460P THE USE OF COMPUTER SIMULATIONS TO ACCOMPANY THE LABORATORY TEACHING OF PHARMACOLOGICAL PRINCIPLES

John Dempster & Chris Prior, Department of Physiology and Pharmacology, University of Strathclyde, Glasgow, G1 1XW.

In addition to developing technical skills, practical classes are useful for demonstrating a range of pharmacological principles. However, as aids for teaching basic principles, such classes have some limitations. Whole animal experiments require ethical justification while electrophysiological experiments are technically complex and require expensive equipment. Experiments using isolated tissues are more readily accessible to students but occasionally these experiments either do not work or give unexpected and unexplained results. Finally, time is often a limiting factor. To circumvent some of these problems, we have developed a suite of computer based practical simulations that can be used in conjunction with normal laboratory classes. The simulations are not designed to replace either the laboratories themselves or the need for academic guidance but serve as a means to extend and reinforce the learning processes associated with the classes. In addition to formal time-tabled sessions, all simulations are available to the students through the relevant course and can be used for revision work in their own time.

The simulations have been written using LabWindows or Visual Basic. Each is based on a classical animal experiment and is a representation of the experiment itself rather than a tutorial describing the experiment. LabWindows provides an excellent programming environment for the creation of on-screen likenesses of pen recorders and oscilloscopes and is therefore particularly useful for this style of presentation. All simulations use algorithms to model drug-response relationships rather than the "library-of-responses" approach and while this makes them harder to design, they are more flexible in their use.

At present, six simulations are used. In the *Anaethetised Cat Simulation*, students can determine the effects of a range of drugs on blood pressure, heart rate, skeletal twitch tension and contractions of the nictitating membrane. In the *Pithed Rat Simulation*, the effects of catecholamines and sympathetic nerve stimulation on blood pressure can be investigated. These "*in vivo*" simulations can be used to determine responses to a number of "unknowns" used in the associated laboratory classes. The *Guinea-pig Isolated Ileum Simulation* allows the calculation of antagonist pA_2 values. The remaining three simulations explore neuromuscular transmission at a number of different levels. The *Rat Isolated Hemi-Diaphragm Simulation* looks at drug effects on twitch tension, the *Electrophysiological Simulation* allows the exploration of motor endplate electrical activity and the *Ion Channel Simulation* determines the effects of agonists and antagonists (both competitive and non-competitive) on a patch-clamp record of ion channel activity.

The simulations are currently used in three out of four years of our degree courses and some have now been in use for four years. Feedback suggests that they are popular with the students both as complements to the practical classes and as a means to the understanding of pharmacological principles. Source codes for the simulations are available free of charge using anonymous FTP from ppserver.dpp.strath.ac.uk (130.159.32.4).

461P REPORT OF A WORKSHOP ON PROBLEM-BASED LEARNING AS APPLIED TO PHARMACOLOGY COURSES

This workshop was organized by the *Pharmacology Higher Education Network* as part of the meeting of the British Pharmacological Society held at Strathclyde University. Among the aims of the Network are to encourage academic staff to use active learning methods which will develop personal skills in our graduates and enhance their learning and employability.

The Chairman, Dr M Hollingsworth, opened the workshop by welcoming the 50 participants. He referred to the first workshop held in April 1995 on "What's required in a pharmacology graduate?" This workshop addressed the skills, knowledge and competencies required by pharmaceutical and non-pharmaceutical employers, for which there was considerable uniformity of needs (*Br. J. Pharmacol.*, **115**, 161-168P).

The current workshop built on that base by addressing the ways in which problem-based learning methods could encourage the development of these characteristics. Many universities are re-examining or instituting major changes in course design. This workshop, therefore, dealt with the educational basis of problem-based learning and the practicalities of incorporating such methods in new courses.

Further details of the Pharmacology Higher Education Network can be obtained from the Convenor of the Network, Dr Ian Hughes, Department of Pharmacology, University of Leeds, Leeds LS2 9JT; tel 01132-334313; fax 01132-334331; e-mail i.e.hughes@leeds.ac.uk

462P PROBLEM-BASED LEARNING FOR CAPABILITY

C.E. Engel, Medical Education Unit, University College London Medical School and Royal Free Hospital School of Medicine, Windeyer Building, 46 Cleveland Street, London W1P 6DB

Higher education should equip its graduates to play a leading role in scholarship, research, professional practice or management. Those who enter our universities now will still be actively engaged in the forties of the next century. They will, therefore, need to be able to adapt to change and participate in change as members of a learned and learning society. They will thus be life-long, self-directed learners, critical thinkers, good communicators and constructive collaborators in groups or teams. These generally applicable competences are developed through problem-based learning (PBL) in the context of developing profession - or specialty-specific competences.

