Essay

Asia-Pacific Journal of Cooperative Education

'The Analytical Club': A Unique Cooperative Education Link Between Industry and Academia

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Received 4 July, 2003; accepted in revised form 6 March 2004

In this article we describe an innovative link between a tertiary chemistry education provider and a British industry. The link termed 'The Analytical Club' provides for a unique collaboration and there are numerous benefits perceived by all parties. The principle benefit is the strengthening of links between the employer (the 'club companies') and tertiary institution. After five years of operation many of the student participants are now fully-fledged members of 'club' companies. (*Asia-Pacific Journal of Cooperative Education, 2004, 5(1),15-18)*

Keywords: Chemistry; United Kingdom; industry links;

According to Pearce (1997) analytical methods are a central component of an industrialized society with the effectiveness of research, development, production, enforcement, healthcare, and contractual specifications all being heavily dependent on having access to quality analytical expertise. As Pearce sees it, analytical methods is essential, and it is in the national interest, that the analytical discipline should be strong, well focused on current and likely future needs, and able to take advantage of professional expertise from wherever it is available. This applies to a variety of analytical disciplines including analytical chemistry, the focus of this paper.

In 1997, the Department of Chemistry, at the University of Surrey in Guildford, United Kingdom developed new specialized niche degree courses, namely, the Masters of Chemistry (MChem), and BSc (Hons) in Analytical and Environmental Chemistry. The drive for these degrees resulted from the opinions of The Royal Society of Chemistry, The Department of Trade and Industry, and The Laboratory of the Government Chemist. In addition, as part of Surrey's prevalidation requirements for new degree courses a questionnaire response was obtained from 20 international chemical companies. The selection of these companies was based on existing successful partnerships through cooperative education (or 'professional training' as it is termed at Surrey), research contracts, and graduate employment. A major request made by these companies was that the new degrees should provide graduates with additional specialist chemical and transferable skills experience, especially in the important field of analytical chemistry, and thereby enhance the students' future employability or research potential. A detailed evaluation of the degree programs offered in analytical chemistry by 18 other UK universities showed a general lack of: (1) real training using modern instruments, (2) practical and transferable skills-based experience in the industrial environment, and (3) cooperative education training based on major industrial projects. As a positive response to the opinions of these chemical companies, who work in the fields of petrochemical, agrochemical, pharmaceutical, chemical, food processing and industrial analytical measurement research and development, 'The Analytical Club' was thus formed.

'The Analytical Club'

The analytical club provides a unique collaboration between the University of Surrey and the chemical industry. The

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members of the club have an advisory role in overseeing the design and operation of degrees in analytical and environmental chemistry (including the existing MSc in Chemical Research in Industry). In January 2001, the analytical club was composed of industrial scientists from Castrol International, Zeneca Agrochemicals (now Syngenta), Ethyl Petroleum Additives, British Petroleum, Tetley GB, Thames Water, Akzo Nobel, Eclipse Scientific, NuFarm UK, Eurotest, and Symonds Environmental. Associate members are Borax, Laboratory of the Government Chemist, and Wyeth Ayerst. Initially the club was designed to facilitate a close relationship with 'local' chemical companies. However, following a recent club meeting Glaxo SmithKline, Pfizer, Micromass UK, and Varian have all asked to join the club. In general, the industrialists who actively participate in the club are research and development laboratory managers or senior technical staff who are specialists in the various areas of analytical chemistry. Most are also responsible for the selection and supervision of cooperative education or professional training placement students for their companies, and have for many years employed Surrey students on 12-month industrial placements.

It should be stressed that the analytical club operates as a club, in that there is no formal financial commitment in terms of membership and the objectives are to have a proactive exchange of expertise and 'real-life training' experience to the mutual benefit of both industry and academia. In addition, many industrial members find the club to be a more informal environment for discussing ideas or problems with fellow industrial and academic analytical chemists.

