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**THE PRACTICE OF CHEMISTRY EDUCATION
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*Chemical education in Europe:
Curricula and policies*

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THE CHEMISTRY GRADUATE DESTINED FOR EMPLOYMENT BUT WITH NO EXPERIENCE OF IT. DOES IT MAKE SENSE?

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ABSTRACT: The rôle of universities in the education of the next generation is perceived in different ways, but many would see, particularly in science, universities taking young people to the forefront of knowledge in a discipline and providing them with ability to be independent learners and thinkers. Universities are autonomous bodies and although cognisant of the world outside, and interacting, with it, tend to see their mission as self-contained. The ultimate destination for many chemistry graduates, industry, is perceived by many academics as being 'out there' and although providing increasingly useful sources of research funds is not seriously addressed as the 'customer' for the universities' products - graduates. This paper describes recent developments through an MChem enhanced undergraduate degree programme, which provides a truly integrated academe-industry degree. The paper traces its history from simple 'sandwich degree training', via an accredited diploma, to a fully fledged degree. [*Chem. Educ. Res. Pract. Eur.*: 2000, *1*, 169-174]

KEYWORDS: *chemistry graduate; employment; industry university partnership; MChem (Industry); new degree*

INTRODUCTION

It has been a long held traditional view that the purpose and function of a university education in the sciences is to provide young people with the foundations of a subject and knowledge to equip them for a lifetime of employment within their discipline. 'Only through a firm grasp of fundamental principles and a breadth of factual knowledge will they be equipped and in a position to contribute to employment in the scientific world', a traditional academic might argue. Most universities would see their rôle as fostering the acquisition of factual knowledge and the application by students of that knowledge to known, and with maturity, unknown situations. Predominantly this application of knowledge will be to academic problems. Yet the raison d'être for studying for a degree is ultimately to gain employment, and therefore to apply knowledge in the work (industrial) context. Key skills, needed by employers, such as team working and many communication and higher order organisational skills are also not easily acquired in the university environment. These skills needed for the future cannot simply be ignored unless we abrogate our responsibility to our students. They have to be acquired in the context they will be used. *My premise is that it simply does not make sense to educate students, predominately for the world of work, and give them no experience of it, whilst they are undergoing their education.*

We need to look afresh at how we educate our young citizens and to consider the approach of a combined university and industry education.

At Nottingham Trent, as one of the 'new' universities, we have a tradition going back over more than 30 years of giving our students an 'applied' education. Historically this has been in the context of an additional year, spent in industry, during their degree course. Although such a period gave students the opportunity of applying knowledge acquired at university to the industrial situation, it was seen as a year apart and in many respects was thus detached from the course. No great importance was really attached to the new transferable skills acquired in the work place, although it was noted (and welcomed) that the students were much more mature on their return to the institution for the final year. No particular attempt was made to maximise the benefit of the industrial year, either through specific preparation or reflection on return to the academic world. In addition there was no tangible award for the year in industry except that the degree title, 'Applied Chemistry' would be used rather than, 'Chemistry' for the course.

Eleven years ago, after consultation with industry, we addressed this situation through the introduction of a 'Diploma in Industrial Studies'. This qualification was the first serious attempt to look at the industrial experience of our students as a whole and to relate it not only to their chemistry studies in general terms, but to the different skills that they would be acquiring through participation in a 'work environment', rather than an academic environment. The concept was to

- see that the students were properly prepared for industry;
- monitor their progress whilst in industry;
- give them chance to reflect on their experiences on their return to us.

