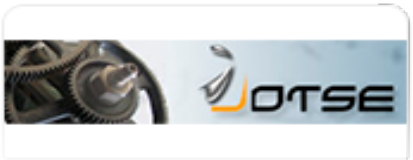

Journal of Technology and Science Education
ISSN: 2014-5349
info@jotse.org
OmniaScience
España

Llorens-Molina, Juan Antonio; Pinto, Gabriel
CHEMISTRY FOR ENGINEERING STUDENTS: A KEY FACTOR FOR SOCIAL AND TECHNOLOGICAL DEVELOPMENT
Journal of Technology and Science Education, vol. 4, núm. 4, 2014, pp. 201-203
OmniaScience
Barcelona, España

Journal of Technology and Science Education

CHEMISTRY FOR ENGINEERING STUDENTS: A KEY FACTOR FOR SOCIAL AND TECHNOLOGICAL DEVELOPMENT

Juan Antonio Llorens-Molina[1], Gabriel Pinto[2]

[1]E.T.S. de Ingeniería Agronómica y del Medio Natural, Universidad Politécnica de Valencia, [2]E.T.S. de Ingenieros Industriales, Universidad Politécnica de Madrid

Spain

juallom2@qim.upv.es, gabriel.pinto@upm.es

The peculiarity of Chemistry as a basic subject in Engineering Studies and its embedded potential difficulties are matters which are now common to universities worldwide. In particular, the learning of Chemistry in the new (post Bologna) degrees of Engineering in Spain and other countries is facing several challenges. In other words, there is a need to deepen into research and innovation tasks aiming at improving such studies within this new educational paradigm. Not to mention, two crucial aspects which are very often neglected, namely, reaching maximum efficiency of all types of available resources and obtaining a "knock on effect" from students and teachers at Secondary school level. The latter playing a crucial role so as to increase students' awareness of the importance that Chemistry has at this particular educational level. Not to mention, how this increases their motivation towards this subject in the Higher Education scenario.

These challenges concern not only the relevance of the contents per se but also the methodological tools involved. Being more precise, we could summarize them as follows:

- The need to reach a greater relevance of Chemistry contents through its social and technological contextualization, linking them to both academic and professional profiles within the several degrees right from the very first year. In this sense, it might be necessary to have a deeper reflection on some of the contents traditionally included in the introductory Chemistry courses by following its advances as a Science as well as its technological applications.
- To relate Chemistry subjects with competences' acquisition. Both the acquisition and the assessment of cross-curricular and generic competences (ethics, creativity, instrumental handling, problem-solving skills, report development, oral communication, teamwork, autonomous learning, etc.). All within the specific competences of the subject itself and gradually incorporated throughout the degree are factors that contribute to implement Chemistry subjects in the context of the current academic change and challenge. Therefore, all the methodological innovation pursuing such objective should be enhanced.
- The role of experimental work needs a deep revision as the activities carried out in the Lab must be seen as real opportunities of acquiring knowledge through students' own experimentation as they not only follow the scientific method but also prove an associated theory. In addition, the experimentation in Chemistry has undergone significant transformation as a consequence of the introduction of the new technologies, ICTs (Information and Communication Technologies) which enable access to quality audio-visual and interactive resources that facilitate the learning-teaching process of such experimentation.
- The implementation of new technologies. Moving a step further, the wide range of possibilities that the web offers users nowadays obliges us to rigorously analyze how the students use it and which are the optimal conditions of web use inside and outside the classroom. Likewise, the implementation of computer applications for virtual experimentation, process modeling, etc. requires, at the same time, a great deal of effort into investigation and innovation. The ultimate goal being to produce a set of good practices for teachers to incorporate in their daily job routines.

- The commitment of Chemistry teaching with the environment and the enhancement of healthy behavior and solidarity. The teaching of Chemistry, as any other subject, cannot ignore the problems and aspirations of the society where it is developed. In this vein, Chemistry can lead to significant contributions: from incorporating sustainability in the lab work (through the implementation of experimental activities at micro scale) to increasing the awareness on proper disposal of the waste products or spreading healthy food habits, for example.

In this sense, the present issue of the Journal of Technology and Science Education - JOTSE consists of six papers. In the first paper, Javier Giménez from Universitat Politècnica de Catalunya (Barcelona Tech) describes how students can use their knowledge of Chemistry in order to understand the Science involved in the technological development carried out at the Ancient Egipt. As an example of case study, students propose solutions to the variation in the colour of the hieroglyphs painted in a papyrus. As pointed out by the author, it is a way to introduce Engineering students to humanistic knowledge with the help of Chemistry and to learn this subject through a Humanities course.

The second paper is from Kevin Pyatt from Regis University (Denver, USA), who analyzes the effectiveness of a curriculum and software implementation that was used to teach and assess first-year Chemistry students understanding of chemical reactions and equations.

