Special section: Microscale Science - Sección especial: ciencia en microescala

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Tracing an ancient ice mummy with an experimental kit

The use of a low-cost kit in chemistry for beginners

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Abstract

A low-cost experimental kit developed for junior high school students proved to be useful for a teaching unit "A world full of metals and how mankind made use of them". The students planned, performed and evaluated experiments to answer the question: How could a person living 5000 years ago make a copper tool found beside an ice mummy at the end of an Ötztal glacier (South Tirol Archaeological Museum).

THE KIT

The context with the title "A world full of metals – and how mankind made use of them" was tested at junior high schools in Lower Saxony several times. This was part of a project to implement "Chemistry in Context" at schools of the German federal states (homepage of Studienseminar).

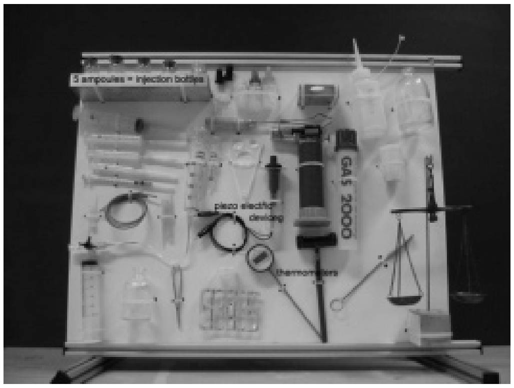

Figure 1
The Student Kit

In one of the learning groups each student had her / his own kit for experiments at school and at home (WLOKA, 2002). The basic version of this kit (fig. 1) consists of injection bottles (2 mL - 10 mL) with fitting stoppers, a small two-pan scale with a stand and weights, a digital thermometer (-50°C until 150°C, ±0.1°C), different disposable syringes with hypodermic needles, a no-cost micro spirit burner (MARSAFY, SCHWARZ, 2002), a microscale butane gas burner, a home made aluminium stand for the injection bottles and a two- pan scale. For electrochemical experiments the kit has to be supplemented by a digital multimeter, a piezo electric device and insulated copper wires with crocodile clips. The kit also contains materials like tubes of different diameters and other equipment, used in hospitals like three-way taps, plastic pipette tips and so on (MENZEL 2000). Small injection bottles inside film canisters and covered by a lockable plastic pouch are very useful for transportation of solids and solutions.

PREREQUISITES FOR THE LESSONS

The students had already acquired first ideas about chemical reactions in the unit "Combustions" (www.nibis.ni.schule.de/). A chemical reaction was considered as a process in which educts disappear and new products with totally different properties are built. The learners interpreted suitable examples in a way that the educts are no longer present after completion of the reaction while the basic building units of their particles cannot get lost (circuit in which an element is formed as last link of a chain). The simplified symbolizing (EICKS, MÖLLERING al 2001) of particles that form a substance was supplemented by introducing atomic symbols and afterwards specified for substances already known. So the students' imagination was broadened.

USE OF THE KIT DURING THE COURSE OF THE LESSONS

Teaching methods and materials

In this chapter it will be described how the students worked with the kit. Here we will deal with the apparatuses that the students had to develop with view to the specific contextual problem. The planning, performing and evaluation of the experiments will be of greatest interest. The teacher should not have an influence on the interpretation of the results, for example by sorting student observations and asking them clever questions (FABRICIUS, 1996). The learners should be allowed to handle their subjective planning and the observation data from their points of view.

In order to understand the historical copper production experiments should be developed to make copper from malachite. Using small malachite beads from necklaces available for about 1 Euro proved to be very useful. The students also liked small pieces removed from bigger ore lumps. Less frequently students used malachite powder, which can be bought, too. While experimenting at school magnifiers are recommended.

Problem

The students were informed about "Ötzi", a 5000 year old mummy found on a glacier in Ötztal / Italy. The fact that a hatchet made of copper was found next to him led to the question: "Where could people at that time get a copper hatchet?".

They found that metal close to malachite ores on the surface. So it can be assumed that they expected a relation between copper and malachite (WLOKA, STRUCKMANN 2004).

First attempt to solve the problem: How did "Ötzi" do the probably experiment?

