

The three training courses for academic teachers were organized in the first, second and third year of the project.

The first Short-term Learning/Teaching/Training Activities was in FHMS. Teaching staff was be trained on the integration of open course work into regular modules, including an introduction into platforms and software modules used and/or developed.

The second Short-term Learning/Teaching/Training Activities was in IPB. The proposed IP was be focused on the exploitation of natural resources or residues/by-products derived from their industrial use through the production of high added value compounds/products.

The last Short-term Learning/Teaching/Training Activities was at ENSCL. The short training program " Reactors and catalytic Process " was carried out at the Unite de Catalyse et de Chimie du Solide - catalytic research.

They contributed to learning new teaching tools and applying them to the planned courses.

C1

21 – 25 September 2015 - INNOCHEM training event in FACHHOCHSCHULE MÜNSTER



Day 1, september 21st

After a short introduction to *Münster University of Applied Sciences* by Ines Roman, head of the *International Office*, local approaches to didactic evaluation and evolution were presented by Thilo Harth, head of the *Academic Quality Unit*. In the following, Michael Bredol as local project leader gave a summary of his insights from his recent participation in ICEE2015 in Zagreb (Croatia), the *International Conference for Engineering Education*.

Day 2, september 22nd

The larger part of the morning hours was devoted to research exchange in order to define common fields of interest for project work. Several delegates from each participating group presented research topics as well as research structures in their respective institutions. At the end of the morning session, Frank Dellmann, Vice President for Teaching and International Affairs, gave an oversight about the internationasation strategy of FHMS. In the afternoon, an introduction into the use of "etherpads" for collaborative text editing was given along with a practical demonstration and a hand-on trial.

Some participants found out immediately and remarked, that instead of the basic version demonstrated in the training event, some “etherpad” variants on several hosts support graphics exchange and mathematical notation as well.

Day 3, september 23rd

Interactive mathematics using the “IPython notebook” was demonstrated and tested in hands-on trials.

First, a notebook to demonstrate its usefulness as graphical tool in the context of a nanotechnology lecture was shown (light scattering function in the Rayleigh-Gans-limit): Secondly, a brief introduction to the notebook and Python was given and tried out by participants:

Further on, the usage in the context of data evaluation and lab coursework was presented. From thermodynamic VLE experiments a data file was loaded, evaluated and fitted to a theoretical model.

Notebooks are text files and can easily be shared with other Python users or exported as html-files to those not running IPython. There is a simple mechanism on github for sharing notebooks and display them in a notebook viewer.

Many more readymade notebooks for tutorial purposes or specialized applications in the fields of e.g. hydrodynamics, optics, engineering etc. can be found on the web, provided by a steadily growing and active community.

Day 4, september 24th

In the morning session, Molecular Modelling using a remote computational engine driven by local graphics user interfaces was simulated.

The system used as computational engine (for the workshop actually installed on a simple laptop computer) was GAMESS-US:

whereas the graphical user-interface tested was MOLDEN:

Both are free for academic use and under constant development. As an alternative, somewhat more simple Java-based systems are available for visualization purposes.

In order to demonstrate the workflow, structure optimization and calculation of IR spectra for the reactive intermediate vinyl alcohol were performed and interpreted in the workshop, simulating part of a student’s exercise to analyse the relative thermodynamic stabilities of the isomers acetaldehyde, vinyl alcohol and ethylene oxide. The following input files have been created during the workshop for that purpose using the MOLDEN system:

Result files after processing with GAMESS-US from these inputs (to be read with MOLDEN):

In the afternoon, some more presentations with respect to research exchange were presented: Contribution by Ulrich Kynast and Contribution by Michael Bredol.

Day 5, september 25th

In this session, potential project output formats were discussed. In order to facilitate the preparation of educational online material, common data formats will have to be defined in this context.

In view of the effort possible in the framework of the project, making already existing material available online (also smaller fragments, where adequate) will be complemented by generation of new output from scratch.

