / Modelling

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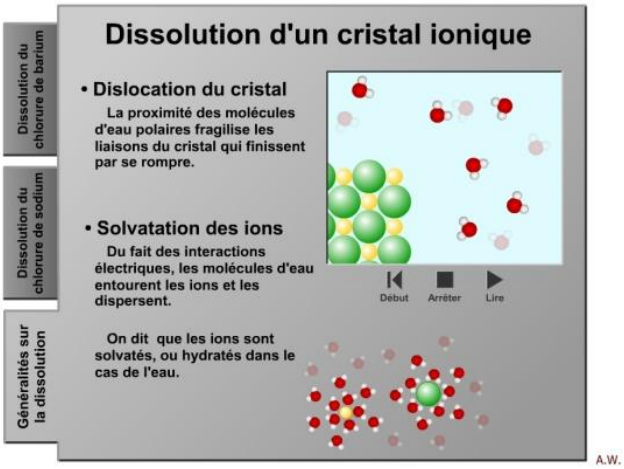
II. Downloadable softwares
III. Innovative applications: e-book, Screencast…

I. Online animations / Modelling
Animations help better understand phenomena that are often abstract for the student. The modelling makes it possible to review the different (macro, micro, and symbolic) levels that will have been discovered all along the sequence.

1. Ionic compound dissolution in water



(Fig. 1 Ionic compound dissolution)

This summary makes it possible to develop a systemic approach to the phenomenon of ionic compound dissolution in water. Indeed, the student perceives the different reading levels, which are often an impediment to learning. The most visual students will comprehend more easily the phenomena represented. It needs to be judiciously integrated within a learning sequence.
http://www.ostralo.net/3_animations/swf/dissolution.swf

2. Chemical reaction
The animation shows a model of typical chemical reaction: it shows the molecular shocks and the evolution of the quantities of reagents and product. Two parameters can be edited: the quantity of matter and the efficiency of the shocks.
http://www.ostralo.net/3_animations/swf/reaction_chocs.swf

Comment (from Portugal): *This digital resource is very good and very easy to use. It will allow complementing the theoretical information and be used to motivate students, breaking some monotony and turning the class more attractive to students. When this animation is used by students, it will allow the deepening of knowledge related to chemical reactions. It is an easier way for students to take conclusions then using the more traditional and theoretical approach. It is a fun way to learn chemistry.*

Other interesting online simulations on the ostralo website:

3. Chromatography of colorants used in medicines
With the help of the simulation the student has to carry out an efficient scientific approach in order to determine the dying composition of each type of capsule.

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5 Solution preparation

- Contents: preparation of solution and dilution, mass concentration.
- Aims: to master the concepts of concentration and dilution viewing the impact of the modification of the removed matters quantities and of the selected volumes on a solution colouration.
- http://www.ostralo.net/3_animations/swf/solution_massique.swf

5. Molecules anaglyphs
Online 3D animations
http://www.ostralo.net/3_animations/swf/molecule3D_Lunettes.swf

6. PCCLPhysics and Chemistry by a Clear Learning
This website contains many varied animations, simulations and exercises. The first asset of the animations is that they help better understand phenomena that are often abstract for the student. Indeed, certain animations make it possible to view the experimental scheme of an experiment directly in relation to the microscopic aspect of the phenomenon studied (such as the Daniell cell). The dynamic aspect of the phenomena at the macroscopic and microscopic levels is often taken into account (examples: the Daniell cell, electrolysis). There is a real concern to better understand the "invisible". With these tools a good synthesis of certain laboratory techniques can be made. However, those tools are also interesting for remediation. Indeed, to remember experimental skills, the student often only has at his/her disposal personal experiences in the laboratory and "paper" documents from the teacher. At home, those resources can help the student remember the correct movements to achieve certain precise manipulations.
http://physiquecollege.free.fr/
http://www.physics-chemistry-interactive-flash-animation.com/ (English version)
http://www.physics-chemistry-interactive-flash-animation.com/chemistry_interactive/daniell_cell.htm