As usual, the students might expect that malachite is a mixture of stone and copper. So the first experiment they propose was separating the metal by melting. The students had to choose the right burner to reach the melting temperature of copper. Information can be taken from books or found in the internet. To reach this temperature of copper in a small scale they took the butane gas burner

It was also proposed to make a movable stone age campfire (WLOKA, STRUCKMANN, 2004) to heat the ore in a crucible (macroscale).The stone is heated sharply in an infusion bottle held by a test tube holder (made from a wooden clothes clamp wrapped in aluminium foil). This experiment is usually done at home (always in a metal tray like for broiling) and repeated at school in macroscale.

The observations from the home experiment were collected at school: A transparent colourless liquid was observed at the cooler parts of the ampoule, leaving a black stone which sometimes broke. White fog left the vial during heating.

By transferring their knowledge from the previous lessons, the students had three hypotheses:

- By heating malachite no copper but carbon was obtained.
- The liquid is water.
- The fog could be small water drops or an invisible gas was produced that formed fog with the humidity of the air (like after opening a bottle with conc. hydrochloric acid).

Students often supposed that copper could have evaporated. This hypothesis was quickly dropped by looking at the boiling temperature of copper.

In case the students expect that air reacts with malachite, they are informed that the malachite is protected by nitrogen during the heating process. The same results can be observed during the test (table, line 1).

Next came the individual searching for copper. Different tests took place to verify or falsify the hypotheses.

The liquid was identified as water mainly by using copper sulfate (table, line 2).

The black solid proved to be no carbon, as it did not burn up in the air during heating (table, line 3). A comparison with the copper compounds in the lab resulted in a new hypothesis: It could be copper (II) oxide. Independent experiments using a blister packing verified this hypothesis.

As no copper could be separated by melting, some students replaced the gas burner by the spirit burner and made identical observations (table, line 3).

Searching for a gas - which could have been formed during the heating - proved to be a little bit more difficult. Two apparatuses were assembled. In the simplest form the vial that was heated was closed by a stopper pierced with a 20-mL syringe and oiled with silicon oil. As the stopper is sometimes pushed off by overpressure, a three-way tap is placed between stopper and syringe to let the gas leave more quickly.

Some students transfered their knowledge from a previous teaching unit and tried to collect the gas with a pneumatic system.

In both cases the volume of the gas was too high to be collected in the syringe or injection bottle. Two questions arose from these observations: What is this gas like? How much gas can leak from such a small piece of malachite?

Investigating the gas showed it was not combustible and it showed a positive lime water test. These tests are easy, when the materials of the kit are used. A small glowing splint (toothpick) is held into an ampoule which was filled with gas in the pneumatic system. From the syringe the gas can be pressed on the tip of the glowing splint. To make the lime water test, some of this indicator is sucked into the syringe and mixed by shaking. The same test can be done in the ampoule with lime water. Tests for other gases (oxygen, hydrogen, nitrogen) are negative.

Measuring the volume released by heating five small stones from a necklace gave a result that produced a big surprise: 0.4 L of gas was collected! (table 4).

The fact that "water is set free from an absolutely dry stone", was so surprising for beginners in grade 8 that they insisted on smashing the stone in order to look for something humid inside (table, line 2).

The restricted environment of "Ötzi´s"world offers solutions

Having gained valuable knowledge, the students transferred some former information from the experimental results of making carbon from carbon dioxide with magnesium. They proposed to take away the oxygen from the copper (II) oxide obtained from malachite by magnesium. The experiment was performed by heating the black stone splinters with magnesium powder. Small copper nuggets were obtained.

Admittedly, Ötzi lived in a world in which elementary magnesium was absent (table, line 5). In this environment only a small selection of substances was available. It was not too difficult for the students to put themselves into this world. They proposed to heat the malachite stone or the copper(II) oxide stone with wood, leaves, skin, hair, bones or other organic matter (table, line 9). Charcoal was also used (table, line 7). As usual, the experiments were done in ampoules. Sometimes the learners alternately added layers of malachite and organic material like in a blast furnace. The surprising result: In each case they succeeded in getting copper from malachite.

Starting with heating, they could only observe small glittering areas on the black stone (magnifier). While the heating was continued, these areas grew…

Closing the cycle: Malachite from copper, carbon dioxide water and air

In a second long-term experiment performed at home it was proved that malachite can be produced from copper oxide, water and carbon dioxide. This also happens with copper (from an electric wire), oxygen, water and carbon dioxide (table, line 10), (KLIE 1981).

