IChemE

0263–8762/01/$10.00+0.00

Trans IChemE, Vol 79, Part A, September 2001

EDITORIAL

THE *PUBLISH* OR *TEACH* DILEMMA IN CHEMICAL ENGINEERING

Through its roughly 100 years of existence, Chemical Engineering has sought a distinctive curriculum and a niche in the university to prepare students for responsible positions in Chemical Industry. In some cases, it took 25 years to reach that goal (United Kingdom and the United States), in other cases 50 years (Germany) and in one case close to 90 years (Spain). Professor Olaf A. Hougen in his publication *Seven Decades of Chemical Engineering* (*Chem Eng Prog*, 1977, 73 (1): 89), mentions three eras of change in the development of Chemical Engineering: Industrial Chemistry (1890–1940), Unit Operations (1920–1950) and Chemical Engineering Science (starting in 1950). Since the dawn of Sciences era, Chemical Engineering has steadily become less art and more science, and its spectrum of activities has grown to include biological systems (micro-organisms and enzymes), new materials (polymers, ceramic and microelectronic materials) and systems and process engineering.

Research in Chemical Engineering is conducted in a variety of fields, and the number of relevant publications has grown exponentially, as have the number of journals. To keep abreast of Chemical Engineering literature is an almost impossible task; not only because of the large number of journals, but because many of them are no longer accessible due to libraries' budget limitations. Furthermore, many Chemical Engineering researchers do not always publish in Chemical Engineering journals, either because of the specificity of the topic or because impact indexes of most Chemical Engineering journals is rather low compared to journals of basic sciences.

Are we spread too thinly? Will Chemical Engineering survive at the end of the 21st century or will it be absorbed by the Chemistry, Physics, Biology or Materials departments as in its origins? Should Chemical Engineering researchers leave aside technological projects and compete with basic scientists? I do not have an answer to these questions, but it might be useful to reflect on some of the factors regarding Chemical Engineering teaching and research and on some of the problems we face today.

TEACHING AND RESEARCH IN CHEMICAL ENGINEERING

The primary duties of faculty members are teaching and research. Well-known professors are leaders in their research field, and it is taken for granted that their creativity and innovation will lead to new courses being taught and new teaching methods being tried. But, research productivity (funded grants, publications etc.) is the official guarantee of academic standards leading to fiscal rewards, promotion and reputation at the expense of poor performance in the classroom. Well-known professors rarely teach undergraduate courses and students cannot benefit from their experience and ingenuity.

Teaching in a university cannot be divorced from research especially the component involving the monitoring of graduate students or postdoctoral fellows. But the increasing pressure of running research groups means professors must juggle with creating proposals, attending meetings, writing publications, refereeing manuscripts from journals, answering the endless e-mail messages, and of course, supervising graduate students. The increasing complexity of today's research, the sophistication of the equipment and the new computer programs coming on to the market, leave little room to reflect on new ideas, and even less time for new teaching ideas.

FACULTY RECOGNITION AND STUDENT MOTIVATION

If teaching really matters, university faculties who excel in teaching should earn more recognition and reward for it. Senior professors should teach undergraduate courses more often, and by appointing a couple of good teaching assistants, they could get help with some of the routine classwork and spend more time in passing on their knowledge and enthusiasm to their undergraduate students and teaching assistants. Part of the faculty recognition for teaching courses might be in the form of extra periods of leave of absence, short stays in foreign universities and should be an important factor in professorial promotion and salary raises. In many universities the all-too-common reward for good research is that the professor has to do less teaching, and eventually the award will be a professorship that, ironically, implies no teaching at all. Thus, if less teaching is the reward for good research, is teaching some kind of punishment or a sign that the professor can do nothing else?

