GREDIQ-RIMA: THE EVOLUTION OF A TEACHING PROJECT OF EXPERIMENTATION IN CHEMISTRY

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Abstract

Authors of this project belong to the Resources Chemistry Teaching Group (GReDiQ) involved in RIMA (Research and innovation in learning methodologies). The audiovisual and multimedia material productions realized have been grouped into three themes: Basic Techniques of Experimentation in Chemistry, Safety in Chemistry Laboratories and Advanced Techniques of Experimentation in Chemistry. This work has been awarded a prize of the Universitat Politècnica de Catalunya (UPC–BARCELONATECH), one of the Autonomous Region of Catalunya and another one of a State scope.

Introduction

The project "Teaching material in digital form for experimentation subjects in chemistry" has consisted in the development of an own and common audiovisual and multimedia material in digital format available for subjects in experimental chemistry of different academic degree courses which are taught in several centers of the Universitat Politècnica de Catalunya (UPC–BARCELONATECH). Authors belong to the Resources Chemistry Teaching Group (GReDiQ) involved in RIMA [1] from Institute of Education Sciences of the UPC.

Chemistry has been included as basic training in most of the curriculums for the new degrees of engineering which are been implanted in the Technical University of Catalonia during the academic year 2009-2010 in a first stage, and during the 2010-2011 academic year in a second phase. Inside this matters subject courses which are based on experimentation in the chemistry laboratory are scheduled. In the method of teaching by skills, the autonomous labour prior to the laboratory sessions is considered fundamental [2], since it is necessary that students know the material handling habits and the safety standards before their arrival in the laboratory. In the last three decades it have been used some presentations (e.g. in video format) for this purpose, but most are considered obsolete or that could be substantially improved [3]. In a lot of them they show us antique laboratories, and even, in some cases, they indicate us habits and methodologies unacceptable for today.

The novelty lies in the fact to adapt these audiovisual materials to the new methodologies of learning where the student body is the centre of learning and it becomes active agent while the faculty it becomes a facilitator of their learning rather than a transmitter of knowledge. It is not tries to show the video in a presence class session. It that is intends is that students in autonomous form be conscious of the learning objectives that are intended to reach in the laboratory session so it is promotes and facilitates which they are prepare before to execute the experimental session on its own [4], in order to avoid them to follow a recipe without further and so increase and promote their learning. The progressive incorporation of resources like Internet with platforms such as Moodle, also streamlines this process because these videos may be

part of the tasks or the non-presence activities which along with questionnaires can represent assessment activities of automatic correction.

The resulting material constitutes a support for autonomous study prior the laboratory access, and it has been conceived as a motivator and facilitator element of student learning, especially for experimental sessions of the matters of chemistry. This has been assumed an effort to synthesize the most important information for obtaining a material of quality and which aims to avoid its obsolescence.

Aims

The key project objectives are:

• Perform a common digital material prepared by the teaching staff of the UPC who belongs to the GReDiQ group to facilitate students' access to the subjects in experimental chemistry. Therefore, the material is aimed at the firsts university courses, although in some cases it may also be suitable for high school.
• Develop productions that refer to the safety and habits in the chemistry lab, the material, the techniques, etc.., the attitudes, skills and knowledge that are essential for students before starting any laboratory practice of chemistry. It also seeks to prove that they are an additional element of learning, so that at no time they can be considered as an alternative to replace the task in the laboratory.
• Synthesize information associated with each production, which it has required a major effort in selecting the information to ensure that the material is been made concise and brief (limits of duration for the productions are range between 4 and 10 minutes), with the purpose to contain only the necessary information and, in principle, sufficient.
• Produce quality material, mainly in video format (Flash) as well some multimedia productions, suitable to be placed on the network, so that it can be used by the entire university community, and that it allows students its use on the non-presence timetable.

