Submission to the Standing Committee on Science and Innovation

Encouraging Student Participation in the Enabling Sciences

Participation in the enabling sciences at both the secondary and tertiary levels has decreased over the past twenty years. The consequences of this decrease are beginning to impact in the employment market with, for example, serious shortages of chemistry graduates, particularly in the pharmaceutical and biotechnology industries. The Queensland Chief Scientist, Peter Andrews, has estimated that there is a need for 75,000 PhD graduates in the enabling sciences over the next six years (Sydney Morning Herald, p7, August 11, 2004). The number of graduates with a PhD in chemistry has fallen from 18 per million people in 1969 to 8 per million in 2003. The impact of falling enrolments on the employment market has been delayed by the bulge in graduates following the baby boom and the related increased intakes of students in the sixties and by changes in the nature of chemical industry in Australia. However, Australian industry will be more dependent than ever on well qualified graduates in the enabling sciences over the next decade and this corresponds to the period when large numbers of these graduates will reach retirement age.

1. Factors inhibiting student participation

One of the major factors determining student choices of courses, particularly at the tertiary level, is perceptions of career opportunities and rewards.

Employment in the sciences has undergone substantial change over the past decade. In the past, the largest employers of chemistry graduates were large industrial manufacturing companies such as BHP, Shell, ICI, Dulux, Roche, etc. There has been substantial downsizing in these companies, particularly in the research and development operations with in many cases all of these activities being moved offshore or outsourced. This has led to the perception that there has been a substantial decrease in employment opportunities for chemists. However, there has been a similarly substantial increase in the number of small companies, many taking on the outsourced research and development activities, and others emerging in the biotechnology and pharmaceutical areas. These small companies do not have the same visibility as do the large companies contributing to the perception of a lack of employment opportunities. At present there are severe shortages of chemists, particularly in the biotechnology and pharmaceutical areas.

The shift in emphasis from large scale manufacturing companies to small scale biotechnology and pharmaceutical companies has led to the perception that the enabling sciences are less relevant and have been displaced by sciences such as biotechnology and genetics. These sciences are critical in most of the new developments but the reality is that more than 50% of the scientists working these companies are chemistry graduates. Chemistry also underpins these areas and is a critical component of biotechnology and genetics courses. The same applies to other emergent areas such as materials science and nanotechnology which are either exclusively staffed by chemists and physicists or by scientists and engineers with strong grounding in these enabling sciences.

An additional factor guiding career choices is the perceived importance of a particular profession and there has been a significant deterioration of the standing of science in the community over recent decades. Now, where science does appear in the popular media, it is most often either pseudo-science or negative stories related to pollution and other toxic agents. The most positive perceptions of science emerge from television programs that focus on forensic science and these have generated strong interest in this area, despite only a very small number of positions being available.

Related to these issues is that misconception that there is little left to discover in the enabling sciences. The reality is that the enabling sciences are ever more active in interdisciplinary science and this is leading to an increase rather than a decrease in the range of important problems needing to be addressed.

Another important factor affecting the choice of subjects at the secondary education level is the background of the teachers of the enabling sciences. A minority of chemistry and physics teachers have formal qualifications in these areas, the majority being biologists or mathematicians, respectively. As a consequence, these teachers are unable to impart the same enthusiasm for the subject and have difficulty teaching what can be challenging subjects to students. The best students, those who are able to cope with these subjects, and the small number of students who do have appropriately trained teachers are highly enthusiastic about the enabling sciences.

2. Encouraging greater participation

Secondary Sector

Most scientists, when asked why they pursued their career, refer to encountering an outstanding teacher during their secondary or tertiary education. It is critical that mechanisms be established to encourage top quality graduates with a passion for science to take up high school teaching. At present, teaching has only a moderate standing in the community and the salaries are poor. It may seem invidious to separate out one group of teachers for preferential treatment, but market loadings are used in the tertiary education sector and would be effective in attracting better qualified teachers of the enabling sciences. There would be positive flow on consequences for the standing of the broader teaching profession.

The enabling sciences are major contributors to many of the newly emerging technologies including biotechnology and nanotechnology. This contribution is largely unrecognised and students frequently pursue other subjects in the mistaken belief that these are the only route to careers in these new areas. There is an urgent need for careers advisors and science teachers to be better briefed on the reality of opportunities for graduates in the enabling sciences.

Tertiary Sector

Interest in the enabling sciences is very strong and growing amongst the very best students. For example, the University of Sydney runs a number of programs for talented students. The chemistry program began 10 years ago with 15 students drawn from the top 7% of the cohort and in 2004, the same program had 56 students drawn from the top 2%. Equivalent programs in physics and mathematics have experienced similar growth. This growth in interest in the enabling sciences is due in part to exciting and challenging publicity and training programs run by the University of Sydney and confirms that with the right advice and encouragement, students will pursue the enabling sciences. What is needed urgently is strategies to expand these activities to broaden the base of interest in enabling sciences.

Most universities in Australia have allowed the enabling sciences to atrophy with the consequence that many no longer have identifiable chemistry or physics departments. The experience at the University of Sydney where the enabling sciences remain vibrant is that there is still strong interest in these subjects, but that much effort is required to properly advise students on why the enabling sciences remain the core of modern technologies. It will be far more difficult for those universities without strong departments to convince students of the importance of the enabling sciences when they have themselves failed to support them. A significant cause of the atrophying of these departments is the preference of students to pursue, in particular, the biological sciences. Data is urgently required on the career opportunities available to graduates of the different sciences and for this data to be made widely available to students when they are making career choices, at the end of Years 10 and 12 of high school.