Confidentiality is always a very important issue with regards to the research and development area of any chemical company. Whilst individual company confidentiality requirements are always respected the club provides a unique interactive level for discussing health and safety issues (Health & Safety Guidance for the Placement of Higher Education Students [HSGPHES], 1999) or technical details relating to purchasing or maintaining major analytical chemistry scientific instruments such as high performance liquid chromatography (HPLC), inductively-coupled plasma atomic emission spectrometry (ICP-AES),[1] elemental analyzers, and so on. More importantly, since the club is linked to the Surrey cooperative education or professional training program any confidentiality issues are dealt with in the same way as for students undertaking a co-op placement. That is, the training experience does not contain any confidential components or all students undertaking a specialist piece of research for the company sign a company confidentiality agreement.

The main functions of the analytical club are to provide:

1. Industrial expertise in both the theoretical and practical applications of analytical and environmental chemistry, and wherever possible, other related areas
2. Real training in the industrial environment using modern instrumentation, international validation programs (International Organization for Standards [ISO] 2004; United Kingdom Accreditation Service [UKAS], 2004; Good Laboratory Practice [GLP], 2004), health and safety issues (fire fighting equipment, hazardous waste disposal, corrosive chemical spillages and storage of chemicals) and problem-solving projects on real industrial-based chemical problems, enhanced transferable skills experience in both the academic and industrial environment, with an active participation in the University of Surrey Skills and TRANSEND Projects (Burden & McAvinia, 2000; University of Surrey, 2004b; Ward, Hammond, Marcilla, Brion, & Mujica, 2003)
3. Cooperative education (or professional training) placements in the UK utilizing the additional laboratory, transferable skills and problem-solving experiences gained through specialist student self-learning practicals and industrial site work undertaken at undergraduate levels 1 and 2
4. Enhanced industrial training to prepare graduates in analytical chemistry for future careers in industry or research
5. Collaboration between industrial and academic colleagues for undertaking innovative research projects (via cooperative education training, final year research, MSc or PhD projects), and pursuing joint research grants.

Benefits of the Analytical Club to Industry

The main advantages for the chemical company members of the analytical club (and therefore the staff and students of the University) are to:

1. Provide a key role in the training of young analytical chemists in the real chemical and industrial workplace
2. Ensure that such chemists have the required 'analytical' and transferable skills necessary for future employment in the chemical industry and or for undertaking postgraduate research
3. Play an active role in the development of modules or practicals and the teaching of analytical chemistry and other related areas within the university and industrial environments
4. Obtain motivated students who through their experiences via these degrees will provide good candidates for cooperative education training, MSc, and PhD positions
5. Provide future research collaborations with academic colleagues
6. Provide an active environment for inter-company research and development interaction, e.g. benchmarking, discussion forum for validation procedures/instrument purchasing, inter-laboratory quality assurance/control programs, and
7. Identify students for future employment.

[1] HPLC and ICP-AES are state of the art analytical chemistry techniques that use sophisticated scientific instruments to measure substances at very low levels; parts per million (ppm) and parts per billion (ppb).

How Does the Analytical Club Work?

Industrial members of the analytical club were actively involved in the development and validation of the degrees in analytical and environmental chemistry. The club meets twice a year, once at a chemical company (to review the structure and operation of the degree programs and participate in inter-company activities, for example, benchmarking, health and safety or quality assurance audits, etc.) and on 'industry day' at the University of Surrey. Industry day is held each year at the university in early November and provides an opportunity for cooperative education (or professional training) students to deliver both poster and oral presentations on their industrial research projects. The audience consists of industrial supervisors, members of academic staff, senior members of the University's Careers Service and Centre for Learning Development (Skills and Library staff), senior professional training tutors from other schools, and undergraduate and postgraduate students. The analytical club meeting is held in the morning of industry day and provides an open forum for discussion about the degree programs with all undergraduate students and academic staff. At recent meetings members of the University Skills Project and the World Association of Cooperative Education (WACE-Professional Training) have provided oral presentations on their employer feedback projects. Second-year analytical and environmental chemistry students take the club minutes of the industry day meeting and provide verbal reports on industrial site and final year projects. Members of the Surrey Careers Service are also invited to these meetings.