As a first step for collaborative and trans-institutional activity, semester projects should be defined and supervised, since most partners have built such elements into their curriculum, so that integration into the current programmes should not be too difficult.

Moreover, it has been stated by several participants, that the innovative core of the project needs to be communicated more clearly. Participating institutions need to see the added value for them in order to be prepared to integrate the outputs.

With respect to employability, the situation with the participating institutions is diverse.

Whereas FHMS and PK report, that a high proportion of the graduates (estimated more than 90%) is employed after one year, EN sees ca. 25% unemployed after one year, and IPB sees their graduates employed, but often abroad. It appears to be obvious, that the high level

of employability reached already over all partners must not be put at risk by any proposed action.

C2

10-14 October 2016 - INNOCHEM training event in Instituto Politécnico de Bragança



Introduction

The INNOCHEM Intensive Program took place in the academic building of the Polytechnic Institute of Bragança, Bragança, Portugal. It was titled **“Innovative Topics and Teaching Methods in the Field**

of Chemical Technology and Engineering”. It aimed at uniting the partners of the program to further acquire knowledge on innovative teaching methods in the chemistry field.

The program consisted of five days comprising 5 thematic sessions:

I – Valorisation of natural products

II – e-laboratories

III – Chemical product design

IV – Project-based learning

V – Gamification

The main program featured lectures from invited guests both from Portugal and Brazil to report their novel types of teaching methods. Two fieldtrips were carried out. One of them to the Brigantia Ecopark, a science and technology park which is focused on energy, environment and eco-construction, in which the participants could get in contact with the research facilities and the start-up companies that are based there.

A fieldtrip to the Douro region was held on the third day, which aimed to show the participants the World Heritage Site of the Douro Valley and the corresponding museum.

The participants were professors of the various fields of Chemical Engineering and Technology from the partner institutions.

Contents

An abstract of the presentations that took place during the Intensive Program, as well as a short CV of the speakers, are available for consultation in the booklet annex of this document.

The course started with the welcome session. The course continued with the technical sessions covering several aspects of innovative topics and teaching methods.

Isabel C.F.R. Ferreira (Polytechnic Institute of Bragança – Mountain Research Centre) – Dr. Isabel Ferreira’s talk was focused on the valorisation of natural products directed to several industrial fields with particular emphasis on the food sector. An overview of new processing technologies for food products, as well as of the use of natural products as food additives alternatives was explained based on the experience of her research team (BioChem Core).

Adélio Mendes and Alexandre Ferreira (Faculty of Engineering of the University of Porto) – The two researchers from the University of Porto showed that new pedagogical and didactical approaches should be accessible and promoted in order to facilitate the acquisition of skills, competences and abilities for communication, creative and critical analysis. They provided their experience in what concerns a novel model developed to teach Chemical Engineering laboratories in a perspective of e-learning.

Alírio Rodrigues (Faculty of Engineering of the University of Porto) – Dr. Alírio showed how teaching product engineering to students can be transversal to many fields, namely in the perfume engineering. Thus, he presented the art of engineering scents and odours into perfumes, as well as all the work that goes into product design at the Laboratory of Separation and Reaction Engineering (LSRE).

Pedro Saraiva (Faculty of Sciences and Technology of the University of Coimbra) – Dr. Pedro Saraiva brought the Chemical Product Design that is lectured at the University of Coimbra by promoting creativity in solving problems and creating product prototypes. This type of teaching has become a staple, allowing the students to become better prepared for the future while reinforcing innovation and entrepreneurial skills.

Vicente Leite and José Oliveira (Polytechnic Institute of Bragança; Superior School of Technology and Management of Águeda, University of Aveiro) – Dr. José Oliveira, in coordination with Dr. Vicente Leite spoke about Project Based Learning, triggered by real-life problems. This type of learning has become a constant throughout the School of Technology and Management of Águeda. The workshop involved the participation of the attendees in various hands-on situations, in order to better understand the concepts of “learning by doing”.