In a pneumatic tub an empty soft drink glass bottle (broad neck) is filled with carbon dioxide. Copper oxide powder is added and spread over the wet inner surface of the bottle by shaking. The bottle is tightly closed and kept on a windowsill for some weeks. The same procedure is done in a second bottle half filled with carbon dioxide and oxygen by adding a piece of copper. Two control experiments take place with copper oxide and with copper kept in air.

After some weeks the formation of malachite can be observed in both bottles while nothing happens in the control experiments. The cycling process is closed.

RESULT OF USING THE KIT

Home experimentation proved to be very useful whenever the students worked with "Chemistry in Context". They accepted this option developing creativity and motivation. It could be observed that the learners liked to work in teams, although everyone had his/her own kit. Division of labour took place, a first step to learn on individual levels.

TABLE
SUMMARY OF THE EXPERIMENTS

Nr.	Subject	Reference
1.	Heating of malachite	Melting of copper
2.	Testing for water	Product from 1
3.	Identification of the black substance	Product from 1
4.	Testing for carbon dioxide	Product from 1
5.	Malachite + magnesium	Experiment to obtain copper
6.	Malachite + organic matter	Experiment to obtain copper
7.	Malachite + charcoal	Experiment to obtain copper
8.	Decomposition of wood	Educt for copper production
9.	Gas from wood + malachite	Alternative to obtain copper
10.	Malachite made of products of decomposition	Cycling process

Source of supply for small malachite splinters:
Miglo e.K.
Am Burgwall 12
19086 Plate
Hermann.Miglo@t-online.de
Price 60 Euro/kg netto
from 1.5 kg cost free delivery

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Analyzing a malachite bead

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INTRODUCTION

In Internet I found that copper can be made from basic copper carbonate: In a first step 100 mg of this green powder were decomposed by heating. After that the black product was reduced with vapour of methylated spirit. By weighing the reactant and the two products of these reactions the loss of weights was obtained needed to evaluate the experiment (El-Marsafy).

Recently a teaching unit on making copper from malachite was published. Together with students of my age they followed the history of making copper during the end of the stone age (Wloka 2005).

Motivated by these publications I tried to make copper from a malachite bead.

Part 1 of my experiment: Heat decomposition of the malachite bead

Material

- Three 5-mL Liquemin ampoules with a stopper to fit them all,
- plastic pipette tip,
- wooden clothes peg wrapped with aluminium foil,
- infusion tube (10 cm),
- scissors,
- tray, two big stoppers (from infusion bottles) as stands,
- micro spirit burner (assembled from one of the ampoules),
- malachite bead (d 3 mm),
- dropper bottle with lime water,

Experiment

1. Work in a tray.
2. Use big stoppers as stands for the burner (fig. 1) and for the ampoule with lime water
3. Transfer the green malachite bead into a dry ampoule.
4. Pierce the stopper from below by the plastic pipette tip.
5. Cut off 5 mm on both ends of the pipette tip.
6. Close the ampoule, connect the pipette tip with 10 cm of tube.
7. Dip the other end of the tube into a second ampoule with 10 drops of lime water.
8. Hold the ampoule with the wooden peg to heat the bead as seen in fig. 1.
9. Observe the cooler parts of the ampoule during its heating.

Not only is a new black solid formed by heating (which kept the shape of the bead). In addition two more products were formed: A colourless, clear liquid (seen as droplets at the cooler parts of the ampoule) and a gas. The gas proved to be carbon dioxide by lime water test. The volume of the liquid was too small to test for water.

Explanation

The decomposition of the malachite by heat resulted in copper(II)-oxide, carbon dioxide and water:

$CuCO_3 \cdot Cu(OH_2)_{(s)} \rightarrow 2\ CuO_{(s)} + H_2O_{(l)} + CO_{2(g)}$ | endothermic

Part 2 of my experiment: Reduction of the black bead

Material

- glass dropper pipette for nose or eye drops,
- tissue paper soaked with methylated spirit,
- micro spirit burner,
- black bead from part 1 or black copper oxide obtained by heating a malachite fragment.

