AuPS/ASB Meeting - Canberra 2005

Symposium 3: Physiology Teaching in the 21st Century: Trends, Challenges and Innovations

Thursday 29 September 2005

Chair: Kay Colthorpe and Hardy Ernst

Challenges facing physiology educators in the 21st century

Ann Sefton, Faculty of Medicine, University of Sydney, NSW 2006, Australia.

Physiology is a core subject in health-related curricula and in medical science programs; aspects are often incorporated into other courses. Broadly, the challenges facing those who teach physiology include issues relating to the increasing amount and complexity of subject knowledge, the different destinations and expectations of the students, the changing nature of those student cohorts, the costs and difficulties of providing modern experimental work, and the need to adopt appropriate, evidence-based educational practices.

Issues include the need for clarity in the specific and generic goals or outcomes, whether for a single unit or an entire program. Designing an explicit progression in knowledge as well as in generic and specific skills supports students. Setting limits provides clarity and avoids unnecessary duplication. Students learn in many different ways; providing a range of learning experiences helps to support them effectively. Active learning is a core aim.

Practicals pose challenges, but offer valuable opportunities for interactive group work. Skills gained include designing an experiment, obtaining, recording, analysing and presenting data in a range of different ways. Problem- or case-based studies can be used effectively within physiology, and physiologists contribute to integrated problem-based medical and other health science programs.

Well-designed information technology offers on-line learning resources, simulations and the means to design and record results for a range of experiments. IT can provide flexibility for students who increasingly need to work.

Formative assessment supports learning. Well-designed summative assessment, matched to the goals of the program, evaluates achievement in a range of essential knowledge and skills. Targeted evaluation provides helpful feedback to staff.

Research led teaching and learning in physiology

R.E. Kemm, Department of Physiology, University of Melbourne, Parkville, VIC 3010, Australia.

'Research Led Teaching' (RLT) and its effective implementation and evaluation are the focus of my interests in improving Science Physiology teaching. My aim is to describe some findings during a recent overseas study tour. Since The Boyer Commission Report on Educating Undergraduates in Research Universities (1988), there has been a strong move by research universities to include RLT in their mission statements. The problem is how to marry the great success of research universities and the commitment of their researcher/academics to research with the effective sharing of their philosophy and enthusiasm with undergraduate students in a RLT philosophy. Projects in various universities address how to introduce this institutional ethos of RLT in curriculum design, such as Warwick University and others, and these can provide useful guides to best practice. Few research universities have published detailed management plans to implement their RLT policies, fewer still have definitive curriculum changes that reflect their mission statements and even fewer have yet provided evidence of changed student learning practices or learning outcomes. It has been difficult to find good examples of coherent and extensive use of RLT in biomedical science curricula, let alone in science physiology. However on my recent study tour I found good, but often isolated, examples of RLT in biomedical science courses as well as interest in other institutions in moving towards formally incorporating RLT practices into their curricula. In biomedical sciences, students usually undertake courses with lectures, laboratory classes and varying amounts of tutorials or e-Learning activities. There may be some problem-based learning elements introduced into science curricula, but funding limits for staff have restricted such approaches to medical courses. In trying to design appropriate science curricula within a research university, the limitations/advantages of each of these modes of delivery/interaction needs to be considered. Another important issue is how to provide central support to academic staff to helps them initiate changes in their approaches to teaching to match the institutional philosophy.

An overall objective for graduates in Science physiology would be for them to have the skills of experimental investigators so that they can continue with a professional career in science or have a thorough appreciation of evidence based research to support other careers. Many of these skills are generic and apply widely across the spectrum of University graduates, whereas others more specific to biomedical sciences need to be added. These common generic skills are usually well identified within an institution's guidelines for teaching and learning.

A major task is to design a curriculum that help the students understand that the challenge for them is to become independent learners during their undergraduate courses so that they are able to be effective life long learners adapting to a rapidly changing world of science. Students are often driven by assessment and many will take a surface, rather than deep approach to learning if that is what is rewarded. It is essential that there is a constructive alignment of assessment that rewards a deep understanding of the subject, rather than using traditional examination processes that reward a detailed knowledge base in the discipline. It is also imperative that students have formative assessment of their progress with such skills, such as critical reviewing of literature and problem solving, rather than be assessed only in end of semester examinations. Traditional mentoring, with few students per academic, achieved this in the past. Increasing pressure of student numbers means this is no longer a viable option and new ways, supported by e-Learning, need to be incorporated to assist in the progressive development of many generic skills. Lecturers are slower to introduce RLT components into the earlier years of physiology, but many more elaborate on their own research in final years of physiology. Enquiry based learning is often practiced in student-centred laboratory classes, but formal structuring of hypothesis testing and experimental design is not often undertaken. There are some examples of on-line e-Learning to reduce staff workloads with new initiatives.