Comment (from Ireland): *A useful resource. (…) The teacher could use it in the classroom and the students could also use it on their own for homework or directed study. Clear and simple, easy to understand. Not particularly innovative but very user-friendly. There are some items for lower secondary school level but the majority are for upper secondary school level.*

II. Downloadable software
1. Sagascience CNRS
Sagascience is a resource developed by the CNRS (French National Centre for Scientific Research) for the general audience as well as researchers, teachers and students. It is a collection of scientific files containing pictures, illustrations, films, learning animations, diagrams, models, interviews of researchers, bibliographies, a glossary, scientific articles and basic data.
The file on Lavoisier is a multimedia animation to discover the interesting personality of the father of modern chemistry.
http://www.cnrs.fr/cw/dossiers/saga.htm

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2. Pictograms and chemical products

(Fig.2. Pictograms and chemical products)

Prevention in the chemistry laboratory is essential to a secure experimental practice. Students must be made aware of safety instructions before the first lab work. One topic of the prevention is reflexive reading of the chemical products labels in the laboratory. On the labels are danger signs, the most visual elements on the label. Thanks to this resource the danger signs of chemical products regularly used in the laboratory can be discovered in an interactive way. Since currently used pictograms are being replaced by new ones (applied since 2010), this application is useful to make the transition easier.
http://www.pedagogie.ac-nantes.fr/1256120320884/0/fiche___ressourcepedagogique

3. ChemLab

This didactic tool is a virtual laboratory in which many experiences can be made (titrations, gravimetric analysis of chloride, gas compression, crude oil distillation, determination of specific heat lab, fractional crystallization and a generic laboratory are available on the demo version). This product is destined to teachers and pupils who do not have the necessary material in the laboratory and to disabled students who are unable to make life-size experiments.
http://modelscience.com/products_fr.html

4. Dozzzaqueux

Measurement curves simulation in aqueous solutions
http://jeanmarie.biansan.free.fr/dozzzaqueux.html

5. Pyacidobasic

Reactions of acid-base titrations simulator.
http://outilsphysiques.tuxfamily.org/pmwiki.php/Oppl/Pyacidobasic

6. Reaction

The tool is used to make a stoichiometric study of the progress of the chemical reaction.

III. Apple Applications

1. How to create molecules on a tablet (iPad…)

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Mobile HyperChem is an Apple App for iPhones, iPod Touches, and iPads to draw and create molecules yourself and manipulate them on the mobile device. Molecules can be saved as required on the mobile device's file system.
http://www.hyper.com/Products/iHyperChem/tabid/521/Default.aspx

2. Electronic book for tablet (iPad …)

- Read and watch an interactive video in the interactive book then solve the problem and watch the video (screencast) of the solving by the teacher.
- How to use it in class: homework or additional information.
- http://www.spaceteacher.org/Energy/Energy_intro.html

3. How to create quizzes or cloze tests with "hotpotatoes"

Two screencasts the aim of which is to help teachers creating cloze tests and quizzes for students.
http://www.spaceteacher.org/NTIC/Intro_NTIC.html

5.1 Creation of new ICT interactive sequences

I. Creation of new sequences associating the use of ICT, experiments and a systemic approach.
II. Training to create new sequences in chemistry for the interactive whiteboard.
III. Creation of a platform with new interactive resources in chemistry (3D animations with the free open source software BLENDER) addressed to 15 year old pupils.

I. How can the systemic approach optimise chemistry learning? What part can ICT have?

The first step of this innovative approach to chemistry learning, consisting in gathering themes among internship supervisors, is completed. Structuration of the standard lesson sequence has been established and the construction of the first theme will begin in 2013. Testing will then be carried out in the schools.
Education sciences learning is more efficient if the learners are involved. This premise infers that in a lesson sequence, the learner sometimes "takes over".
In a lecture, the teacher always keeps things under control, delivering his/her speech, stopping to answer a question, and resuming. When the lesson is really interactive, the process depends partly on the student's initiatives, is co-built. How can the teacher organise and manage such types of learning?
A situation in which all the participants cannot control all the parameters is said complex. The "science of complex situations" is the systems theory. It is used in many areas, from company management to psychotherapy. Could it structure an interactive learning of chemistry?