Experiment:

1. Remove the rubber head of the dropper pipette.
2. Transfer the black substance into its glass tube leaving space like seen in Fig. 3.
3. Push the tissue paper - wetted with methylated spirit (alcohol) – into its rubber head.
4. Re-assemble the dropper pipette
5. Heat the black substance without burning the rubber head (Fig. 3, left).
4. Repeatedly press the rubber head to add alcohol vapours to the solid during heating and cooling.

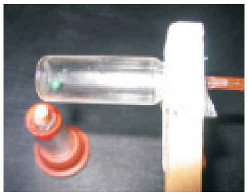

Fig. 1
Malachite bead before heating it in an ampoule held above a micro spirit burner with a wooden peg

***Observations* (Photo 3 right)**

The black substance changes leaving a solid with a shining surface of the colour of copper. At the cooler parts of the glass clear and colourless droplets appear.

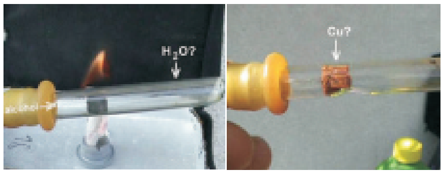

Fig. 2 Reduction of the product from part 1 by vapours of methylated spirit
left: heating, right: product of the chemical reaction

Explanation

Methylated spirit is a reducing agent: It is more eager for oxygen than the copper particles in copper oxide: So they lose their oxygen atoms and copper metal is left.

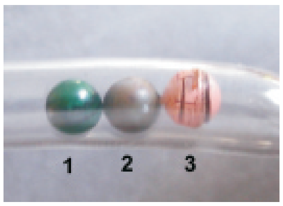

Fig. 3 shows a malachite bead (1) and the products after heat decomposition (2) and reduction (3).

1) Malachite bead
2) black copper oxide bead
3) copper bead

If the bead is pure copper, it should have the metal properties, called malleability and shine. So I hammered the bead until I had very thin pieces, which could be sandpapered to release the metallic luster (fig. 4)

Fig. 4
Bead obtained from malachite by chemical reactions before and after hammering

Thanks to my teacher

He encouraged me to do the experiments with malachite, he helped me to write this contribution and did the photos for me.

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*/ JOACHIM KNIEPERT is the students of the High School Alexander-von- Humboldt, Lauterbach, Germany

"Chemistry Aid" for developing countries

Chemistry is probably one of the most difficult subjects to teach in developing countries because students do not have access to chemicals, resources and equipment and teachers cannot demonstrate chemical reactions. Yet such countries desperately need "home-grown" chemists as part of national development plans rather than relying on expatriate experts.

The Royal Society of Chemistry, under its initiative to support Chemistry worldwide, and the Chemistry Video Consortium (CVC) have come together to launch "Chemistry Aid", cf. "Live Aid", to support the learning and teaching of Chemistry. In the first instance a pilot project with the Science Advisory and Information Network of Kenya has led to RSC/CVC sending out videos and CDROMs for schools, colleges and universities, including material produced by the Educational Techniques Group Trust. This work has been described in RSC News (June 2004). Another initiative has led to the CVC sending one of its authors to do hands-on workshops on Microscale Chemistry. This has resulted in the adoption of Microscale Chemistry for the forthcoming group of 1st year students at the University of Nairobi in October 2005. To meet the need for equipment overseas the RSC has supported the charity "LabAid" in dispatching consignments of equipment to Africa (see RSC News for April 2005). The success of these pilot projects suggests that such initiatives could and should be expanded to other developing countries. Indeed such visits have taken place or are in the pipeline, e.g. Uganda (RSC News for February 2005), the Cameroons (visit in progress), Malawi (visit pending by Dr Simon Campbell, RSC President) and Namibia (visit pending by RSC staff member).

It is clear that the RSC could have a very positive role in directly supporting Chemistry overseas (cf. RSC News) and coordinating help from national bodies (the Commission for Africa and the British Council) and international bodies (UNESCO). Members could be encouraged to support this work via charity donations, and chemical industries could sponsor initiatives.

Contact people for this initiative are: Dr COLIN OSBORNE (RSC Education Department; OsborneC@rsc.org) and Dr TONY REST (CVC; University of Southampton; Chairman of the RSC Educational Techniques Group Trust; a.j.rest@soton.ac.uk).

