Submission accompanying the appearance of Prof Margaret Britz, A/Prof Stephen Ritchie and Mr Stephen Loggie as witnesses before

The Senate Standing Committee on Employment, Workplace Relations and Education
Inquiry into Academic Standards of School Education
Public Hearing, Brisbane, 6 June 2007

Context

There are numerous reports available that highlight an on-going "science crisis", documenting trends that have emerged over the last 20 years in a declining interest in science in high schools and the accompanying implication that there is a failure in the curriculum or delivery of science education in Australia's school system[1]. In this brief paper, we wish to comment on three issues in context of Terms of Reference 1. and 2. This draws on the experience of the witnesses in tertiary science education (Prof Britz), science teacher education (A/Prof Ritchie) and delivering senior secondary education to gifted science students (Mr Loggie).

What universities want

University tertiary science courses aim to skill graduates with attributes to prepare them for future professional employment in industry, research, education and other diverse destinations. A minimum outcome is science literacy that forms the knowledge base, philosophy and problem-solving approach unique to science that can be used throughout life and in different settings. For many professions, registration, accreditation or licence to practice demands deep discipline knowledge and evidence of professional competency. Increasingly employers are demanding additional attributes that are needed for translation into employment and the "real world" – good written and oral communication skills, understanding of social dynamics in groups, working well independently and in groups, as well as computing skills (the "generic skills"). Most graduates recognize that it is not the knowledge acquired at university that is important, but the ability to translate the underlying knowledge and approach into different contexts – learning the process of learning. The tertiary science sector is expected to deliver many outcomes building on the knowledge, skills and experience of high school graduates who are increasingly recognized as poorly prepared to acquire the professional and generic attributes during a three- or four-year degree. The perception of falling quality of high school graduates entering universities is influenced by:

- Tertiary academics expecting a stronger, "hard wired" knowledge base in incoming students, while high school curriculum caters for a variety of outcomes and exit expectations (not just university entry).
- Diversity of "science" subjects offered in high school curricula. Some subjects are seen as "softer science" by tertiary academics, while attractive to high school students and engaging their interest.
- English and a mathematics subject are the only prerequisites for entering many science degrees. Dropping prerequisites occurred to ensure entry numbers and to cater to the decline in students selecting chemistry and higher maths.
- Diversity in teaching, learning and assessment approaches. Moves to teaching science in context or investigative approaches in years 1-12 does not necessary prepare students for the more traditional assessment used in universities.
- Growth in the total numbers of university students entering science degrees with the expansion of participation over the last 25 years. With the exception of elite professional courses, science faculties recruit students with entry scores well below other disciplines (e.g. published OPs in Queensland down to 19 on a 25 point scale, with 1 representing highest achievement).

Literacy and numeracy skill, as well as underpinning discipline knowledge, must then be addressed at university by embedding remedial content into curriculum design. Lack of financial flexibility to run concurrent streams then means that elite students are not challenged in their first year at many universities.

Closer links between the tertiary and secondary sectors, and a concurrent review of what universities can deliver, and how, is needed in the short-term while the issues of curriculum design across the primary and secondary sectors are in focus. Years 1-12 should not lose diversity while addressing the "science crisis", given that science skills are valuable outside the science profession. There is also a tension between producing widely educated year 12 students who are non-specialists and the needs of universities to have specialists entering. Perhaps a "year 13" should be on the agenda.

We see some wonderfully talented, skilled, dedicated, curious and well-prepared entrants into university science courses, so the positive outcomes from the year 1-12 experience should not be minimized or dismissed.

What students want and need

Attitude and community values strongly influence how today's students approach their education. Secondary students lead complicated and busy lives, where study is just one component and not necessarily the main focus. They are outcome focused and clearly recognize what they need to do to achieve their goals: they want to learn but under circumstances that suit their lifestyle, needs and wants. The way they learn has also changed and the way that education is delivered has changed. This translates into tertiary studies, where juggling life, job and full-time study means that many students depend on electronic delivery rather than attending classes and apparently do not understand the "effort and reward" relationship: education is increasingly seen as delivered to the student rather than a learning experience through exchange, challenge and guidance. Exceeding comfort zones for some students is seen as a breach of contract in delivering tertiary education, rather than challenging them to perform at a higher level that may open new thinking processes. In some instances, students entering university are frustrated because they want to learn but lack the fundamental knowledge to achieve at a high level – a commentary on how much "hard wiring" should be balanced against the need to excite and motivate year 1-12 students about science. Talented students are motivated by the context of science but find it hard to pick up the content. It is unlikely that prophesizing about future jobs and careers in science will influence some of the underlying community and youthful attitudes, nor change the perception of the value of science education.

A commentary on teachers

The standard of the science teaching graduates is higher today than ever before: four-year degrees, often with concurrent studies with science students rather than in separate courses, better prepares teachers. Science teachers are generally more oriented to the sciences than education as an academic discipline and are more likely to enter a higher degree program in science education through a MSc rather than MEd. Many senior high school teachers now have higher degrees (Masters in science or doctorates) and choose to take up careers in teaching, wanting more than the laboratory can offer. Teachers need constant motivation to stay abreast of the changing and growing scope of science knowledge and professional opportunities, yet the reward for this is sometimes obscure and the means of achieving this unclear (who pays, who replaces staff on study leave, secondment or placements). Professional development and refreshment, particularly for middle school teachers, is important: primary students are intrigued and interested in science, but lose this enthusiasm in the middle school years – curriculum, content or teaching may all be causal.

[1] R. Tyler, 2007. "Australian Education Review. Re-imaging Science Education: engaging students in science for Australia's future", Australian Council for Educational Research