Rui Pedro Lopes (Polytechnic Institute of Bragança) - Dr. Rui Pedro Lopes showed that learning could be a game. His teaching encompasses gamification, using typical elements of game playing for

the students to better understand the subjects at hand. In this way he has managed to increase motivation, autonomy and improve grades.

Rogério Tavares (Federal University of Rio Grande do Sul, Brazil) – Dr. Rogério Tavares also showed the benefits of gamification in the classrooms. He brought many examples of digital games with the main theme of chemistry and biology, that can be used to improve knowledge in these areas while also being fun to play and engaging.

Evaluation

On the “final remarks” a reflection concerning the workshop was done. By having invited guests from different backgrounds and experiences the Intensive Program allowed the participants to understand that teaching methodologies are transversal and can be applied in various areas. During the lectures, participants informally inquire the lecturers, in a very dynamic interaction, allowing the theme of the presentation to be correctly understood. A very positive feedback was given by all the participants.

Conclusions

The Intensive Program was another step in the end goal of the INNOCHEM project, to improve teaching methods in line with the Bologna process. Thus, the theme of this program, “Innovative Topics and Teaching Methods” was quite important in further deepening the knowledge of how chemistry and chemical engineering can be taught to students. The Intensive Program had 7 invited speakers on various topics, from both Portugal and Brazil belonging to various institutions, proving that teaching is becoming a more interactive task and new methodologies can aid motivation, interest and improve learning.

C3

3 - 7 April 2017 – INNOCHEM training event in ECOLE NATIONALE SUPERIEURE DE CHIMIE DE LILLE



This INNOCHEM training activities has demonstrated the application of scientific research and laboratory classes for teaching students in Ecole Nationale Supérieure de Chimie de Lille. The interest of students to the real-life experiences makes this scientific approach highly efficient for teaching. During this meeting the research laboratories and equipment have been shown to the participants. Besides it, the examples of the research in the fields of biomass valorization for energy and chemicals, new materials and engineering tools used for student teaching have been demonstrated.

SESSION 1: 3.04.2017

Presentation of the ENSCL

An overview of the analysis techniques (XPS, LEIS, TOF-SIMS) as well as some examples of catalytic applications has been presented. The presentation highlighted the various facilities owned by the center and their applications. Presentation of advanced equipment by research engineer and technicians.

SESSION 2: 4.04.2017

The RealCat platform has been presented as a versatile tool for homogeneous, heterogeneous and biotechnological catalytic applications in the gas-liquid and gaseous, liquid.

Presentation of RealCat high throughput equipment and FEI (advanced TEMe microscope) The research carried out in this Pilot Hall has been presented. The activity is particularly focused on two themes:

- production of clean new fuels from renewable and fossil resources
- synthesis of platform molecules from renewable and fossil resources.

Presentation of the infrastructure of the Hall Pilote, high pressure catalytic reactors and analytic systems.

SESSION 3: 5.04.2017

Two aspects through two tools have been presented: one at the design stage, with a model (named DISC) meant to design serious games by teachers of higher education and one at the use stage, with a tool to visualize the learners' traces of serious game use. A practical application has been demonstrated with a serious game designed with DISC as an activity of a fluid mechanic course.

Presentation of chemical technologies for manufacturing of high quality glass ware.

SESSION 5: 6.04.2017

The program of practical projects for students in ENSCL reflects a specific application field (surface treatment, metallurgy, cristallochemistry, catalysis materials...) has been presented. The particular approach used hereby is to put them with problematics they do not have seen within their lectures. Aspen Plus is ASPEN is a process simulation software widely used in industry today. Students use this software to analyze results from pilot plants. An example of chemical engineering laboratory classes has been presented by Erasmus student.

A group of students has presented the approach they have followed as well as their results.

SESSION 6: 7.04.2017

The post-meeting actions have been defined.