European Conference of Chemistry Teachers
Eisenstadt , Austria, 30 March - 2 April 2005

Two years after Lienz and four years after Vienna this conference organized by the Association of Chemistry Teachers in Austria was another highlight. Like in a big family participants from Austria, Hungary, Germany, Israel, Macedonia, Netherlands, Romania, Russia, Slovakia, Slovenia, South Africa, Switzerland spent 4 days of lectures, workshops, poster presentations, exhibitions, excursions and last not least of pleasant and useful social events.

More than 550 participants came to Eisenstadt, 49 lecturers gave 12 plenary lectures and 21 other lectures and 16 workshops. 2 Poster session with 35 posters were presented, 13 excursions offered.

Some examples of the lectures:

WOFGANG HECKL. Nanotechnology – vision and facts.

In his introduction Professor HECKL (Head of Deutsches Museum in Munich) mentioned the importance of the invention of the scanning probe microscope principle for the new technology implemented in research laboratories at the beginning of the new century. "The tiny nanoworld of quantum mechanics hidden at the scale of a billionth of a meter now becomes directly accessible and, moreover, direct manipulation at the atomic and molecular scale is possible. In our experiments, we now are able to move individual molecules, but the promise for the future is to manufacture matter, to build functional units up to molecular machines starting from the individual building blocks of matter…".

ROBERT HUBER. Proteins and their structures: innovations for science and realization in medicine.

In 1988 Professor HUBER (Head of the Max-Planck-Institute for Biochemistry in Munich) was awarded by the Nobel Prize for Chemistry.

> "Protein christallography experienced in the last twenty years a rapid development in methods and instrumentation, allowing the determination of very large and complex protein structures, particularly when combined with electron microscopy. These structures document an unlimited versatility and adaptability of the proteins` structure, but reveal also unexpected relationships. The structures are a basis for understanding their binding specifities and catalytic properties (chemistry),

their spectral and electron transfer properties (physics) and their roles in physiological systems (biology and medicine.”

Clemens Koch. Alchemist silvering and gilding.

In his lecture Dr. Koch, chemistry teacher at Deutsches Gymnasium Biel / Switzerland, first performed some simple experiments to show how to cover metallic surfaces with zinc, copper, brass, silver and gold. Afterwards some experiments were demonstrated which showed how alchemistic procedures can make metals “golden”.

Peter Menzel . Science-laboratory for pupils – children´s university

Professor Menzel from University Hohenheim – Stuttgart demonstrated experiments with burning candles and bubbling mineral water designed to be performed by children in preschool and primary school ages.

He described his activities in the Fehling-Lab at Stuttgart, a joint project of University Hohenheim and University Stuttgart initiated by him in 2001.

“About 7000 pupils could already purchase/do experiments. 3–4 days a week children become researcher in natural sciences. They discover the world of smelling, crystals, acids, gases, and colours. Essential aspects for the development of the experiments are to work self-supporting, to use every day materials, to make products to take along with and to stimulate the experimenting at home… The synergy of pupils-lab and (inservice teachers) training centre turns out very well.”

Viktor Obendrauf. “Nicely wrapped up is nearly won” esthetic aspects of chemistry

As an old tradition of the European Chemistry Teacher conference Professor Obendrauf from University Graz / Austria was asked to perform the last event of the conference: Nearly all participants of the conference attended this firework of more than 30 fascinating experiment, brilliant power point presentations and brilliant comments.

> “a pretty experiment is in itself often more valuable than twenty formulae extracted from our minds” (Albert Einstein 1879-1955).

The word “pretty” in Einstein´s quotation unites aspects of aesthetics as a science discipline with the results of modern research on brain. Neurobiological research proves that lasting learning is closely linked with emotions. A `pretty´ experiment arouses emotions like potentially dangerous experiments.

As a rule students remember nothing better than ‘beautiful´ and ‘dangerous´ experiments. But that is not all: through aesthetically arranged experiments they frequently grasp the associated theoretical concepts mor easily…”.

Werner Schalko. Pupils´ experiments with the metal tungsten.