The final challenge is to evaluate whether or not RLT incorporated throughout a curriculum, has resulted in useful learning outcomes. Valid statistical comparisons of different curricula are always difficult in education, so it maybe more useful to see if the curricula goals are met. Student engagement questionnaires can help determine if the students have appreciated the RLT approach and have adopted a deeper learning style. However, new instruments need to be designed to see if students have the desired skills on graduation, such as hypothesis formation and testing, analytical and interpretive skills etc. Some such instruments are available, but more are needed.

The Boyer Commission on Educating Undergraduates in the Research University (1998) Reinventing undergraduate education: A blueprint for America's research universities. http://naples.cc.sunysb.edu/Pres/boyer.nsf/

Problem-based learning (PBL): A novel and effective approach for teaching research skills by addressing contemporary research problems in physiology

J. Schwartz[1] and P. Buckley[1,2], [1]Discipline of Physiology, School of Molecular and Biomedical Science, University of Adelaide, Adelaide SA, Australia and [2]School of Pharmacy & Medical Sciences, University of South Australia, Adelaide SA, Australia. (Introduced by Michael Roberts)

The biomedical science degree at Adelaide is oriented to research graduates, so we introduced a new unit in Physiology III. A unique component of that unit is a PBL course, the aims of which are to expose students to the science of addressing unresolved research issues, thereby developing their skills of scientific thinking and hypothesis setting and testing.

We base the full-year course on a series of 7-8 contemporary research questions, ranging from basic cellular physiology to medicine. Students are also challenged to address ethical issues incorporated into the PBL research cases. Students work together in small-groups on assignments, researching literature, and participate in regular group discussions. Assessment in this course tests the process of scientific thinking and teamwork, as well as content knowledge.

The PBL course prepares students for a research career by providing as much of a real research team experience as can be engineered into a single component of the year 3 curriculum. Students learn to appreciate the value in advancing science of teamwork, brainstorming in groups to produce thought-provoking discussions and other virtues normally acquired only in laboratory-based research training schemes. PBL cases begin with the introduction of a contemporary research issue by having the students interpret a series of key observations or results. Subsequent discussion is directed at achieving a basic level of background understanding through marshalling the students¿ own knowledge and on-the-spot research of relevant literature. Subsequently, students do further literature research, identify gaps and discrepancies in the current understanding of the scientific problem and frame hypotheses and design strategies to address the gaps/discrepancies. The students discuss matters as though members of a research team, and individuals report to the PBL group on material in which they develop specific expertise.

We assessed the impact of the PBL course by determining the extent to which attitudes toward research-oriented skills are changed. In 2001-2004, students were asked at the beginning and end of Physiology III to rate the importance of individual aspects of the course on a scale from 0 to 10 (least to most). Surveys were anonymous, but coded to match individuals¿ responses. Students had no access to their earlier responses when completing the second survey. The familiar and conventional educational category, *Importance of Informational Content and Facts*, was considered as a standard aspect of all courses, whereas the others are more related to the PBL course; these were:

A. stimulation of new thoughts through discussion (8.28±1.39 beginning; 8.96±0.98 end)
B. capacity to provoke new thoughts by others (7.55±1.65; 8.38±1.23)
C. introduction of new ideas (8.29±1.2; 8.29±1.03)
D. experience working in teams (8.37±1.53; 8.52±1.25)
E. discussion of current questions in science (8.31±1.44; 8.70±1.28)
F. discussion of ethical issues in science (7.77±1.70; 7.84±1.66)
G. self-directed learning in research. (7.77±1.70; 7.84±1.66)

48 students completed the survey. Responses were analysed by paired T-test and two-way ANOVA and Tukey's test, as appropriate.

Aspects A, B, E and G were significantly more important aspects to the students at the end of the year than at the beginning. There was also a significant effect of the year¿s experience. At the beginning of the year, there was no significant difference among the importance attached to the various aspects. By the end of the year, the students considered A, D, E, and G more important than *informational content and facts* (8.00±1.58 beginning; 7.68±1.38 end).