Methodology

Until recently it was frequent for the students' attendance to the lab sessions without any previous preparation. nowadays, however, as indicated in the "Guide for the assessment of competences in the laboratories on the field of Science and Technology" by quality assurance agency in higher education AQU Catalunya [2] (method of teaching by competences on experimentation course subjects) exists a considerable agreement among professionals in education, who consider that to ensure that students learn significantly in chemical laboratories, there are three phases or moments to highlight and differentiate:

- Pre-lab
- Laboratory
- Post-lab

When developing the work plan have been classified the productions into three thematic subject:

Basic Techniques of Experimentation in Chemistry:

• Measurement of masses (direct and heavy heavy by difference)
• Measurement of volumes
• Preparation of disolutions (of solid and liquid solutes)
• Volumetric methods: acid-base titration
• Filtration (at atmospheric pressure and vacuum)
• Centrifugation
• Distillation (simple and fractional)
• Extraction (liquid-liquid and solid-liquid)
• Chemical reaction (test tube)
• Glossary of laboratory material

Safety in Chemistry Laboratories:

• General safety standards in the laboratory
• Storage of chemicals in the laboratory
• Handling of chemicals in the laboratory
• Chemical waste management in the laboratory (I) Waste classification
• Chemical waste management in the laboratory (II) Handling of waste
• Interventions in case of emergency in the laboratory

Advanced Techniques of Experimentation in Chemistry:

• Molecular absorption spectrophotometry (UV-visible)
• Atomic absorption spectrophotometry
• Chromatography I (thin layer)
• Chromatography II (gas chromatography)

For each production has made a prior bibliographic search on the topic moreover has been necessary to design a cover and a list of credits, and it has been prepared a work paper for each film. Next the script has been written (reviewed by the coordinators of each of the campuses participating in the project) it has carried out the experiment in the laboratory to control the duration and finally have been made the filming, post-production and dubbing. In Figure 1 shows examples of the filming corresponding to the filtration technique, and the Figure 2 shows examples of the materials in Flash.

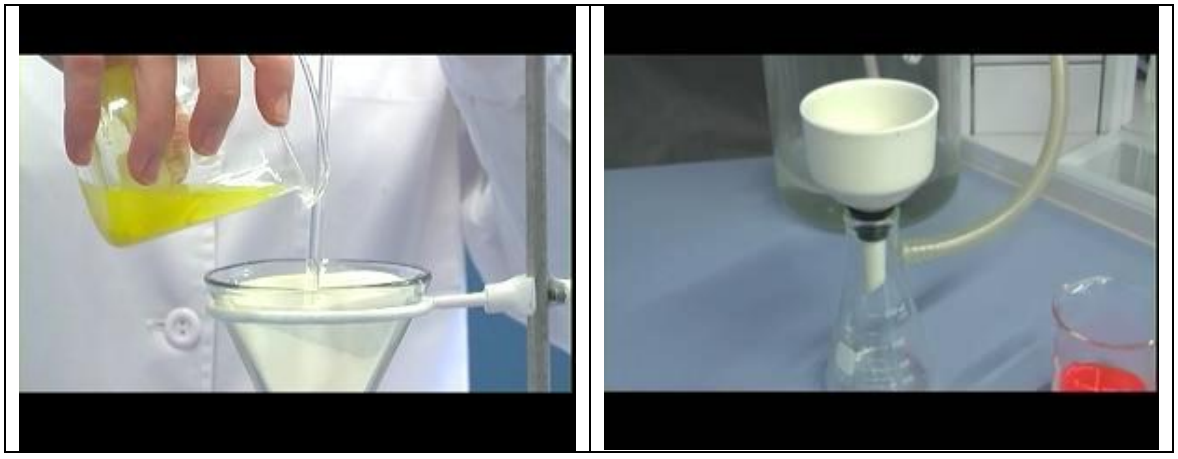

Fig. 1. Images of the filming for the filtration.