Mag. Schalko from Gymnasium Sacre´ Coeur Vienna / Austria cooperated with a group of boys and girls to demonstrate nice experiments on this metal.

> “Tungsten is taken as an element with which experiments can easily be done by students. At the same time tungsten provides phenomena which can be taken as a starting point for further research.
>
> By comparing tungsten to ther metals suggested for classroom use in the curriculum, it is shown which areas tungsten might replace other metals because of its special properties.”

Michael W. Tausch. “All you need is light”. Curricular innovations in chemistry teaching.

In his lecture Professor Tausch from University Duisburg-Essen presented “an experimental approach to the conceptual framework which is as simple as possible, but able to explain all basic phenomena involving light in a reasonable first approximation for students in high school, college and university.

The follow experiments were carried out during the lecture:

- The glowing razor blade (photoelectroluminiscense).
- Light antenna from Burgenland´s red wine (photogalvanic cells with non sensitized titanium dioxide.
- Fluid and rigid chameleons (photochromism, photosteady equilibrium, molecular switches, nanomachines).
- Photo-Blue-Tube (photoredox reactions, coupled reaction cycles).
- Photo-Blue-Accu (photoelectrochemical energy conversion and storage, model experiments for the cycle of photosynthesis and respiration)”.

The next conference, 9th European Conference of Chemistry teachers, will be in Styria (Austria).

Peter Schwarz

3rd. International Microscale Chemistry Symposium

This Symposium was held at Universidad Iberoamericana-Ciudad de México (May 18-20, 2005), with the purpose of gathering international and national experts to share their latest developments in Microscale Chemistry, and to honor Drs. Ronald Pike, Mohan Singh and Zvi Szafran (professors at different US institutions) for their pioneering work in this field.

Key speakers and workshop leaders included:

Alejandro Baeza (Universidad Nacional Autónoma de México), James A. Bertsch (Aldon Corporation, USA), Kwok Man Chan (St. Stephen College, Hong Kong SAR China), Arturo Fregoso Infante (Universidad Iberoamericana – México), Miguel García Guerrero (Universidad Nacional Autónoma de México), Wing Hong Chan (Hong Kong Baptist University, Hong Kong SAR China), Kenneth Doxsee (University of Oregon, USA) , Christer Gruvberg (University of Gotheborg, Sweden), Muhamad Hugerat (Arab College for Education – Israel), Martha Elena Ibargüengoitia (Universidad Iberoamericana –México), Jorge G. Ibanez (Universidad Iberoamericana – México), Angela Kohler (Humboldt University, Germany), Mordechai Livneh (Bar Illan University, Israel), Bruce Mattson (Creighton Jesuit University, USA), Viktor Obendrauf (Graz Pedagogical Academy, Austria), Ronald Pike (Univ. of Utah; National Microscale Chemistry Center, USA), Peter Schwarz (Micrecol, Egypt – Germany), Mohan Singh (National Microscale Chemistry Center, Merrimack College, USA), Zvi Szafran (Georgia Technical Institute; National Microscale Chemistry Center, USA)

In addition, two contests were held:

1. *The chemical production of the colors of the Mexican flag: green, white and red* (1st. Place- Mercedes Llano Lomas, Graciela Muller Carrera and Marta Rodríguez Pérez. Universidad Nacional Autónoma de México, Fac. de Química. 2nd. Place- Martha Elena Ibargüengoitia Cervantes. Universidad Iberoamericana-Ciudad de México, Depto. de Ing. y C. Químicas).
2. *Fabrication of miniature, low-cost magnetic stirrers.* (1st. Place- Germán Godínez Cardozo and José Antonio Martínez Lozano, Universidad Politécnica de Pachuca. 2nd. place- Freddy Isidro Maldonado. FES-Cuautitlán-UNAM).

This symposium gathered teachers and researchers from 4 continents, coming from 14 countries and from 15 states from within Mexico, and it was organized by the *Mexican Microscale Chemistry Center*, of the Dept. of Chem. and Eng. Sciences at UIA.

In order to extend the benefits of the presence of the experts mentioned above to High School students and their teachers, special conferences and demonstrations were organized for approximately 200 students from different schools.

This event was co-sponsored by UIA, CONACYT, PROVITEC, TELMEX, ANIQ, CoDAT and the Green Chemistry Institute.