In summary, we introduced a novel PBL system for educating students in the science of research through discussion of contemporary research issues. The program apparently has been effective in shaping the students' thinking about physiology in terms of research.

Improving learning outcomes for students in Clinical Physiology

C.R Dallemagne, School of Life Sciences, Queensland University of Technology, GPO Box 2434, Brisbane, Queensland 4001, Australia.

Principles of effective teaching and good practice have been explored by several authors, and is the corner stone of learning (Crickering & Zelda, 1987; Ramsden, 2003). Two are encouraging active learning and emphasizing 'time on task'. Application of these principles can be facilitated by the various media modes available. Interactive media form gives investigative and exploration experiences and are facilitated by web resources (amongst others) (Laurillard, 2002). Learning facts does not necessarily increase understanding and critical thinking. Self confidence in one's ability is needed to engage in critical thinking activities (Van Wiegel, 2005). A lack of such confidence leads students to rely on a surface approach of learning facts and figures as this seems safer. Learning and thinking skills are distinct entities but necessarily complement each other (Marton & Ramsden, 1988). Similarly, reflection on learning in specific content domains is preferable to learning "metacognitive skills" (ibid.). Dispositional behaviour modulates students' approach to their learning of specific topics. The Project Zero "patterns of thinking" project has identified three distinct components necessary for a favourable dispositional behaviour towards critical and creative thinking, namely ability, inclination and sensitivity (Harvard Graduate School of Education, Project Zero). Not all students may possess all three, some may lack the discipline-sensitive imagination to develop their own activities for their learning: technology helps us devise well-designed exercises. Clinical Physiology is an advanced unit, designed for students in Biological Sciences and Nutrition. It builds on understanding and knowledge of basic Anatomy and of 2nd level Physiology. The teaching strategies assist students in understanding the rationale for development of the pathophysiology, diagnostic investigations and treatment of major disorders of the human body. Designing activities that students enjoy interacting with, will encourage them to spend more time with the material, hence increasing 'time on task' in a productive way. Developed on line resources were analysed by the Flashlight Evaluation model consisting of a triangulation between technology, activity and learning outcome (Ehrmann 1998). The methodology for the study has been described elsewhere (Goss *et al.*, 2003). Results showed that access and navigation were satisfactory, but there was poor use of interactive activities. Students' answers in examination reflected mostly a surface approach to learning: facts, but no development of reasoning in the answers.

The results of the evaluation of the on line site, and the examination answers motivated us to further develop the on line site with the aim of encouraging active learning and time-on-task. Using interactive activities that are interesting and enjoyable can help students develop inclination and sensitivity in the thinking of the discipline. The topics were clearly identified and within each topic case histories were or are being developed with a common structure. Active learning will be fostered by generating discussion using several on line strategies including a general discussion forum and a chat room. Critical thinking will be developed by some of the elements of the site as students reflect on their conceptualisation of case studies. Time-on-task is the third element we wish to address. As the activities are more enjoyable, and the students perceive the benefit of engaging with them for their studies, they will increase time spent on the subject matter. Feedback given *via* the on line teaching, in lectures and tutorials, should encourage students' participation.

Chickering, A.W. & Zelda F.G. (1987) *American Association Higher Education Bulletin,* 39, 3-7.

Ehrman S. (1998) *TLT Group,* http://www.tltgroup.org/about/ehrmann.html.

Goss H., Winslett G., Matt I. & Rowe J. (2003) Flashlight - an evaluation model with enlightening outcomes. Brisbane: Effective Teaching and Learning Conference Proceedings 2003.

Harvard Graduate School of Education Project Zero (2001). Dispositional characteristics. http://www.pz.harvard.edu/Research/PatThk.htm.

Laurillard D. (2002) *Rethinking University Teaching. A conversational framework for the effective use of learning technologies.* 2nd ed. London: RoutledgeFalmer.

Marton, F. & Ramsden P. (1988) What does it take to improve learning? Chapter 14 In P. Ramsden (Ed), *Improving learning : new perspectives*. London: Kogan Page.

Ramsden P. (2003) *Learning to teach in higher education*. 2nd ed. London: RoutledgeFalmer.

Van Wiegel (2005) From Course Management to Curricular Capabilities. Chapter 12 In P. McGee *Course Management Systems for Learning: Beyond Accidental Pedagogy*, Patricia McGee, Ali Jafari & Colleen Carmean (eds). Idea Group Inc. http://www.idea-group.com.