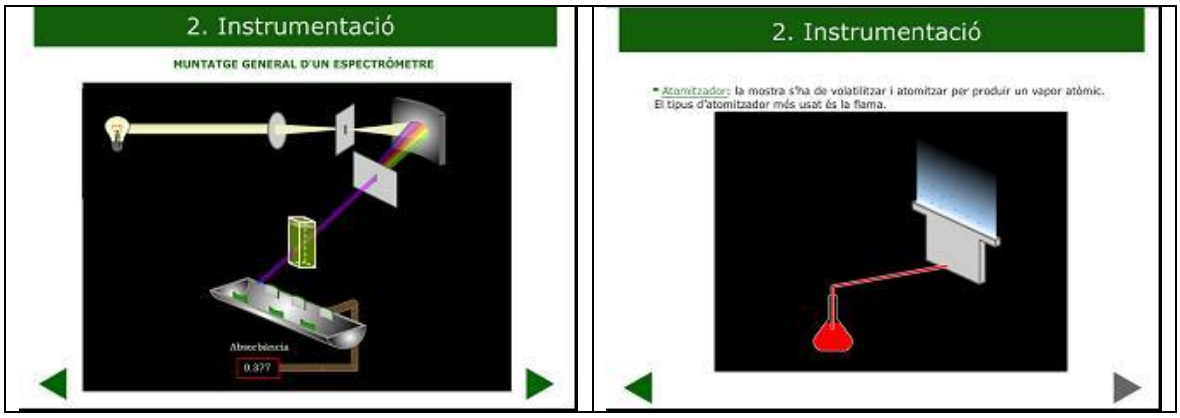

Fig. 2. Images of the filmings corresponds at the molecular absorption spectrophotometry (on the left) and to the atomic absorption (on the right).

Results and Conclusions

Once developed, the material is located in an open access web site (*UPCommons*), available to all teachers and students.

To evaluate the goodness of the project it has been considered that a first indicator is the volume of downloads of the videos from *UPCommons* (about 25,000 per course). In Figure 3 it can see an example of the statistics that can be extracted from *UPCommons*.

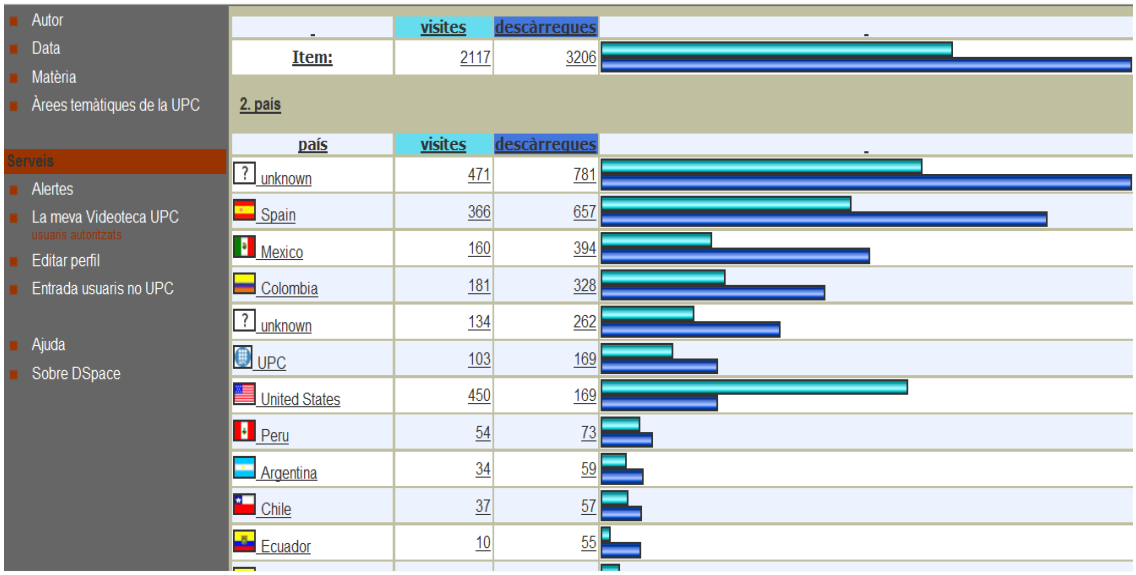

Fig. 3. Statistics corresponding to the video: gas chromatography/mass spectrometry.

Furthermore, through a survey of student satisfaction of the UPC, in order to check what was the situation before entering a chemistry lab at the university, for comparison with the results obtained after the use of the material produced; it has been confirmed the positive reception it has had. In the survey were evaluated prior knowledge primarily in terms of equipping and basic laboratory techniques, habits and the safety standards. They were also asked about the format of the material used to initiate them into different topics (paper, video, multimedia, ...).

This work has been honored with several awards and honors:

13th Award to the Quality in University Teaching - UPC 2010 (Award for teaching initiative)

Jaume Vicens Vives Distinction to the university quality 2010 - Generalitat de Catalunya (modality collective award)

Prize "*Science in Action 2010*" (1st prize of the modality "Didactic materials of sciences, in support non-interactive" - Santillana Award)

Viewing the volume of downloads and the good acceptance received, the conclusion has been that the development of this type of material has been useful and necessary.

Acknowledgements

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