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Educating Chemical Engineers for coming Challenges

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Summary

Winds of changes have been blowing all over the world, in recent times, with visible effects in higher education.

Over the past twenty or so years we have been witnessing the bringing into our everyday life of the progress in science and technology accumulated during the second half of the XX Century, namely in life sciences and digital technology. At the same time, major political changes occurred in Europe, paving the way for the global market economy.

These changes can be seen and felt by all: (i) our individual and local universe is larger and larger; (ii) time and space concepts and dimensions have changed dramatically; (iii) the "economy and comfort" Society poses new demands to higher education; (iv) the reference of whatever (quality, competition, etc.) is now Europe and the World, not our City or our Country; (v) standards must be high, inflexibly high, attitude holistic, mind flexible; (vi) youngsters face new challenges in the managing of their individual carriers; (vi) lifelong learning is the key concept to have the edge.

The European countries started a major movement as a response to such changes, aiming at creating an European Area of Knowledge, the well known Bologna Process that is on the process of changing much of the face of both our higher education and our model of research.

In this framework, the structure and contents of (chemical) engineering degrees is under review as we look for new feasible curricula and methods of teaching/learning that answer the demands of Society.

Somewhere back in the fifties and sixties the second paradigm of chemical engineering emerged and swiftly gained recognition. With transport phenomena and studies based on elementary mechanisms it has been possible to transport chemical engineering away from the limited number of unit operations that dominated the conceptual approaches and in that way it has been possible to enlarge the frontiers of chemical engineering.

Today, maybe we do not speak of a third paradigm (or do we?), but we speak of life sciences and of biology as one of the four basic sciences, together with mathematics, physics and chemistry, we speak of environmental issues and of sustainability, of (nano) structures and of material science issues, we have to speak of an economy based on hydrogen and on other

alternative energy resources, we have to speak of product development, still and always speaking of optimised, safe, simple to operate systems.

All this is part of chemical engineering, perceived necessarily on a multidisciplinary context. It is clear that there is not a single solution, 'a single' structure, in our search for new curricula

Also, new methods for learning have to be brought in and old concepts have to be revisited: (i) students should be brought nearer to the practice of chemical engineering; (ii) It is important that sufficient practical experience, both in the laboratory, pilot plant and industry should be included in the core curriculum; (iii) topics for promoting holistic thinking through integrated approaches and strengthening of horizontal issues should be part of the studies; (iv) cultural diversity in chemical engineering education is desirable, which means that student and educational staff exchanges between countries and cultures should be encouraged.

In the lecture I shall identify and examine both some of the 'high pressures sources' that are responsible for such 'winds' and the changes that are occurring. I shall also comment and give my views on some of the main tasks ahead for the building of the European Higher Education Area and on some specific implications in methods and curricula in the chemical engineering area.