Thus the students were helped to prepare good quality *curricula vitae* and applications for industry, they learnt about different job types from visiting industrial speakers, were given advice on interview technique and tuition in report writing and were taught about safety, risk assessment and decision making. Whilst in industry, they were visited by academic staff, who also remained in touch with the students by telephone regularly. Assessments were made on the students' progress and their overall ability at the end of their industrial year. In addition they wrote a detailed report of their work and experiences, which was carefully assessed (in contrast to a superficial satisfactory/unsatisfactory assessment of the industrial report which had been made in the past). On return to the institution the students had a long personal interview with the visiting tutor about their experiences (debriefing). Additionally they gave presentations about their particular industrial company to their peers (which were assessed) and they received lectures about management in industry, company finance etc. If they were successful in all this, as most were, they received a 'Diploma in Industrial Studies' (with a commendation for the very good students) in addition to their degree. The course proved popular with students, spread to other departments in the university, and other universities, and received approval from the Royal Society of Chemistry in granting one year's exemption from postgraduate structured assessment for MRSC/CChem status of the Society.

Two years ago, with the embedding of the 4 year MChem degree in the UK (4 year university based undergraduate degree in chemistry) we embarked upon a further development of our policy of bringing together the academic and industrial experience. The time was now right to have a truly holistic approach to the education of young people for the

