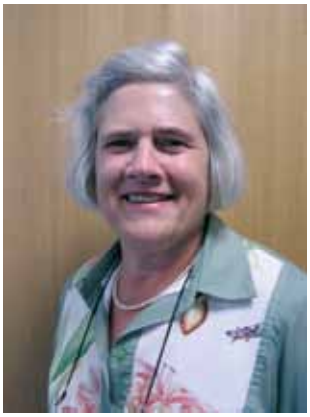
The challenges of teaching microbiology

Chris Burke

National Centre for Marine Conservation and Resource Sustainability
Australian Maritime College
An Institute of the University of Tasmania
Locked bag 1370
Launceston, TAS 7250
Tel (03) 6324 3806
Fax (03) 6324 3804
Email C.Burke@utas.edu.au



Cheryl J Power

Department of Microbiology and Immunology
The University of Melbourne
Parkville VIC 3010
Tel (03) 8344 0332
Email cheryljp@unimelb.edu.au

By its nature, education looks to the future – in that the benefits are in the future with an educated populace. However, education functions in the present and faces problems that must be resolved now, in order to achieve the future benefit. The true measure of education, then, is the success of student learning, which is served by good teaching. Altering our perspective as teachers to seeing the goal as student learning outcomes rather than being 'good teachers' opens up many different challenges. Understanding too that if we have taught well, then student learning will continue lifelong. As the American philosopher, Eric Hoffer, said *"The central task of education is to implant a will and facility for learning; it should produce not learned but learning people"* [1].

What students learn in one class influences and is influenced by what is learnt elsewhere, so that we need to teach with reference to the whole student learning experience. By doing this, teachers can construct courses that produce learning that is greater than the sum of the parts. The traditional collegiality of higher education should provide a fertile ground for academics to work in this manner. However, compared to the collegiality of research, teaching has often been done in isolation. Apart from the lost opportunity of effective integration within courses, this has meant that teaching practices have been less likely to be rationally reviewed against the effectiveness of their learning outcomes. Even good teachers may not be able to explain why and how students learnt in their courses. Over the last decade or so this has been changing, particularly since the seminal work of Boyer focused attention onto the scholarship of teaching (and learning) in higher education [2]. The scholarship of teaching and learning (SoTL) provides not only the opportunity to achieve strong learning outcomes, but also a field of research [3]. In this manner, SoTL moves from a perspective of solving teaching problems to understanding how students learn. This requires a much larger time frame and data set than one semester's class and, like any research, establishes worthwhile questions to be answered with experimental data.

In order to understand new concepts, learners must integrate new knowledge with their pre-existing knowledge and concepts and reconsider any misconceptions. Learning can be defined as the transfer of new knowledge from short-term, limited capacity, working memory to long-term memory. Failure to do so means that knowledge retention will be poor. Identifying students' initial knowledge is important for determining the path towards the desired learning outcomes, which should be defined at progressively finer levels: course, year, unit and topics within units. After defining the learning outcomes, the means by which their achievement will be measured must be established. From all of these, the teaching activities can then be developed to align initial student knowledge with the target – the learning outcomes. Essentially, we define the *what* and *how* of a unit and can explain *why* the teaching program can achieve its learning goals.

Another challenge to teaching science is the changing nature of society. We are faced with ever more complex conundrums that require an educated populace to make ever more complex political decisions (for example, the recent Copenhagen Climate Change conference). Thus, it is vital that our students graduate with a sound understanding of their disciplines, in order that they will be able to participate rationally in such decisions. It is not feasible that we can teach all that students need to know, but must instead teach them how to continue learning within the discipline – how does a professional microbiologist think? With what learning resources are they familiar? Can they apply their existing knowledge to pose sensible questions and then examine these questions? All of this underlines the importance of teaching students not only what to know within microbiology, but also how to think as a professional. In this context, the discipline societies such as the Australian Society for Microbiology (ASM) can play an important role. The American Society for Microbiology has been active within the field of microbiology education for some time now and has developed or contributed to substantial programs such as:

The *MicrobeLibrary,* which provides peer-reviewed teaching resources.

The annual Conference for Undergraduate Educators, *ASMCUE.*

The *Biology Scholars Program* for teaching and applying SoTL.

