



518300-LLP-2011-IT-COMENIUS-CNW

## Virtual Meeting Networking Activity on “Successful Experiences”

Meeting held 10 April 2014, 15:00 – 17:00 CET

The video of the meeting is available on this Internet address:

<http://flashmeeting.e2bn.net/fm/4fd5e6-17249>

### Participants

#### Partners

Zlata Selak (Inforef), Julien Keutgen (Inforef), Murat Demirbaş (Kırıkkale University), Milena Koleva (Technical University of Gabrovo), Angel Anchev (Technical University of Gabrovo), Marcela Grecová (ICT Prague), Zdeněk Hrdlička (ICT Prague), Dionysios Koulougliotis (TEI of Ionian Islands), Selina Martin (CECE), Marie Walsh (Limerick Institute of Technology), Marilena Carnasciali (University of Genova), Magdalena Galaj (WSINF), Juraj Dubrava (TRANSFER Slovensko)

#### Teachers and Experts

Mária Dojčanová (Slovakia), Ömer Faruk Şen (Turkey), Elif Tuğçe Karakaca (Turkey), Hüseyin Miraç Pektaş (Turkey), Erdi Erdoğan (Turkey), Şengül Akıncı (Turkey), Erdem Hareket (Turkey), Alessandra Mulas (Belgium), Ilka Boyanova (Bulgaria), Maria Nikolova (Bulgaria), Galina Kirova (Bulgaria), Daniel Petkov (Bulgaria), Katiusha Stancheva (Bulgaria), Katerina Salta (Greece), John Koutelekos (Greece), Antonio Jesus Torres Gil (Spain), Rose Lawlor (Ireland), Michelle Starr (Ireland), Marco Rametta (Italy), Mariusz Jarocki (WSINF)

#### Minutes

As an introduction Professor Maria Maddalena Carnasciali introduced the agenda of the meeting .

#### Teachers' opinions

##### Belgian Teachers

The meeting took place at HELMo Sainte-Croix, Liège. It gathered experts, teachers and students (future teachers) from Liège and Louvain involved in the project “Chemistry is All Around Network”.

#### 1) Project activities:

Reminder of the main activities of the project: gathering interactive resources on chemistry and creating a European network to share good practices. The third year of the project is dedicated to successful experiences. Presentation of the relevant section on the portal and of the forms to be used by the teachers and experts: the guidelines to test the teaching resources and the comment form for international publications and papers. All the forms as well as a selection of publications were translated in French and made available on Inforef [website](#). Other documents (portal evaluation and testimonial forms) were also presented.





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## 2) ICT resources

### 2.1) MOOC – Fostering learning in the digital era

Laurent Gruber presented the concept of MOOC (Massive Open Online Courses) to the participants. The digital era changes our relation to knowledge; the teacher is no longer the sole source of information as students can find it on the Internet. MOOC are online platforms that provide courses to a very large audience. There are two general categories of MOOC. xMOOC maintain a passive transmissive approach to knowledge (texts, videos...) while cMOOC connect learners who can teach each other. More and more universities provide courses through MOOC.

Laurent Gruber then presented flipped classrooms with the support of an interactive platform, in which students prepare their lessons before seeing them in group in the classroom.

Using the potential of new MOOC environments, the digital platform (MOODLE, CLAROLINE...) will be a real SPACE for interactive learning activities aiming to develop skills based on delineated pedagogical scenarios. It will include specific educational resources: videos, presentations, guidelines, protocols, questionnaires, discussion forums, online innovative evaluation practices such as post-assessment strategies.

The platform will be the ideal support for the “flipped classroom” strategy: the transmissive part of teaching will be remote, with the help of technologies (online video, paper documents, exercises to prepare...) and activity-based learning and interactions will be “on-site”: discussions between the teacher and students and between peers, group projects, lab activities, debates...

The term “Flipped Classrooms” appeared around 2007 when two secondary school chemistry teachers, Jonathan Bergman and Aaron Sams discovered the potential of videos.

In so-called traditional education, students are given exercises, homework ... to apply the lesson previously received. Here, the strategy is flipped: the “lesson” takes place out of the classroom through different means and media and the classroom is used for exercises, applications and works. The aim is to drive the transmissive part away from the classroom to give it back its (co-)learning potential. Flipped classrooms reset and redevelop the traditional space-times of teaching and learning.

### 2.2) Examples of new learning sequences

- Discovery of the chemical reaction in flipped classroom through **the platform Claroline Connect** (for third year students)
- **“MOODLE: how can ICT support the investigative approach?”** Evaluation of a teaching resource through the platform MOODLE. First year science students at HELMo tested the resource “[Discovering the chemical reaction](#)” on the Interactive Whiteboard. According to the students, there were two main benefits: increasing their knowledge of the subject and learning how to use the IWB.
- **“Evaluation of ICT tools – an experience in England”**. Jerome Kariger, a third year science student who writes his dissertation on ICT in learning, travelled to Portsmouth and tested a resource with English secondary school students. The resource uses animations presented on the Interactive Whiteboard. He then submitted questionnaires to teachers and students to evaluate the resource. This trip also provided the opportunity to observe the technologies used in English schools and compare with the Belgian situation.
- **“Working group TIChimiE – Co-building learning scenarios using ICT”**. The working group TIChimiE gathers teachers and future teachers from different schools in Liège and its province. It is led by Divna Brajkovic, who presented their results. The working group was created thanks to two projects: the European project “Chemistry is All Around Network” and “École Numérique”, a Belgian initiative to fund projects that involve ICT in education (see [publication](#) in the database of the portal). The objective of this group is to create learning scenarios in a triple cooperation: 2<sup>nd</sup> year science students – internship supervisors – HELMo science teachers. These scenarios foster the investigative approach and integrate ICT. Four sub-groups





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work four topics: “atom models”, “photosynthesis”, “introduction to chemistry” and “statics – components of forces”. The groups work among other on the interactive whiteboard and tablets (received in the framework of the project “École Numérique”) and with the technical help of Inforef (which provides training and support). The working group TIChimiE will keep creating new ICT scenarios during the year 2014-2015.

- “There’s carbon, and then there’s carbon”: a riddle to solve on tablet, presented by Nathalie Matthys. Ms Matthys also showed the website [Didac-TIC](#), which contains tools to be used in science classes.
- Implementation of a grid to review the interactivity in the use of the interactive whiteboard, by Tanguy Pironet.