To have access to the Symposium documents (Summary, Calendar and Abstracts) please go to http://www.uia.mx/investigacion/cmqm/default.html in the Sm option (hexagon), after July 1, 2005

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The International Conference on Institutional Evaluation Techniques in Education (ICIETE, Samos, Greece, 2005)

The International Conference on Institutional Evaluation Techniques in Education (ICIETE) was held in Samos, Greece, 1-3 July, 2005 to bring together educators, decision makers, higher education institution managers, experts, evaluation stakeholders and practitioners, and provide them with the opportunity to interact in a cross-cultural educational environment. The conference provided the attendants with the opportunity to contemplate the common challenges posed to education and evaluation by the rapidly changing technical progress and labour market needs, and to find valid solutions that would respond to the scrutinized problems. The discussions aimed at improving the institutional evaluation techniques in education through adoption of shared ‘good practices’ and tested experiences.

The conference was organized by the Research and Training Institute of East Aegean (INEAG) with the cooperation of the National and Kapodistrian University of Athens and the Pontificia Universidad Javeriana, Bogotá, Colombia. According to the chairman of the conference organizing committee, Kyriakos Kioulafas, professor at the National and Kapodistrian University of Athens, the conference proceedings were expected to create “a forum for intensive interdisciplinary interaction and collegial debate”.

The event continued the Samos international conference tradition in creating a genuine and stimulating event environment. The highlights of the conference were the extremely broad thematic streams, which covered processes, procedures, instruments, techniques, and ways of improving the evaluation carried out in the diverse areas of concern represented by the participants. The conference proceedings were also aimed at discussing ways of improving the trainers’/teachers capabilities regarding *evaluation in education*.

The conference assembled a relatively restricted and elitist number of education experts, higher education institution managers and evaluation stakeholders, who represented well-respected and renowned universities and institutions from Europe, who came to Samos ICIETE with the specific aim of sharing experience and benefiting from the 'good practices' of other institutions. The attending institution representatives and individual researchers came from Greece, Russia, USA, Latvia, UK, Slovenia, Colombia and Romania. The conference acknowledged the common interest that educators and institutions' managers have vis-à-vis the evaluation issues and the complex roles of training and education systems within a European knowledge-based society, whose capacity to sustain economic growth and social cohesion must be consistently ensured.

The conference covered three dense days of presentations and post-presentation discussions which gathered under 9 panel discussions extremely valuable and interesting evaluation studies. In spite of the heterogeneous character of the conference presentations, which expanded over an impressive spectrum of evaluation topics, ranging from as distant areas as life long learning and English language written evaluation up to the use of concept maps for the improvement of future mathematics teachers, the conference was a successful international event on evaluation in education.

Some presenters focused their lectures on the use of active educational strategies and methods to improve the quality of science education. A relatively large number of presentations centred on the portfolio form of evaluation and on qualification/competence recognition, illuminating whimsical queries and further issues relating to the practical use thereof. The approaches on evaluation and recognition of informal learning continued the discussions on the competence recognition process.

The contributions in the field of e-learning, virtual learning and VLE of a significant number of presentations were highly valued by the participants and constituted another 'hard core' of the conference proceedings. The topic enhanced active and profitable exchanges of 'good practices' which will turn into valid solutions for the development of e-learning systems in the countries represented by participants. Other topics that captured the general interest and opened up new research inquiry opportunities were: improvement of trainers' training, institutional approach to international university collaboration, and adult education.

The panel discussions further incorporated topics like: the role of personality, gender in a collaborative task design, literary education and assessment, teaching methods for disabled children and study groups. The conference also hosted the overview of the impressive 'next generation' USA Globe Programme, which displayed the complex and ambitious world environment training programme for trainers' and researchers'. Apart from the educational benefit that resulted from the scientific and methodological intercourse of many prestigious European institutions, the participants also partook of a friendly and stimulating environment and had plenty of opportunities to interact with their colleagues more informally.

It is, however, the great merit of the INEAG to have provided the international education science community with this generous opportunity to identify their problems, to find solutions that could benefit them all, to stimulate common research and open up new research inquiry opportunities.