Project description

Internship supervisors gather the themes
A survey among field teachers made it possible to pinpoint relevant themes of chemistry learning, between the 3rd and the 6th year (15-18 years old).
3rd The concepts of molecule, atom and ion Chemical reaction
4th Stoichiometry & mole
Chemical bond
5th Thermodynamics
Chemical equilibrium
6th Redox
Acid-base
Lesson sequences building
Every theme will be related to a group of tasks. A lesson sequence for a continuing learning of the theme, developing skills related to the group of tasks using ICT to represent microscopic moments, will be built for every theme. The sequences will be integrated in a systemic approach
Validation of the sequences
Each sequence goes back to the originator field teachers. It is tested in the class.
Results dissemination

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The results of the works are sent to the other partner countries and added on the European portal.

II.Creation of new ICT interactive sequences for interactive whiteboard
Inforef organises with experts free trainings to create new sequences in chemistry: using the interactive whiteboard and modelling in addition to the experimental approach.
Two training days took place on the 3rd and 9th of December for ten educational advisors of SeGEC.
Trainings for teachers are scheduled on the 7th and 21st of March 2013.
http://www.inforef.be/pages/news_afficher.php?id_news=25

III. Creation of new ICT interactive sequences
Creation of the platform DIDAC-TIC addressed to 15 year old pupils. http://didac-tic.sk1.be/
Guidance to create lesson sequences and 3D animations with the free open source software BLENDER).

6 Workshop

The working group meeting on students' motivation took place the 26th of September in Liège. Around twenty teachers and all the Belgian experts in chemistry participated: two professors of chemistry at the University of Louvain-la-Neuve, two college trainers for teachers, one educational counsellor and official representative for Belgian education, one expert trainer in ICT, and one member of the Belgian Chemistry Association.
Two topics were developed:

7.1 Students' motivation

Discussion on the publications and papers added by the partners on the portal and reminding of the procedure to add comments.
Presentation of the national summary text made by the Belgian experts team (University of Louvain-la-Neuve) and debate with the participants.

7.2 ICT resources

Presentation of some of the existing resources selected and reviewed by the Belgian experts and teachers.
Exchanges on teachers' questions and expectations.
Several tools to meet their expectations:
Creation of new interactive resources with flash, 3D Screencast (ethanol fuel), tablet (creation of molecules); interactive book; e-learning platform.
It was also suggested to create new lesson sequences: how systematism can optimize chemistry learning? What part can ICT have?

Results of the workshop
After identifying and analysing the existing ICT resources it emerged that it is difficult to find didactic tools adapted to the students' level in the appropriate language.
Solutions are proposed to teachers in Belgium: creating new ICT resources with the technical help of Inforef's team. Several tools will be developed:

- To create new lessons associating the use of ICT, experiments and a systemic approach.
- To create new sequences in chemistry: using the interactive whiteboard and modelling in addition to the experimental approach.
- To create lesson sequences and 3D animations for 15 year old students. These tools are being created on the DIDAC-TIC platform http://didac-tic.sk1.be/.

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Cooperation between teachers and experts:
The experts supervise several professor groups are divided according to:

- the area (Liège or Louvain),
- the education level of the pupils (15 or 18) upon which the teachers' training depend (normal school or university),
- the objective of the working group: analysing existing teaching resources, creating new lesson sequences using the interactive whiteboard, the systemic approach and the platform "didac-tic".

(Fig. 3. Workshop)

8 Conclusions

Chemistry is a particularly complex science, in which beginners need support from an expert in order to:
1. Master the science jargon
2. Master it through experiments
3. Master it through the use of ICT

References

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