### 3) National synthesis on “Successful Experiences and Good Practices in Teaching Chemistry at School”

Presentation of the Belgian paper by its author, Divna Brajkovic. The paper presents the situation of ICT in French-speaking schools, explains how to introduce ICT in the investigative approach and presents several initiatives also addressed during this workshop.

#### 4) Conclusion:

1. Ressource testing is still under progress in Belgian schools
2. The construction of new learning sequences is going on:
  - on flipped classroom through the platform Caroline Connect
  - on evaluation with MOODLE
  - on the interactive whiteboard and tablets
3. Comments on partner publication are still coming and being translated.

### Bulgarian Teachers

Workshop on “Successful experience and good practice in teaching chemistry at school” under the Chemistry is all around Network Project was held on 14<sup>th</sup> of March 2014 in the conference room of the University Library of the Technical University of Gabrovo. It was attended by chemistry teachers from secondary schools associated of the Technical University - Gabrovo project, as well as representatives of universities and organizations as experts.

**Milena Koleva**, contact person for the project "Chemistry is all around Network" for TU - Gabrovo, presented the current and future activities under the 3th thematic area “Successful experience and good practice in teaching chemistry at school” as well as the commitment of teachers and experts in them.

During the first discussion teachers and experts presented their comments on publications and papers available on the section “Successful experience and good practice” of the project portal. Partners’ pedagogical experience described in publications as “Activity approaches by teaching chemistry - prove pedagogical experience from educational practice” (Slovak Republic), “Chemistry teachers inventions fair” and “High school science talents” (Czech Republic), “English for chemistry: film bank” (Poland), „A Science Teacher Education Course in a Science Centre: A Successful Strategy to Empower Teachers to Master Museum Resources Exploration?” (Portugal), “Design, development and implementation of a technology enhanced hybrid course on molecular symmetry: students’ outcomes and attitudes” (Greece), “Virtual chemistry laboratory: effect of constructivist learning environment” (Turkey) etc., considering possibility of its implementation in Bulgarian school education.





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#### Some of the comments:

- the lack of language skills (in English or German) limits the application of large number of existing interactive materials in chemistry due to the misconception of specific chemical terminology. Possible solution of the problem could be the combined education – such an approach could improve significantly the quality of chemistry teaching at school;
- because of the limited number of chemistry classes in Bulgaria there is no possibility for individual work with talented students. In fact that approach is the “future of education” and in this term the experience of Czech Republic is very interesting and innovative;
- the practice described in “Chemistry teachers inventions fair“ helps teachers to keep up with new teaching methods and to develop their own ways to apply this knowledge in the classroom; this experience is fully applicable in Bulgaria because Bulgarian teachers will have the similar opportunities to learn about the latest scientific advances and their application in practice.

According to both teachers and experts, among the partners' papers on successful experience available on the project portal [Cnopeд](#) the most interesting are “English for chemistry: film bank” (Poland), „On-line chemistry education for talented students” (Czech Republic).

During the second discussion teachers and experts commented some aspects of experimental testing of interactive materials, available on the project portal in the chemistry classes. They were carefully identified by chemistry teachers at the end of the second project, on the basis of criteria like school profile, level of students' knowledge, available technical equipment. Chemistry teachers approved products as PhET, Virtual chemical laboratory (<http://chemistry.dortikum.net>), <http://chemgeneration.com/bg/>, <http://www.learner.org/resources/series61.html>, <http://resursi.e-edu.bg/zmon/action/goToProgram?id=Prog9.908> etc.). Some problems related to organization of testing, development of additional methodological and supporting materials, systemizing and analyzing of testing results, and getting feedback from the students were also discussed. Possibility to test some chemistry video-lessons developed on the educational platform “Ucha.se” in all schools involved in the national project network was commented.

The second part of the meeting was organized as practical workshop on application of specific software in development of educational content. The workshop was held under the methodological guidance of assoc. prof. Milena Kirova from Sofia University, expert in audiovisual technologies – teachers divided in small groups, with the methodological and technical support of the experts tried to develop a small part of school lesson related to “Chemical bonds”, applying animation techniques.

#### At the end of the meeting participants agreed on the following:

1. Popularization of successful teaching experience and practices is a way to help the chemistry teachers in their efforts and contributes to restore the students' motivation to study Chemistry. In this sense Chemistry Network Project plays important role because trough the project network proved successful pedagogical experience and good practice to be shared with chemistry teachers from large number of schools in European countries.
2. Achievement of scientific literacy and development of key competences in natural sciences as final result is a complex process influenced by many important factors as: quality of educational plans and programs in terms of their volume and content; teacher's role and methodological skills - to present the educational content, to apply innovative approaches to involve students in the educational process, to work individually with talented students, etc.; adequate technical support etc. It is important to popularize successful







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experience not only in application of ICTs to present the educational content in attractive and understandable way (although it is obviously one of the preferable approaches to enhance students' interest to in chemistry) but this one related to development of methodological and didactic materials, evaluation of students' knowledge and teachers' training also.

3. Having in mind some specific features of Bulgarian education system, following partner's practice could be successfully implemented and contribute to motivate students to study chemistry:

- Close collaboration „Business – University - school” as instrument for motivation both students and teachers (good practice in Czech Republic and Poland) ;
- Development of internet-“bank” for exchange of tested in the practice interactive educational materials in chemistry, accessible by all chemistry teachers in Bulgaria;
- Personal work with talented students, like in Czech Republic;

4. Based on the school profile, available technical equipment and students' language skills, teachers defined as suitable for testing in chemistry classes 10 interactive materials as PhET, <http://chemgeneration.com/bg/>, <http://www.learner.org/resources/series61.html>, Virtual chemical laboratory (<http://chemistry.dortikum.net>), <http://resursi.e-edu.bg/zmon/action/goToProgram?id=Prog9.908> etc. With the methodological support of experts these materials will be experimentally tested and testing results will be summarized, analyzed and delivered to the other project partners. Experimental Chemistry lessons will be held across the network of schools associated with the project with the help of the “Ucha.se” administrators as a result of the various, attractive interactive materials available there.

## Czech teachers

Czech workshop related to Successful Experience was held on 29<sup>th</sup> January 2014 at ICT Prague. 15 secondary school teachers and one student of pedagogy took part. New, very interesting and actual topics and ideas were discussed.

The first part of the workshop was focused on different views of chemistry teaching. There were presented two contributions on Successful Experience in Chemistry Education, the first of them by Dr. Květoslava Stejskalová from the Academy of Sciences who presented their activities to support popularization of science, including the ones designed for pre-schoolers (prenatal age has not been involved to science popularization yet). The second lecture was organized by Mrs. Lada Macháčová, a teacher at Gymnázium Přerov, a high school having a very good reputation in chemistry teaching. She presented examples of Successful Experiences, e.g. students who took part at national Chemistry Olympiad. The presentations were followed by vast teachers' discussion focusing on the role of school science experiments and barriers for their implementation.