The third paper is from a group of authors (Salome Chepkorir, Edna Marusoi Cheptonui and Agnes Chemutai) from University of Eldoret, Kenya, who discuss several aspects on the teaching methods used by Chemistry teachers. As a matter of fact, these scholars outline the teachers' availability to fulfill students' varied needs, their use of teaching and learning resources, teachers' personal levels of skills and knowledge of the subject matter (Chemistry) and the impact of students' negative attitudes towards this particular subject on teachers' effectiveness. Although this study was performed in secondary schools, conclusions can be extended to other educative levels.

The fourth paper by Liberato Cardellini, from Italy, presents his experience about difficulties encountered by students in solving chemical problems. He emphasizes about the logical process that takes place while solving problems in order to improve students reasoning, a step further than just applying formulae.

The fifth paper, from Luis A. Tortajada, from Universitat Politècnica de València (Spain) deals with a well-known and key issue in Chemistry: the effective use of algorithms in contrast to a poor understanding of chemical concepts. This work is a valuable contribution in order to analyze and overcome this problem. For this purpose, collaborative learning strategies are put into practice and, at the same time, useful criteria for their management and assessment are provided. The results give clear evidence concerning the usefulness of this method of solving multi-step problems in Chemistry to achieve a deeper and more meaningful understanding of the concepts involved.

And finally, in the sixth paper, Patricia Morales from Pontificia Universidad Católica del Perú (PUCP) tackles the problem of problem-solving skills assessment in a Problem Based Learning (PBL) context. For this purpose, assessment tools based on the Sugrue theoretical model are proposed and validated for three key topics in General Chemistry, namely, Thermodynamics, Kinetics and Chemical equilibrium. One of the most relevant contributions of this paper consists in providing a valuable methodological basis to monitor students' achievement in further investigations concerning PBL implementation.

We thank Dr. María Martínez (UPC, Barcelona Tech), Editor in chief of this Journal, for giving us the opportunity to collaborate in this special issue on Chemical Education in Engineering. We also appreciate the interest and effort shown by the authors and the reviewers of papers.

We really hope that you will enjoy reading this selection of papers where, as indicated in the title of the present issue, authors from three continents have shown how the process of learning Chemistry for Engineering students is "a key factor for social and technological development".

Citation: Llorens-Molina, J.A., & Pinto, G. (2014). Chemistry for Engineering students: A key factor for social and technological development. *Journal of Technology and Science Education (JOTSE), 4(4), 201-203.* http://dx.doi.org/10.3926/jotse.140

On-line ISSN: 2013-6374 – Print ISSN: 2014-5349 – DL: B-2000-2012

AUTHOR BIOGRAPHY

Juan Antonio Llorens-Molina

Juan Antonio Llorens-Molina started its professional career as Secondary School teacher in 1978. He received its PhD in Chemistry in 1987 and he held different posts related to in-service teacher education for more than ten years and also worked as a preservice teacher instructor at the University of Valencia (UV). Nowadays, he works as associate professor in the School of Agricultural Engineering and Environment, at Polytechnic University of Valencia (UPV). He has been member of different editorial boards (Cultura y Educación, Enseñanza de las Ciencias, JOTSE…) and scientific societies as RSEQ or ICUC. His research is focused both on Phytochemistry Resources and Agroforestry Ecology, in the Mediterranean Agroforestal Institute (UPV), and Chemistry Education. He has published several books as educational essays, many textbooks for Secondary School Physic and Chemistry, and about hundred technical and educational papers. Currently, he is involved in the design and development of Massive Online Open Courses (MOOCs) and other audiovisual resources for online teaching, at the UPV.

Gabriel Pinto

Gabriel Pinto works as a full professor in Chemical Engineering at Technical University of Madrid (UPM). He received an MSc degree in Chemistry in 1985 and a PhD in Physical Chemistry in 1990, both from the Complutense University of Madrid. He has, since 1986, been professor in the E.T.S. de Ingenieros Industriales of the UPM, where he teaches mainly General and Inorganic Chemistry. His research has concentrated on optical and electrical characterization of polymers and polymer composites, on the creation and validation of educational tools concerning science and everyday life, and on the problems of teaching and learning of science at different educative levels. He is member of different editorial boards (JOTSE, EduQ, ALDEQ…) and holds membership of various scientific societies (RSEQ, RSEF, SCQ, ICUC, IGIP, IUPAC…). He has published various books, such as Química al Alcance de Todos (Pearson, 2006), a few Websites and over 130 technical and educational papers. He has been Vice Dean for Education Innovation during ten years and so has been strongly involved in educational changes in University concerning the so-known Bologna process.

Published by OmniaScience (www.omniascience.com)

Journal of Technology and Science Education, 2014 (www.jotse.org)