It is quite common to hear that young people in European universities are not attracted by engineering studies. The chemical industry and the associated institutions have managed to convey suitable information and to provide incentives and a positive image about the chemical world. But the new generations have other priorities: studies with more social impact (of course, chemical engineering has that), extra curricular activities as part of the regular

programme (such as spending some time as an exchange student overseas), time to learn a foreign language or perhaps having a chance to take some humanities electives. Again, virtuallyall these activities require a lot of time (most of the chemical engineering programmes are just too hectic), and dedication to the students, and as a French writer once said: *Time does not forgive what we do without it.*

UNIVERSITY–INDUSTRY RELATIONS

In university–industry meetings, the need for closer cooperation between both institutions is always stressed and this is understandable. The university needs industry to identify potential research problems, to ascertain industry needs regarding the contents and modernization of courses and, of course, to get some financial support. The industry needs two major products of universities: chemical engineering *graduates* and *research results* useful in solving problems.

Industry–university interactions can be very productive and of mutual benefit, but the gap between both institutions is not always small. One of the reasons may be that university research is largely supported by national or international agencies, and the industrial partnership is almost symbolic. Better relations between the academic and industrial sectors need to be promoted, both in teaching and research, and realization on both sides the kind of environmental factors that may hinder a fruitful cooperation.

CHEMICAL ENGINEERING IN THE EUROPEAN CONTEXT

Europe has had in the last century, and still has, different versions of the chemical engineer: The *Verfahrensingenier* (a kind of mechanical engineer + chemist), the industrial chemist, and the chemical engineer properly. There is no common European chemical engineering curriculum, and this is a drawback for many of the exchange students involved in overseas programmes (Erasmus or Socrates). Chemical engineering curricula need urgent reform, establishing a common core of courses, even with the same names, and giving the students a chance of a slight specialization in their senior year. This does not preclude departments keeping some courses that reflect the special areas of faculty expertise and regional or national concern. This kind of action would make student life much easier and the universities would be tuned in to this era of intended 'world globalization' while retaining the intellectual standards of the profession.

Most of the countries in southern Europe have adopted Chemical Engineering studies of the Anglo-American model, and students fit better in to British or American universities, than in German universities. The exchange programmes have been a success so far, and as the production of well-trained chemical engineers in the southern countries is high, there is no worry about a shortage of them, willing to work in industry, anywhere they are needed.

Most of the countries in the south of Europe have adopted the Anglo-American model of Chemical Engineering curricula. Hence their graduates are better suited for graduate work in British or American universities than in German universities. Several exchange programs have been successful, and because the production of well-trained chemical engineers in the southern European countries is high, these nations have no worries about potential shortages of well qualified chemical engineers.

Research programmes in the European Union (EU), involving institutions and industries from several countries, have been very successful. They have promoted research to solve industrial problems, have made possible the exchange of professors and students, and have contributed to a reduction in the research facilities gap between countries in the north and south of Europe. Unfortunately, in new calls for proposals, application possibilities for chemical engineering departments seem rather grim, and apparently only big groups or institutions have the chance to get funding. This approach may be the wrong way to go, because if the small, but dynamic groups do not get the funding they need from the EU, they may focus their efforts on research problems chosen for economic rather than social or industrial reasons.

THE UNFORESEEABLE FUTURE

The new century has opened many windows of opportunity in Chemical Engineering with the advent of the new technologies. The days when a refinery was designed with a slide-rule belong to the past, but many of the old technologies, such as distillation, are still widely used, in spite of being highly energy intensive.

New processes will emerge, but process improvements will also be needed for the not so new technologies. In the new era, the chemical engineer will have to interact more with chemists, biologists and material scientists, and therefore a common language will be needed and perhaps some degree of specialization. But it is easy to foresee that we will continue using heat and mass transfer coefficients and reaction kinetic constants based on experimental data. One of the limitations is that we cannot predict those useful parameters *a priori* from basic principles, but it is also a sign of our strength, an ability to combine experimental results, empirical correlations, rigorous analysis to obtain functional solutions that permit us to design and operate large scale plants that function safely and profitably, to the benefit of society. The ability to solve seemingly impossible problems is the hallmark of the profession.

Chemical engineering will continually evolve and tend to encompass more diverse topics. Evolution is necessary to meet the industrial requirements, but some present research areas might have a more appropriate and stimulating environment in another existing departments.

I think it is time to thank the reader who has had the patience to get this far! I also hope that the reader will find the selection of articles in this issue of the *Transactions of the Institution of Chemical Engineer*s useful, covering a diversity of Chemical Engineering topics, with authors from several countries.

José Coca
International Editor for Spain