The end of the workshop was saved for a short questionnaire with following questions and answers:

1. *What made you most pleased during your teaching practise?*

- Students who have succeeded in science competitions and/or study chemistry at universities
- Good relationships with pupils/students
- Successful projects for students

2. *Your interesting experience from practice*

- Cooperation with science centres. Students can see what the real science is and get contacts with experts.



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### 3. Barriers to get new successful experiences

- Lack of interest and poor relationships with parents
- Students are afraid from failure
- Too much ICT (for example smart phones, MP3...)
- Legislation and lack of funds for laboratory equipment

### 4. What could help you to overcome the barriers?

- Greater support from the state and better communication with parents (more understanding)
- More science experiments, less ICT presentations
- A guide book for beginning chemistry teachers
- CIAAN project as a useful source of inspiration

## Greek Teachers

The Greek National Workshop on Successful Experiences and Good Practices in Chemistry Teaching took place on Saturday March 15<sup>th</sup> 2014. A total of 15 people (9 teachers and 6 scientific experts) participated in the three sessions of Workshop.

**In the first part of the workshop, there was a discussion on the topic: “What constitutes a successful experience in teaching chemistry?” based a) on the personal experiences and opinions of the participants and b) on the information provided by the Papers and Publications related to “Successful Experiences” in the project database.**

- It is important that the student is convinced that engaging in chemistry learning can be a rewarding experience and teachers have to make an effort to provide the reasons on why one should try to learn chemistry. For this reason, it constitutes a good practice to give emphasis on how scientific knowledge can be connected with everyday life experiences and to exploit interdisciplinarity between science-related fields such as physics, chemistry and biology
- Experience shows that a lesson introduction like a short activity which will attract students' attention and trigger motivation to learn, plays a significant role.
- A successful teaching approach is one that is well organized, that excites students' curiosity and keeps them interested but at the same time achieves significant learning outcomes. The fact that students show enhanced interest does not guarantee that they have also understood the material taught. The teaching practice must always be evaluated both by the teacher who should closely observe students' behaviour and test their performance and by getting feedback from the students themselves.
- In a successful teaching experience, there is strong interaction in-between students and between the students and the teacher. The student must have acquired competences in asking questions in finding ways to answer them. Engaging in practical activities (lab work) and working in small groups (2-3 people) with pre-assigned specific roles by the teacher are good teaching practices for achieving this goal.
- A large part of the discussion was devoted to the circumstances under which the cooperative teaching approach can be successful and the lack of culture of working as a team member in Greek society was pointed out.
- Some of the publication the participants referred to during the discussion were the following:





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- i) The publication entitled STEP (Czech Republic) which describes nine activities aiming at popularization of science and achieving more meaningful learning by trying to understand the reasons for learning something.
- ii) A Spanish publication which is related with an approach for teaching complex phenomena such as fluorescence and phosphorescence via the use of simple diagrams and pictures without involving strict mathematical formalism and
- iii) An Irish publication entitled “Engaging first year science students through a multidisciplinary approach”, in which the elements of multi-disciplinarity (physics, chemistry, biology) and cooperation provided overall a successful teaching approach.

**In the second session, participants were asked to have an open discussion and exchange of experiences and opinions on the testing in real classrooms of specific teaching resources available in the “Teaching Resources” section of the project portal.**

- The following teaching resources were presented by the teachers who tested them in their classes: ChemsSketch 12 Software, BBC School Science (GCSE level – Units related with fuels and polymers), Phet (applications on stoichiometry, atomic structure, chemical kinetics), Jmol, The Periodic Table of Videos, Chemical Compound of the Month.
- There was extensive discussion on the adaptation of the teaching resources for the use in class, difficulties encountered and students’ reactions. In regard with the adaptation teachers pointed out the use of worksheets, the discussion with the students of the English terminology (which in most cases acted as a motivating factor), some difficulties they encountered in their efforts to use simulations for teaching chemical kinetics concepts.
- In regard with students’ responses and learning outcomes the general conclusion was that overall there was positive feedback and that a careful organization of the material may lead to better learning outcomes than the traditional teaching approach. However, all teachers agreed that in the grades where the chemistry course taught plays a role for the students’ future career, students are reluctant in getting involved in alternative teaching approaches because they feel that they will not learn what is needed in order to perform well in the final exam.

**In the third and last session, participants were asked to make proposals of good teaching practices and to discuss on the conditions which are required for successful implementation of a novel teaching approach. The following basic issues were raised and discussed:**

- Lab work is considered a good teaching practice, however there exist different barriers (such as the limited teaching time and infrastructure, the pressure to the teacher for “covering the material”, the students’ perception for lab work as a simple game, the students’ interest solely in performing well in the national exams which so far do not include lab-related exam questions).
- Another proposed good practice is the appropriate incorporation in school chemistry of modern scientific analytical techniques (via collaboration with universities and research centers).
- The cooperative teaching approach, despite its difficulties in implementation, is considered a good practice which helps both the low and high achievement students at the same time.
- Two additional proposals of good teaching practices are the interdisciplinary teaching approach and the targeted use of ICT for teaching fundamental chemistry topics such as stereochemistry.
- There was extensive discussion on the possible advantages from the use of e-learning platforms based on the experience of one of the participating teachers. It was agreed that this technique helps the teacher get more easily feedback on the effectiveness of the teaching process.





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- Participants agreed that for the successful implementation of an alternative/novel teaching approach it is important that students are gradually trained to work with the fashion that is required from the specific approach.
- Finally, emphasis was put on the need of helping students focus their interest and effort in the understanding of the concept under study and avoid confusion and chaos in their mind. Very often students get overenthusiastic and believe that they can easily approach and explain everything. However, this can lead to the opposite effect, ie. aversion towards science. It has to be clear to the students that knowledge is built slowly and systematically.

## Spanish Teachers

The workshop on Teacher training under the Chemistry is all around Network Project was held on 1st April 2014 in Santo Tomás de Villanueva School in Granada. Twelve people, among them teachers (9) from various school levels and experts (3) were present.

During the meeting, participants were asked to discuss the following topics:

- Teachers' and experts' personal successful experiences
- Analysis of international papers and publications on successful experiences and good practices
- Analysis of testing of teaching resources made by partners (uploaded on the project portal)
- Discussion on teaching resources tested at national level (if already done)
- Planning of future/possible testing.