Industrial colleagues also played an important role in the design of niche analytical and environmental modules, specialized practicals and the operation of instruments (HPLC, capillary gas chromatography, flame atomic absorption spectrometry, ultra-violet and infra-red spectrometers)[2] for self-learning practicals. Many of these instruments were donated by the chemical companies of the analytical club, for example, Borax, Castrol International, Ethyl Petroleum Additives, Zeneca Agrochemicals/Syngenta, and Wyeth Ayerst. The specialist student self-learning practicals involve personal training on instruments via computer-aided instruction. This type of individual practical experience was designed to utilize many of the key aims of the Surrey Skills Project and the 'national' key skills listed by the Qualifications and Curriculum Authority (QCA, 2004), namely, planning and organization, personal effectiveness and numeracy, problem solving, improved self and group learning using information technology. Examples of the self-learning practicals include infrared spectrometry, capillary gas chromatography, normal and reverse phase high performance liquid chromatography (HPLC), flame atomic absorption spectrometry (FAAS), ion chromatography and inductively coupled plasma-mass spectrometry. Many of these techniques are recognized by the chemical industry as being the backbone of their research and development work. Industrial colleagues have regularly reminded academic teachers that there is an essential need to train young analytical chemists in the operation, and not just the theory of these instruments.

According to Boyle (2000) the most important feature of industrial training is to ensure that skills development is built into the course allowing 'on-the-job' development. This is a key feature of the operation of the analytical club and the analytical and environmental chemistry degrees. Twice a semester, students studying at undergraduate levels 1 and 2 undertake on-site analytical instruction and problem-solving visits to the various chemical companies. Attendance is a compulsory part of these modules and the on-site activities contribute to a significant part of the coursework marks. Through these visits students gain direct industrial experience of the 'business environment', including health and safety enforcement, quality assurance (ISO, 2004; UKAS, 2004; GLP, 2004) audit trails, quality assurance programs, the operation of advanced instrumentation and sample analysis using on-line and in-line techniques relative to chemical processing. This 'real-training' experience is not a site tour (as would be typical for a secondary school visit) but involves practical work, instrument operation (X-ray fluorescence, Fourier transform infra-red spectrometry, gas chromatography-mass spectrometry, inductively coupled atomic emission spectrometry, etc.) and active interaction with industrial colleagues at the 'coal face'. Coursework is set for each industrial site visit involving many aspects of advanced transferable skills development. The projects are designed in relation to the requirements of the company. Many projects include self and group activities, data logging, graphical and/or statistical data evaluation, information retrieval (on-line computer searches), new analytical method development and presentations (oral, written technical reports, posters). All assessment of the coursework is undertaken by chemistry department staff. However, feed-back forms are provided by the industrial supervisors who comment on the scientific content of the work and it's relevance to their industrial requirements. For most students this on-site experience also provides valuable industrial experience before they undertake their 12-month industrial placement (level 3), and in many cases provides the 'experience' they use to select the company or research area of their placement.

During the Surrey 12-month cooperative education (or professional training) period in industry and the final undergraduate degree year (level 4), all analytical environmental chemistry students undertake specialized industrial research projects and develop an in-depth review of a famous scientist. This 'on-the-job' training provides an excellent foundation for post-cooperative education training and good graduate employment opportunities.

After the first five years of operating the analytical club many students on these analytical and environmental degrees have undertaken postgraduate research or been employed with the analytical club companies. In particular, 12 graduates now work for these companies, seven have undertaken an MSc degree in industry, and eight have or are

[2] These techniques like HPLC and ICP-AES are used to probe for low levels of certain substances. Some are suitable for one type or class of substance (e.g., organics) and others for other substances (e.g., heavy metal pollutants, etc.).

completing PhD research programs. Interestingly, two graduates are now teachers, one is an accountant, and two have set-up their own analytical laboratories in either environmental and food analysis or the forensic science service.

Summary

In summary, the analytical club has been established as part of the teaching and cooperative education program of specialist niche degrees in analytical and environmental chemistry. At the University of Surrey cooperative education (or professional training) placements occur in nearly every academic subject (University of Surrey, 2004a). The concept of forming such informal clubs between academia and other professions is an exciting opportunity to advance educational learning opportunities. Moreover, chemical companies are looking for graduates with enhanced transferable skill and 'real-life' training experience. It is also important that educators not only rely on traditional academic methods of teaching but should innovate their courses with the ideas and expertise of industrial or professional colleagues. The end result is a more stimulating work environment for all parties involved and ultimately graduates who are properly trained for future employment.

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