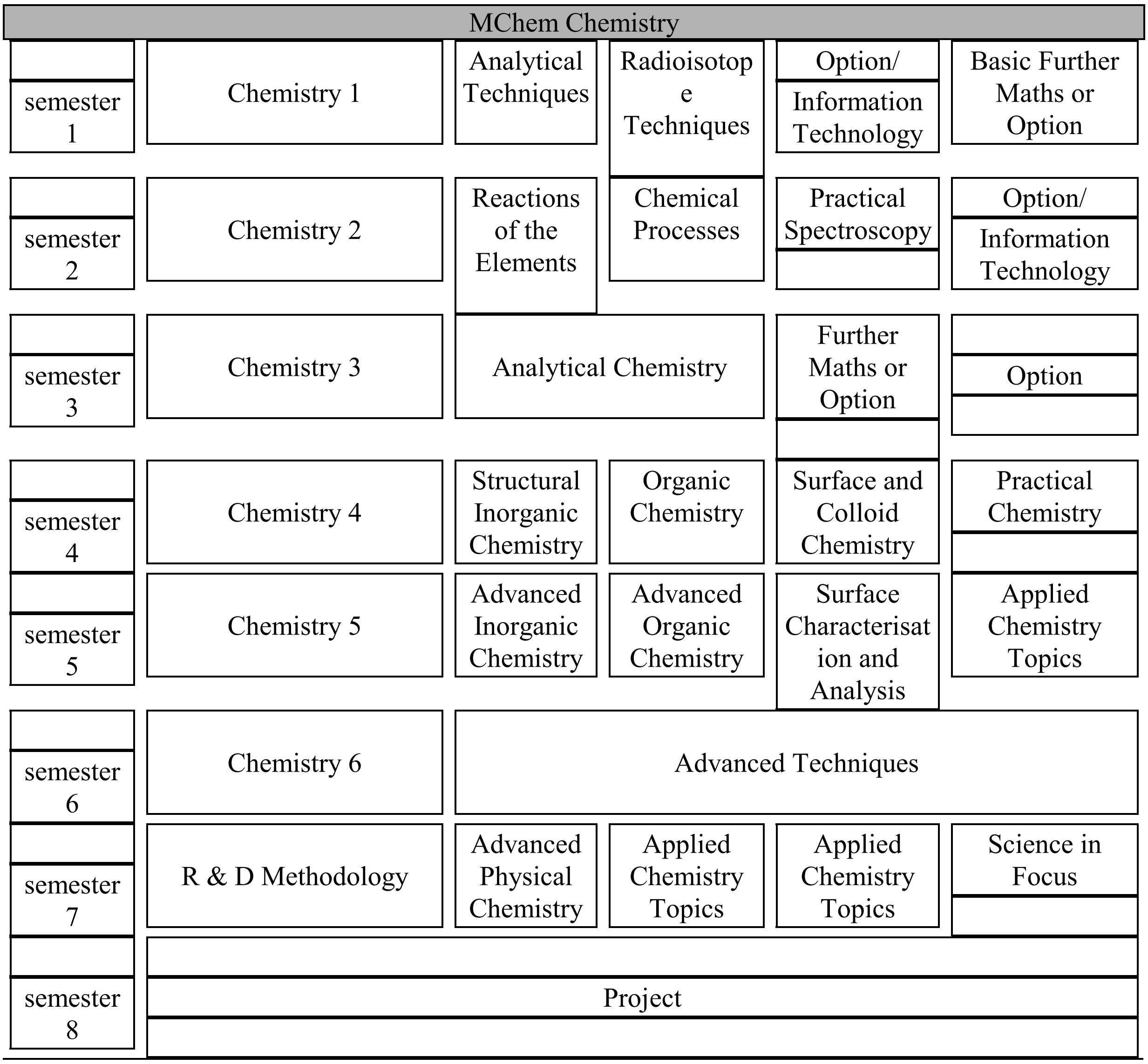

FIGURE 1. *The programme MChem Chemistry.*

world for which they would be part. After consultations and a strict validation procedure our course, MChem (Industry), was approved. It built on and incorporated all of the features of the Diploma in Industrial Studies. The current programme contains the 'core modules' of our full-time MChem programme (see Figure 1 and Figure 2) with a module 'Industry in Perspective' in the second year (semester 3) to prepare students for industry, and a module 'Science in Focus' in the fourth year (semester 7), when they return, to extend and contextualise the student's knowledge in management and science issues etc related to industry. Both modules are of 10 credit points value. (Students study 120 credit points value each year in the UK system).

In summary the industry year comprises five modules:

- students choose TWO from liquid crystals, organometallic chemistry and advanced analytical chemistry (these are traditional academic modules worth 10 points each, labelled Applied Chemistry Topics in Figure 2);
- professional skills (20 points);

- research & development methodology (20 points);
- project (60 points).