They came to a variety of conclusions:

### 1. Teachers' and experts' personal successful experiences

During the meeting university teachers and secondary teachers showed us educational experiences that have helped to improve students' motivation and meaningful learning. Some of these experiences were: cooperative learning based methodologies, laboratory experiences, organization and participation in science fairs, and the use of ICT resources in the classroom. The use of ICT resources in some schools has been in using electronic devices like digital tablets. These devices make digital textbooks and educational multimedia applications directly accessible to students. We looked at applications like 3D "Molecules Edit&Drill", designed to enable students to build, construct, modify and examine molecules in 3D. This application fosters learning experiences about chemical structures and isomers, and the students used it to create a databank of molecules.

Some teachers have been using social networks like Twitter as an instrument for motivating their students. Pupils and teachers have been publishing photos of their educational activities and laboratory experiences, as well as links to webs and videos about chemistry. Also, there is a facebook site about the project "Chemistry is all around network in Spain" that lets us share information among teachers about successful experiences and educational resources.

Some teachers are beginning to experiment a new teaching model named "the flipped classroom" that inverts traditional teaching methods, delivering instruction online outside of class and moving "homework" into the classroom. In this model, students watch lectures at home at their own pace, communicating with peers and teachers via online discussions and concept engagement takes place in the classroom with the help of the teacher. The traditional role of the teacher changes and the teacher turns into a guide of students learning. Some examples of brief explanations that have been used within this approach can be found in some videoblogs like "Veritasium", "Minute Physics" and "Minute Earth".







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Teaching of inorganic chemical nomenclature was one of the main topics of discussion during the meeting. One of the experts, Manuel Fernández, whose research is about Science Education, has recently written a paper about the teaching of inorganic chemical nomenclature. This expert supports a reduction of learning contents, teaching only familiar and everyday compounds to avoid pupils' demotivation and overall rejection of chemical contents. Teachers felt that it was an interesting paper and suggested including it in the publications section of the project portal.

## 2. Analysis of international papers and publications on successful experiences and good practices

Most of the papers and publications commented on by teachers and experts were those that were written in Spanish. These publications dealt with use of ICT resources in the classroom and educational approaches based on a constructivist interpretation of teaching and learning: contextual science, STS contents, inquiry and argumentation in the classroom, experiments about everyday chemistry and recreational chemistry, cooperative learning, etc.

All the teachers and experts agreed on the importance of ICT resources. We can find ICT resources in virtual labs in applications about visualization of molecules and videos about chemistry lectures. There was unanimity on the need for laboratory experiences, but they are not effective under all circumstances, because it is necessary to prepare such experiences by giving the students a conceptual basis that link to science laboratory instruction.

University and secondary teachers agreed that a methodological change must be accompanied by a lower teacher-student ratio, given that nowadays all of them have too many students and they can't apply non-traditional teaching approaches. Furthermore, the university admission tests are designed with a traditional approach that does not promote new teaching methodologies.

## 3. Analysis of testing of teaching resources

Some teaching resources in the Chemistry is all Around Network portal have been used by some teachers and some group of students. Three of the most useful resources suggested are:

### **FQ-Experimentos (FQ-experiments), by Fernando Díaz Escalera.**

This resource proposes activities about problem based learning and propose simple experiments that pupils can watch in video-records. This resource has been used to support physics and chemistry learning in 4<sup>o</sup> course of compulsory secondary education, with very satisfactory results. The use of this resource in particular improved student motivation.

### **Iniciación interactiva a la materia (interactive incitation to matter), by Mariano Gaité Cuesta.**

This resource has been applied in 1<sup>o</sup> course of baccalaureate during the didactic unit about atomic models and elemental particles. Its application in the classroom has been developed with the use of digital tablets and the students evaluation has been positive.

### **Tabla periódica de los elementos (periodic table of elements), by Benito Navarro.**

This resource has been applied in some schools by a cooperative learning activity which consisted in building a giant periodic table during the science fair in the school. It is a resource that has been valued positively by teachers and students. This website shows us several ways to classify chemical elements depending on different criteria.





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We have planned the future evaluation of portal resources in several schools. This evaluation is still pending and it will be organized in the near future, and the schools involved will communicate with each other by email.

## Irish Teachers

The Workshop on Successful Experiences took place in Limerick Institute of Technology on Wednesday March 26<sup>th</sup> 2014.

The attendees included teachers, experts and associate partners.

The meeting was started by Marie Walsh who gave an overview of the project to date. This included a report on the conference and meetings in Limerick and the requirements for this phase of the project.

It was noted that the website needs to be kept more up to date. Information relating to the meeting in Limerick is still on the homepage. Information should now be available for the meeting in Portugal.

Then followed a roundtable about the description of resources reviewed by each participant. Where possible the items reviewed were displayed on the screen to illustrate their usefulness. General points that emerged included:

- The large number of different resources – this is a testament to the amount of work done collecting these but there is still room for improvement on accessibility on the project portal.
- Usefulness of some interactive resources that included virtual experiments, quizzes and so on.

The teachers and experts had reviewed publications and papers from nearly every other partner country. These included resources on:

- Using videos in the Chemistry class
- Activities using Hydrogen Peroxide
- Successful experience in Primary School Science Education
- Teaching Chemistry at school - 'Granny's Chest'.
- Digital simulation and experimental activities in physics and chemistry
- Planning and Realisation Concept of the Inquiry – Based Science Education in Science Education
- Pre-school science education in Portugal
- English for Chemistry: FILM BANK
- Fostering the use of ICT in Pedagogical Practices in Science Education
- Chemistry Education – The Relevance of Innovative Pedagogical Practices in the early years
- Teaching Chemistry with a new cooperative model in the
- 3D visualization types in multimedia applications for science learning
- European ICT survey for schools
- Experiences in the laboratory for the gaseous media in the lower school
- Cooperative work in Science lessons
- Activity approaches for teaching Chemistry
- TALNET- Project for inquisitive youth
- A Science Teacher Education Course in a Science Centre: A Successful Strategy to Empower Teachers to Master Museum Resources Exploration?





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- Chemistry in the Kitchen
- 'Earth belongs to all of us'
- A paper from Greece 'Exploring the phenomena of 'change of phase' of pure substances using the Microcomputer-based laboratory (MBL)
- Some strategies to improve performance in school chemistry, based on two cognitive factors by Eleni Danili & Norman Reid
- Fluorescence: an Interdisciplinary Phenomenon for Different Education Levels

As each of these was described or demonstrated, it became clear that interactivity and blended learning were important. There was a discussion relating to the use of Virtual Laboratories and how they could possibly complement the actual laboratory experiences. There was a lot of discussion about virtual laboratories and simulations. Some of the teachers demonstrated resources they have used in the classroom or for revision or homework activities. Some of the resources gave useful worksheets or protocols that contributed even more to their usefulness.