The *Journal of Microbiology and Biology Education* for publication on SoTL.

The developments of communities of practice such as these provide powerful tools for enhancing teaching and learning in microbiology, simply because teachers can learn from others, rather than always starting anew. It would be timely for the ASM to likewise determine how it can influence microbiology education in Australia. What do we want graduate microbiologists to know and to be able to do with their knowledge? What do we want other graduates to know and understand of microbiology? See for example the *National Graduate Attributes Project*.

Finally, there is the challenge of the changing nature of education. Perhaps the most obvious of these are the changes being implemented to the undergraduate programs at the University of Melbourne: the Melbourne model. This is based on six broad undergraduate programs followed by a professional graduate degree, research higher degree or entry directly into employment. The emphasis in the new degrees is on academic breadth as well as disciplinary depth. Depth is described as the expertise gained by studying a core program in a major discipline, whereas breadth results from choosing additional subjects from outside the major area of study, to develop other kinds of expertise. Breadth studies make up at least 25 per cent of the academic program.

The Melbourne model has impacted on the study of microbiology at Melbourne University in two main ways. Firstly, the disciplines of microbiology and immunology have been combined to constitute one major rather than two. The major includes one microbiology and one immunology lecture unit and a practical unit including techniques from both disciplines. Students then choose one or both of virology or advanced immunology to complete their major. From several viewpoints these subjects team well together, but the compulsory combination has meant that the microbiology taught has a distinct medical focus rather than a broader, more general view, as it previously had.

Secondly, the inclusion of breadth means that students have less opportunity to pursue subject areas associated with, or complementary to, their chosen area of study. The number of undergraduate subjects on offer has decreased, particularly practical subjects. As such the addition of one or two postgraduate study years becomes even more desirable, particularly if an extended practical experience is sought. The prerequisite second year subjects for students enrolled in a science degree remain unchanged and include a general microbiology lecture unit including some immunology and a microbiology practical unit. For students enrolled in a biomedicine degree, a subject combining medical microbiology and immunology with case–study based practicals is taught. Both science and biomedicine students then complete the same combined major in their third year. Class sizes are comparable to previous years, with the exception of the entry subject for biomedicine students which has expanded significantly. As in previous years, the only subjects required as prerequisites for studying microbiology in second year are two first-year biology units. Microbiology features in some of the breadth subjects and some microbiology subjects are able to be chosen as breadth subjects by other than science and biomedicine students. In this way, a taste of our discipline can be disseminated to an interested few, but for the large part it will continue to be the domain of committed science students and students enrolled in a postgraduate medical or dental degree.

This issue of *Microbiology Australia* addresses all of the issues raised in this editorial and we hope that you find the articles thought-provoking and helpful as you develop your teaching programs to engender the learning outcomes that you believe appropriate. In the end, the challenge for all microbiology educators, both within formal educational institutions as well as employers training staff, is to be able to explain why we teach in the manner that we do and how it leads to good learning outcomes. We thank the contributors, reviewers and editorial staff for their combined efforts in producing this issue.

References

1. Hoffer, E. (1973) *Reflections on the Human Condition.* Harper and Row, New York.
2. Boyer, E.L. (1990) *Scholarship Reconsidered: Priorities of the Professoriate.* Carnegie Foundation for the Advancement of Teaching.
3. Bass, R. (1999) The Scholarship of Teaching: what's the problem? *Inventio 1.* At: http://www.doiiit.gmu.edu/Archives/feb98/rbass.htm

Biographies

Chris Burke is a senior lecturer and degree coordinator in the NCMCRS. He has a strong interest in teaching and has taught in microbial ecology and aquatic ecology for nearly 20 years. In 2007 he was awarded a Carrick Citation for Outstanding Contribution to Student Learning and is currently a UTas Teaching Fellow.

Cheryl Power is a lecturer in the Department of Microbiology & Immunology at the University of Melbourne. She has taught microbiology to students enrolled in many different courses for over 30 years. Her educational research interests include the use of assessment to drive student learning and the importance of practical class experiences in microbiology courses. She was Convenor of the Education Special Interest group for over 15 years and was the Guest Editor of *Microbiology Australia*, Volume 24, No. 4, November 2003 which was the first issue of the journal devoted entirely to educational issues.