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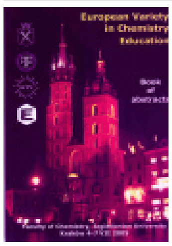

European Variety in Chemistry Education-2005

Kraków, Poland, 4 - 7 July 2005

For more than ten years, the Royal Society of Chemistry and the Physical Sciences Subject Centre of the Higher Education Academy in the UK have organized an annual conference, *Variety in Chemistry Education*, which has a practioner-oriented approach to chemistry education at university level. To widen the exchange of experience compassing staff from the universities of the continental Europe, this year we took the decision to organize a related conference in Poland, *European Variety in Chemistry Education-2005*. The conference was held in Kraków, Poland from 4 to 7 July 2005.

The conference provides a forum for the exchange of ideas related to teaching and learning chemistry at degree level, the sharing of good practice and innovation, and the dissemination of outcomes of pedagogic research mapping to chemistry at university level in Europe.

- Contributions on a core of key issues are presented:
- Chemistry for non-chemists,
- Practical education: the role,
- effectiveness and organisation of the laboratory,
- Student placement (internship),
- IT-supported education and assessment,
- Innovation in content, methods, and assessment,
- Interdisciplinarity,
- Relation and links between education and research,
- Chemical education research,
- Teacher training,

European educational programmes and projects: examples of good, transferable practice.

In addition, two general sessions are organised:

- Chemistry studies in the context of the Bologna process
- Chemical education for safety, peace and human welfare

Over 90 academic teachers from 18 European countries (Bulgaria, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, Lithuania, the Netherlands, Poland, Russia, Serbia and Montenegro, Slovenia, Spain, Turkey, the UK, Ukraine) as well as teachers from outside that continent (New Zealand, Canada, Columbia) have participated. Six plenary lectures were given e.g.

– Problem Solving and Assessment

Stuart W Bennett, Open University, United Kingdom

- Multimedia Educational Software as Means for Attracting Better Candidates for Chemical Studies in Poland

Marek Kwiatkowski, University of Gdansk, Poland

- Transforming Undergraduate Education in Chemistry for Preparing Secondary-Level Teachers: The Need for a Close Collaboration of Faculty in Science and Science Education

Georgios Tsaparlis, University of Ioannina, Grece

- What is Scholarship in Chemistry Education?

Michael Gagan, Royal Society of Chemistry, United Kingdom

as well as 40 conference communications. In addition, 35 posters were displayed and there was opportunity to participate in three scientific workshops:

Pascal Mimero, ECTN, *"EChemTest", A European Evaluation Tool to Certify at University Level both the Academic and Professional Knowledge in Chemistry*

Bill Byers, University of Ulster, United Kingdom, *Promoting Learning Through Peer Group Work*

Liberato Cardellini, Marche Polytechnical University, Italy, *Ionic Equilibrium Problems: Is There A Better Way To Solve Them?*

International dimension of chemical education was stressed in the lectures:

Leo Gros, *Eurovariety in Chemistry: on the way to a European Framework for Chemical Education,*

Anna Kolasa, *The Chemistry Eurobachelor - A framework for a European first cycle degree in chemistry,*

Janusz Wójcik, Danuta Gilner, Andrzej Rajca, Andrzej Skibiński, *Leonardo da Vinci pilot project CHLASTS - WP 2.2 product,*

Rainer Salzer, *Analytical Chemistry In the European Higher Education Area,*

The conference was under the patronage of Polskie Towarzystwo Chemiczne (Polish Chemical Society), ECTN (European Chemistry Thematic Network), EuChemMS. The arrival of the guests and co-financing the stay of students and colleagues from the Eastern Europe were be made possible by much appreciated support from the OPCW (Organisation for Prevention of Chemical Weapons). The conference was organized by Faculty of Chemistry, Jagiellonian University.

The book of abstracts was published and also presented on the website of the conference (www.chemia.uj.edu.pl/eurovariety) and therefore available for all academic teachers and lecturers. Moreover, the CD containing the full text of all lectures will be prepared by the end of 2005.

Conference participants had professionally fruitful time in Krakow as well as many agreeable and unforgettable impressions. This conference will act as a catalyst for a cycle of similar meetings in the years to come. Next conference 2nd European Variety in Chemistry Education will be organized in Prague (Czech Republic) in the year 2007 by Dr Hana Ctrnactova.

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