It was noted during the discussion and in the subsequent group work that the *Chemistry is all around us project* has a very attractive portal and very useful teaching and learning modules.

Workshop members broke into groups and discussed how they have used materials available on the portal:

Group 1:

School level – Primary

Area of syllabus: Changes of state.

Resource used: [www.planet-science.com](http://www.planet-science.com)

How resources are used: The website listed above includes videos as stimulus to engage, interactive games relating to the concepts and suggested activities to develop the concept of changes of state at primary level.

Group 2:

School level – Upper secondary

Area of syllabus: Environmental Chemistry (water, pH, acids and bases, atmospheric chemistry)

Resource used: [www.chemistry-is.eu](http://www.chemistry-is.eu) (Chemistry and the Environment)

How resources are used: The website listed above includes videos, multiple choice question quizzes, useful links to other resources and instructions for practical activities to enhance the teaching of the concept.

Group 3:

School level – lower secondary

Area of syllabus: Atomic structure and Periodic table

Resource used: 50 really cool online tools for science teachers & [www.scienceunleashed.ie](http://www.scienceunleashed.ie)

How resources are used: atom builder, sub atomic particles, uses of the different elements, Salk's periodic table on the portal is very useful.

Each group presented the resources they would use and put them in the context of a lesson sequence.

This activity was followed by a general discussion on resources and successful experiences. Once again the RSC Learn Chemistry portal was cited as being a source of a myriad of resources for all levels and teaching approaches. ([www.RSC.org/learn-Chemistry](http://www.RSC.org/learn-Chemistry)). The precursor project *Chemistry is all around us* with its





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teaching units was once again praised for its content. The comparison in terms of attractiveness of the two portals was noted.

Some of the teachers spoke about the reactions of their students to particular resources. Marie Walsh gathered surveys from students and teachers that will be summarised at a later date.

The meeting ended with the collection of the portal evaluation questionnaires.

The participants were thanked for their on-going commitment to the project.

### Italian Teachers

The workshop on "Successful experiences" took place in March, the 26th at the Department of Chemistry and Industrial Chemistry of Genoa and involved 13 people including experts and teachers.

As the previous workshops highlighted some difficulties by teachers in teaching chemistry, we have transferred their suggestions in some activities of the National Plan project Scientific Degrees (PLS)-Chemical Area in order to give a concrete answer to the needs expressed in the framework of the European project (EP).

So we started the workshop presenting two of them:

- the first PLS activity is a course held by Prof. Alberto Regis, who is one of our experts and is a training Chemistry teachers in his life. The training course is about the chemical bond and the teachers involved prepare worksheets with the collaboration of Prof. Regis: the aim is to learn how to build by themselves the tools they will use;

- the second PLS task is about using ICT in teaching Chemistry: for this task has been chosen the site [tavolaperiodica.it](http://tavolaperiodica.it) that is introduced to secondary school students during a two-hour lesson in a computer classroom.

The initiative is showing a positive effect on teachers, who claim to have received many suggestions and the urge to introduce [tavolaperiodica.it](http://tavolaperiodica.it) in their own teaching.

During the afternoon session of the workshop, the participants were divided into 2 groups. The composition of each group was not accidental but chosen in order to have an expert and at least one exponent for each grade of school.

The first group discussed the properties of substances (simple and compound), and examined it vertically through the experience of the participants.

The second group discussed the topic of food: also in this case through the experience of participants. Marco Rametta (upper secondary school), recommended a molecular modeling software, ArgusLab, very useful to understand, for example, the structure of proteins. At the conclusion of the discussions, both groups listed the pros and cons of the tools used.

They agree that:







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- digital tools should be interactive, so as to stimulate the active involvement of the student
- a digital tool can not be an instrument of self-learning: it can not replace the teacher and can not replace the laboratory, but it can be a deepening or a help for students with special educational needs
- it is better to use a digital instrument that deals with few concepts in a clear and focused way
- digital resources can and should be interdisciplinary tools; for example, to learn foreign languages while studying science and vice versa
- attention to the representations of the microscopic level, that digital resources offer: they are powerful tools but they must be adapted to the user's level or they risk to distort completely what you want to convey.

On the basis of the above considerations, experts and teachers discussed about the possibility of performing a teaching resource, as future and concluding work of the project. The resource should be organized in three levels of deepening and modeling:

1. suitable for primary school
2. suitable for lower secondary school
3. suitable for upper secondary school

It should include simulations with possibility of choosing among more variables and interactive questionnaires. The subject of the resource has been chosen considering the most dealt topics at school, the need of verticality starting from primary school and the personal experience of the participants.

Accordingly, the agreed topic was SOLUBILITY.

## **Polish Teachers**

The workshop was attended by 12 participants. 5 of them were project Chemistry experts and 5 Chemistry teachers. 2 other participants were WSIU representatives Magdalena Gałaj and Aneta Orska. Below there is a list of experts and teachers involved in the workshop activities.

### **Objectives of the workshop**

The main objective of the workshop was to discuss the issues and activities already realized and to be achieved in the third year of the Chemistry is All Around Network project.

The workshop was also intended to involve teachers and experts into further project activities related to planning, designing, implementing and disseminating resources and materials collected on the portal by the project's consortium. What is more, the objective of the workshop was to introduce teachers and experts to final activities of the project i.e. two international conferences (Braganza and Genoa), as well as to discuss final outcomes of the project and its sustainability.

### **Workshop Organization**

The workshop was organized on 1 April 2014 at 8:00-12:00. It was agreed that the needed cooperation and exchange of information will be done by e-mail prior to the workshop. The workshop was participated by quite a small number of experts and teachers. We managed to invite and introduce a few new teachers to the project who agreed to join us and help us evaluate final products.

The workshop was moderated by Magdalena Gałaj WSIU and the main expert conducting the workshop was dr Mariusz Jarocki. The workshop took place at the premises of the Foreign Languages Department, in the classroom equipped with a whiteboard for better visualization of the portal contents. Each participant had his





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or her own laptop for more convenient and effective workflow. During the workshop teachers and experts received all the necessary materials about the project requirements to facilitate project work.