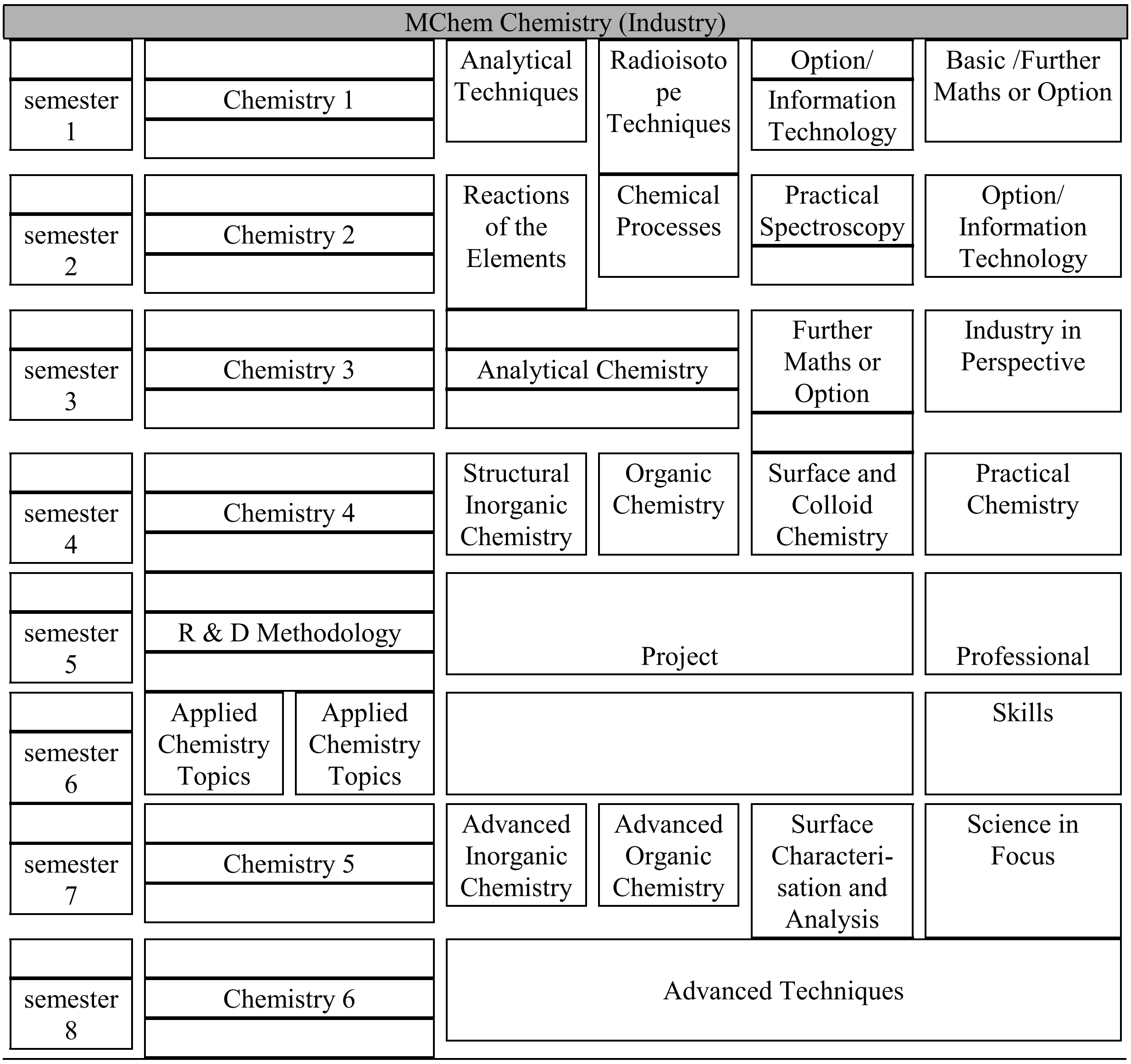

FIGURE 2. *The programme MChem Chemistry (Industry).*

What marks the programme out as being radically different from degree programmes which have operated in the past, is that 50% of the marks which contribute to the final degree classification come from the year spent in industry.

The academic modules are taught by distance learning and feature 2/3 formative assessments, an assignment based around practical work (data for which is provided) and an examination taken 2 weeks before the new academic year. A residential revision session is offered just before the examinations.

The professional skills module is based around the 3 visits made by academic staff during the industrial year. It comprises both appraisals of the student made by academic staff and the company - both short term on going and summative, a detailed case study made by the student of some aspect of the company's business (which includes an oral presentation) and a 'cognitive skills in work-based learning pack'. The latter is distance learning material, which helps students to identify cognitive skills they are developing during their time with the company.

The R & D methodology module acts as a preparation for the project module and involves elements of the rigours of experimentation associated with an extended project. The student makes a risk assessment of the project and a full report on the literature survey. It is in this R & D module that the student focuses on his/her own project in the context of the company. Previously he/she may have been assisting others, carrying out some routine tasks for the running of the laboratory and generally being directed in his/her tasks. The approaches taken, such as the design of experiments, choice of instrumentation, safety issues etc, which have been learnt are now applied to the establishment of a unique project, belonging to that student.

The project is of the traditional type being an extended piece of practical research work, familiar to most academics and undertaken normally by final year students. It is a substantial piece of experimentation, '60 full day equivalents' of research and culminates in a project report where the emphasis is on interpretation/discussion of results. Additionally the students have to give a presentation and are subject to a *viva voce* examination. They also have to prepare a poster about their project.

The modules and time in industry are designed to expose the students to the full range of key skills, including oral and written communication, team working, professionalism and the development of good interpersonal relationships.

The operation of our course has been such that the first cohort of students are completing their industrial period (year 3 of the 4 year course) in September 1999. Therefore no strict, meaningful analysis of its impact and results can be made at this juncture. However information provided by students suggests that they have enjoyed the experience very much, although it has proved hard work. Industrialists have been impressed with the professionalism of the course and have commented that it has brought new meaning to the traditional sandwich year, and have valued the newfound partnership with the university in training the new generation of graduates.

If it proves to be as successful as our long running Diploma in Industrial Studies then it is set to make its mark. Colleagues who are supportive of this type of approach to chemical education or wish to offer constructive criticism are invited to contact the author.

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