### **Delivery of the contents**

The workshop started with a brief introduction by Magdalena Gałaj, where teachers and experts were quickly reminded about the project activities and once again reminded about the deadlines. Teachers were introduced to the contents of the portal briefly and asked to study it on their own back home in order to complete the evaluation questionnaire. Due to the fact that WSIU is lagging behind with a few activities new dates were discussed and tasks assigned to new teachers and experts.

The main part of the workshop was occupied by presenting the portal resources with reference to materials, papers and articles with reference to Successful Experiences in teaching and learning chemistry. Participants were also able to discuss the Polish situation with reference to teaching and educating prospective teachers of chemistry and motivating young people to study the subject further on their own.

Prior to the workshop each teacher and expert was asked to think of their most successful best practices implemented in their classrooms.

Then dr Mariusz Jarocki took over with a presentation of a few most interesting resources collected on the portal. Dr Jarocki started with a short presentation of the Polish situation to let everybody realize the availability of the resources online. He briefly reminded websites and objectives of all of the collected resources and initiatives in Poland. Dr Jarocki referred to the resources described in his paper, which is going to be presented during the 5<sup>th</sup> International project conference in Braganza, Portugal.

### **Examples of good practices discussed during the workshop:**

#### **1/ Initiatives of Universities and Polytechnics**

**a/ Jagiellonian University** – A language course for chemistry students and teachers - <http://www.efch.jcj.uj.edu.pl>

English for Chemistry: Film Bank is a non-profit project, aiming to provide materials for teaching English for Specific Purposes at B2 level in accordance with the Common European Framework of Reference to the students of the Faculty of Chemistry at the Jagiellonian University in Kraków.

The project was conducted in the academic year 2010/11 by third year students of this faculty under the supervision of Dorota Klimek, a teacher of English at the Jagiellonian Language Centre.

The film bank includes a set of listening comprehension exercises based on films concerning a variety of chemistry subjects, carefully selected from the multitude of materials available on the Internet. The films are accompanied by a follow-up section, consisting of complementary reading and vocabulary exercises. The materials can be used in the classroom and for self-study purposes alike. The files are also available as printable pdfs.

The course aims to bridge the gap in the Polish Chemistry Teacher's education and qualifications with reference to language training so needed in order to use materials available in English language versions.

**b/ Higher education institutions in Poland** are quite active in promoting learning and teaching chemistry in an interesting and innovative way. In the current academic year, Jagiellonian University in Cracow Department of Chemistry invites pupils and students of secondary schools to participate in *Meetings with interesting chemistry, Cryogenic Demonstrations, Workshops for high school graduates - "Last call before Matura exam"* ; *Lectures on "Chemistry has many names"*. The above listed are only a few among many exciting initiatives for young people, whose main objective is to increase awareness of the society and promote better





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comprehension of science oriented subjects. Similar initiatives are promoted by University of Lodz, University of Warsaw, Technical University of Lodz and many others.

## 2/ Initiatives of Chemical businesses and industry

**a/** The chemical portal [www.poczujchemie.pl](http://www.poczujchemie.pl), the main result of the project by PKN ORLEN Chemical Plant, as interactive, dynamic, with a modern graphic design, stands out from the other solutions suggested by chemical business. The portal included presentations of experiences and interactive learning tools. The novelty consists of competitions with prizes (including non-virtual), often organized by the exchange of multimedia records of chemical experiences. The pioneer feature is also a formula for direct contact of schools with 'mobile' experts, 'experts on the road' who promote not only the chemistry as it is, but also through loosely related activities available through the portal. The portal gathered many experts who interact with users on blogs and forums. Many of these experts are PKN ORLEN scholars who stand out not only due to their knowledge, but also due to pro-social attitudes. The portal has an additional interface for mobile devices. In this version of the site the authors abandon a typical professional hierarchy, known from other information portals for a loose convention of the computer game.

**b/** Chemical Plant "Police" co-operates with schools and universities from the West Pomeranian region, which include: University of Szczecin, West Pomeranian University of Technology, Maritime Academy, and West Pomeranian Business School. Among many partner universities are also Poznan University of Technology, Warsaw University and Warsaw School of Economics. Cooperation with schools and universities is based on long-term contracts on the basis of organized programs and internships in the company in order to prepare students and prospective teachers for their work either in the chemical or educational sector.

## 3/ Initiatives collected and available online

**a/** "Baza Narzędzi Dydaktycznych" is the best example of an online database of resources for both teaching and learning chemistry in Poland. It offers a variety of tasks within the subject of chemistry, physics, mathematics and humanities with comments and answer keys. The intention of this initiative was to support teachers who endeavor to make teaching and learning chemistry at school more interesting. The authors of the portal were encouraged and inspired by the results of recent studies indicating that young people are more likely to go to school today than five years ago. New core curriculum of general education tends to go from memory learning, „learning for the test”, the repetition of algorithms and „chaining dates.” The initiative wants to promote the new systematic approach towards teaching critical thinking, reasoning, and logical thinking skills. The whole portal offers proven ideas and sets of tasks in chemistry and physics which can be useful for conducting interesting classes in these subjects. The portal authors invite educators, teachers, and teacher trainers to add to the tasks discussed. The portal's main objective is to serve as a source of inspiration not only for teachers but also for students across disciplines and parents who want better education for their children; education which is more attractive for them, awakening their imagination and ability to think independently.

**b/** "Projekt Gimnazjalny Akademii Uczniowskiej" an online database full of lesson plans and ready-to-implement solutions based on the conduct of experiments, observations, learning games and activities with the problematic question. Various scenarios of projects equipped with tailored lesson plans were developed by teachers and students and validated by experts as a good practice of science teaching in the modern Polish classroom. Teachers, actively involved in the project, participated in the *Akademia uczniowska* course on "experimentation and mutual learning". All lesson plans collected in the database include the following issues





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formulated by the students: needs analysis, research questions, hypotheses, description of the students' experiences, planned and carried out projects designed Mutual Learning, educational games and evaluation.

### **The reaction of teachers and experts**

Teachers and experts were generally quite positive about the contents of the workshop. Technology mattered here a lot as some teachers complained about poor internet connection at home when they wanted to upload their comments. Teachers appreciated the Polish language version of the portal. Dr Jarocki pointed out the functionality of the resources but also stressed the fact there is a huge demand for young teachers and experts to be able to create their own interactive materials. This would of course have to involve a change in the training of prospective teachers so that on completion of their training or university course they will be able to design and create their own materials with the least effort and time. Such materials would give teacher freedom to select the most interesting content to be introduced to his or her students, as well as will allow them to adapt it to the learners needs – from the most talented to the weakest ones. The teachers pointed out poor chemistry lab infrastructure. Access to latest technologies during the lesson is possible only in schools with computer-equipped or white-board-equipped classrooms. Another problem was, which was discussed during previous workshops was the language barrier. Interactive resources could only be implemented fully when the teacher and his or her students are able to understand and explain the chemical processes fully. In Polish reality students may have fewer problems to understand the technical concepts. This could be both a disadvantage and advantage. Mainly due to the fact that thanks to materials available in the foreign language versions both students and teachers can develop linguistically. Of course for a busy teacher of chemistry is mean more preparation and work prior to the lesson. Further discussion during the workshop also tackled the issues related to chemical industry involvement into the learning and teaching processes both in lower-secondary and secondary schools, as well as universities. For example the organization of internship programs for most talented students at university level or conducting interesting lessons in the chemical plant labs in order to facilitate young learners' interest in chemical phenomena in everyday life.

### **Skills Acquired**

Teachers and experts were briefly acquainted with the contents of the portal with reference to successful experiences, all the resources available there and new teachers were introduced to their roles in further project assignments.

### **The evaluation of the portal**

Evaluation of the portal was not carried out during the workshop. The questionnaires about the portal were distributed to all the participants and questions were briefly discussed. The results will be collected from each of the experts and teachers by WSIU representatives and the report will be produced at the later time.

## **Slovak Teachers**

Slovak National Workshop took place on 26.3. in Bratislava in headquarter of TRANSFER Slovensko. 12 teachers of chemistry from elementary schools and from high schools participated at this workshop. In comparison with the original group there were three more teachers of chemistry from secondary vocational schools in Nitra and Prešov. The workshop started at 8.30 in the morning and ended at 16.00.

Thematically it was divided into two parts:

### **1. Discussion dedicated to lectures and publications published on the project's web page.**







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All the participants discussed to the first topic, during this discussion they appreciated all the lectures and very good outline of publications dedicated to successful experiences in teaching chemistry. The first interesting lecture was from the Czech Republic which provided review of all successful experiences focused on various competitions, activities, portals, Olympiad etc. All teachers appreciated these information mainly because of the fact that many of these activities is done also at Slovakia. Polish lecture was very innovative in the means of tools for better motivation of students towards chemistry. Spanish contribution about cooperative learning was also interesting. Teachers discussed also about interesting Belgian report about use of ICT technologies during teaching chemistry and about digital school. Slovak publications in which were teachers interested were the ones which explained chemistry in unusual way. They discussed mainly about publications as Chemistry and Cooking, Olives in salmonia and fruit in syrup, 3D visualisation types in multimedia applications in science education and New games in chemistry for attractive chemistry education.

## 2. Current problems in teaching chemistry and natural sciences at Slovak primary and secondary schools

Katarina Javorova from Department of Didactic and in Science presented short output which OECD published few weeks ago results of project PISA – the biggest and the most important international research in the area of measurements of education results, which takes place all over the world. In solving problems Slovak students achieved average result which was 483 points. These results are significantly lower than average results in other OECD countries. Result of Slovak students in mathematical literacy of international study PISA 2012 is under the average of countries which participated in this project. Results similar to Slovak ones reached countries as Norway, Portugal, Italy, Spain, Russian Federation, the United States of America, Lithuania, Sweden and Hungary. From OECD countries only 5 of them reached lower results than Slovak republic – Israel, Greece, Turkey, Chile and Mexico.

Results of Slovak students in natural sciences literacy is under the average of countries of OECD. Results similar to Slovak Republic were reached in Iceland, Dubai (SAE), Israel, Greece and Turkey. Significantly lower results than Slovak republic from OECD countries reached Chile and Mexico.

Results of Slovak students in the fifth cycle of international study PISA are not satisfying. In every studied area, whether it was mathematical, scientific or reading there was a significant decrease in results of Slovak students. It is the first time when results of Slovak students in all three areas are significantly lower than average results of OECD countries. Teachers agreed that the results are alarming and that it is needed to add scientific lessons as well as lessons of mathematics which were lowered in past.

Ministry of Education of Slovak Republic wants to empower teaching of mathematics and scientific subjects, this information appeared in medias on 25.8.2013: According to the proposal of Ministry of Education there should be added lessons of mathematics, biology, physics and chemistry in timetables of students. On the one hand students should spend more time with calculations on the other hand there will be lowered lesson dotation of other subjects. Teachers think that it will be at the expense of foreign languages.

**Increase in science lessons at primary and secondary schools. Proposal for chemistry:** Elementary schools – from 4 lessons to 5, Secondary schools – from 5 lessons to 6. All teachers discuss about this number of lessons and about new curriculum.

Published proposal lacks samples of curriculum for 8-year grammar schools and it is not clear what will be and what won't be in the curriculum for elementary schools.

Nowadays the teaching conditions for teaching of scientific subjects got better, thanks to EU projects the school chemical laboratories were newly furnished, classes have new modern technologies (mainly interactive boards). New teaching principles and methods started to be practised – exploratory method, IBSE research





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conception, project teaching and digital pH – metres became very popular in teaching chemistry (Vernier, IP COACH etc.).

Big discussion was about decision that teachers could share their experiences with students of teaching in combination with chemistry during three semesters (in years 2012 – 2014) within the project *Incubator of innovative teachers of scientific subjects at elementary and secondary schools* (KEGA Project n. 035UK-4/2012). We realised more than 20 professional lectures connected with seminars and workshops for students of Faculty of Science UK. Students were presented experiences from years of pedagogical practice of innovative teachers of elementary and secondary schools.

Initiators of project plan to continue in realisation of professional psycho-pedagogical lectures, seminars, workshops and prepare new activities. They want to make available new trends in chemistry teaching for students of teaching subjects in combination with chemistry and by this way they want to connect theory with practice.

Teachers could share their experiences with teaching of chemistry at elementary and secondary schools at 1. and 2.national conference organised by civic association - Association of chemistry teachers (ZUCH) in February 2013 and 2014. In this programme were presented previews of innovative approaches and particular chemistry lessons, new textbooks for grammar schools were presented and some serious problems which bother teachers were discussed (insufficient dotation for chemistry lessons, school reform and its impact on education, preparation on chemistry Olympiad and work with talented students, chemistry laboratories and their equipment, support of scientific education and how to make teaching of scientific subjects more attractive and etc.).

Teachers at Slovak schools try to make some changes and know how to teach „good“ but they need also support from school leadership, municipal offices, National Education Office and mainly from Ministry of Education. It is needed to end the reform, make new curriculum and textbooks, to state what has to be taught (in which year) and let teachers (school) to teach in their way.

## Turkish Teachers

In the meeting room of Education Faculty of Kirikkale University, The Workshop had been done by eleven participants including experts, academicians and teachers on Wednesday April second 2014.

The meeting was started with the knowledgeable conversation which was done by Dr. Murat Demirbas. In this meeting, Dr.Murat Demirbas gave general information about the project.

At the first part of the meeting, the importance of chemistry teaching and problems in concepts teaching was discussed by participants. As a result of discussions, we can say;

The aim of science education is teaching students the right ways of getting scientific knowledge and improving students' scientific understandings. With this way, students are expected to become science literate.

It is seen that different approaches are being implemented to students in the process of achieving the scientific knowledge. Positivist thinking approach is one of these kinds.

With this approach the target for students is reaching the objective knowledge with using inductive and deductive methods. Meaningful learning and teaching with discovery comes to the forefront in positivist approach. In meaningful learning, the connections between the concepts come into prominence and deductive





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approach is being used. At the same time, in discovery learning students are being expected to achieve objective knowledge with using inductive approach.

Today students are intended for approaching the phenomenon as a scientist for getting subjective knowledge. In this regard, students can fall into some misconceptions while creating their own scientific knowledge. In this respect, determining and rectifying these misconceptions become crucial.

Chemistry education which takes part in science education has important relationship with other as disciplines and therefore, it has significance importance in science. Chemistry is seen difficult by educators, researchers and chemistry teachers. The reason this difficulty comes from the abstract nature of concepts and also the symbols and equations that used in chemistry. With parallel to this, so many research results indicates that there has been difficulties in teaching so many concepts in chemistry and at the end of the teaching process misconceptions and misunderstandings of concepts has been identified in students (Taber, 1997; Boo, 1998; Tan and Treagust, 1999; Nicoll 2001; Piquette and Heikkinen, 2005;cited; Doymuş and Şimşek, 2007).

### Using Concept Caricatures in Chemistry Teaching

In teaching of chemistry subjects, concept caricatures take an important place. It can be said that usage of concept caricatures are done in two different ways:

- In the first approach, teachers construct concept caricatures and give students work sheets.
- In the second approach, students are given a specific topic. Then, students prepare concept caricatures about the topic.

It is known that the second way is more used. This approach is said as more effective in reducing misconceptions. A study which is related to construction students' knowledge correctly, (Öztuna Kaplan and Boyacıoğlu, 2013) links between atoms are resembled to blood links.

When such types of studies are examined, it is seen that students can embody concept correctly. As a result of the study, it is seen that students can learn topics effectively. Thus, it can be said that concept caricatures are successful methods in teaching. Because of this reason, they can be used in teaching more frequently.

### Using Analogies In Chemistry Teaching

Another way in chemistry teaching to provide students with effective learning is analogies. (Bilgin and Geban, 2001). Important points in applying this method can be ordered as:

- Analogies should be determined according to topic
- Analogies should be related to students' prior knowledge
- Analogies should be constructed from known to unknown
- The link between analog and goal of the course should be constructed by students

Another important thing in analogy teaching is that teachers should give importance on "breaking points" to prevent misconceptions.

### Using Experimental Process in Chemistry Teaching

The presence of experimental applications is an essential element of chemistry education. It is essential role for both teachers and students in learning and teaching in order to construct meaningful learning. For effective chemistry laboratory application, scientific process skills (SPS) should be integrated to learning process. Laboratories should not only serve the aim of reinforcing theoretical knowledge, but they should also allow students to discover knowledge on their own. Therefore, there is a need that laboratory application should engage students in using SPS such as;





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- Problem analysis
- Research plans
- Research management
- Data recording
- Interpretation of findings to construct and organize their own learning

The study (Feyzioğlu, 2009) shows that there is a positive relation between SPS taught in laboratory applications meaningful learning and students' achievement. Therefore, laboratory applications with SPS should be employed for more effective chemistry education and meaningful learning.

To employed daily life experiment in chemistry lesson is also essential factor for meaningful learning. Especially science topics should be related to daily life in order to activate student's interest, curiosity about the content and meaningful learning. Also, teachers should design learning environment that students enable to use their knowledge in order to understand daily life events. For example, teachers can ask students whether they observe any color change when adding lemon juice to the cabbage salad in acid-base lessons and then they discuss the reasons of color change. Therefore, students can learn and remember new information best when it is linked to daily life.

### **Questioning Approach in Chemistry Teaching**

Questioning takes important place for students' learning in chemistry teaching. In this respect, students should be active participants in learning environments. Some of active teaching methods are project based teaching style and principle based teaching. Students try to solve problem cases with group work in these kinds of methods. Besides, students can develop new designs and proper activities related to their topics with projects. Thus, students will gain lot of skills and provide meaningful learning.

### **Using ICT In Chemistry Teaching**

Chemistry teaching has a lot of abstract concepts. Particularly, it is very important that embody the abstract concepts in molecular structure topics. In this respect, ICT applications should be use. But, while ICT applications are used, it is paid attention that use computer supported applications and get supported with tangible applications. Thus, we can say that students will learn the topics effectively.

If chemistry teachers are sufficient in chemistry field, this sufficiency will contribute to their teaching. In this regard, in service training should be arranged for teachers, teachers should be informed about new methods and teachers should be encouraged to doing master degree and PhD. It is seen that the teachers who improves themselves in their fields make more effective teaching in their classes.

### **Results and Discussions**

When each topic is taken into consideration, some points can be said as:

Experiments should be designed according to the student's prior knowledge and cognitive skills. Thus, meaningful learning is provided instead of memorization. In addition, teachers should provide opportunities that can take an active role to students in their own learning (Ricco and Carnasciali, 2014). Chemistry education is a basis for the development of modern society. For this reason, the investments that made in this area are important. In this point, some investments that are for educating students who have responsibility and make active participation must be made. Teachers have great role in educating these students. Teachers must explain some events that environment for students occurring in daily life, they must interpret these events and they must response to students' interests when determining experiments that to be applied







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(Gonçalves et al, 2014). When studies are examined, it can be said that active learning areas should be prepared for students in chemistry learning. Students must be in the academic environment for doing and experiencing science and they should configure their own knowledge. Students must gain some skills that can work in experimental environment. Substantial experiences are significant for students' learning. As well as, computer aided practices can be used for concretizing abstract concepts. Finally, with all these methods and practices students would learn chemistry more effectively.