Typically students in a first PBL session will use their existing knowledge and experience to tackle an unknown situation or problem. They will practice a logical analytical approach and identify what they need to study, in order to progress with the problem. In the second session they will share what they have learned in the meantime and apply this to the problem.

The underpinning educational theory (Norman & Schmidt, 1992; Schmidt, 1993),
the role of the group's tutor, and other aspects of the system supporting PBL will be discussed.

Norman, G.R., Schmidt, H.G. (1992) *Academic Medicine*, 67, 557.
Schmidt, H.G. (1993) *Medical Eduction*, 27,422.

463P THE USE OF PROBLEM-BASED LEARNING IN A PHARMACOLOGY COURSE FOR SCIENCE STUDENTS

D. Crankshaw, Honours Programme in Biology and Pharmacology and Department of Obstetrics and Gynaecology, McMaster University, Hamilton, Ontario, Canada

A quintessential difference between university and most other forms of education is the degree of self-reliance that universities expect from their students. In some jurisdictions, however, university students have become passive absorbers of pre-digested information (Rangachari, 1991). This is a poor way to learn, because it does not allow students to develop the skills necessary to continue learning in the less structured environment of the workplace. Problem-based learning (PBL) is a method of teaching and learning that emphasizes student self-reliance. In addition PBL is a means by which students and educators can cope with the burgeoning volume of information in pharmacology (Rangachari *et al.*, 1995) by focusing on learning principles as opposed to the collection of facts.

The Honours Biology and Pharmacology Co-operative Programme at McMaster University uses PBL in all its pharmacology courses (Rangachari, 1994). One such course is "4.A03, Drug and signal transmission" which deals with receptors, second messengers, receptor classification and receptor theory. Like all other courses, to run successfully, it needs students, teachers and objectives. The central component for delivery is the so-called Problem, in the context of small tutorial groups. Evaluation is a multi-faceted process involving self- and peer-assessment, brief written reports on each problem, a major exercise in which students are asked to write a problem on a novel topic using the principles learned and a problem-solving exercise in an examination format.

As a result of this course students not only achieve the stated pharmacological objectives but they also develop a range of skills and competencies including: team-working skills, responsibility, effective information-gathering, oral and written communication, critical thinking, self-assessment, self-reliance and an ability to learn.

Many Deans and Department Heads see PBL as the panacea by which they can reduce the time their staff spend teaching and as a result increase research productivity. They are probably quite wrong. PBL is labour-intensive (Rangachari, 1993) and resource-intensive; unlimited access to a well-stocked library is crucial and the availability of the latest in information technology is desirable. There are also social and cultural obstacles to the implementation of PBL.

PBL was not instituted in this programme as an experiment, but because we believed in it. Thus, in this age when all innovations in education are being subjected to the pseudo-scientific scrutiny of the psychometrists, the only evidence for the effectiveness of PBL in teaching pharmacology is the only one that matters - the quality of our graduates.

Rangachari, P.K. (1991) *Am. J. Physiol.* 260, S14.
Rangachari, P.K. (1993) *Nigerian J. Physiol. Sci.* 9,1.
Rangachari, P.K. (1994) *Trends. Pharmacol. Sci.* 15, 211.
Rangachari, P.K. *et al.* (1995) in *Pharmacological Sciences: Perspectives for Research and Therapy in the Late 1990s* ed Cuello, A.C. & Collier, B.

464P PROBLEM-BASED LEARNING: PUTTING THE STUDENTS IN CONTROL

Jeanette Boersma, Respiratory Biology, Rhône-Poulenc Rorer Ltd., Rainham Road South, Dagenham, Essex, RM10 7XS.

The days of didactic teaching and information overload are out; problem-based learning (PBL) is a new style of education which is coming in and it's not a fad! PBL creates a stimulating environment in which students and tutors can discuss concepts of pharmacology (and other disciplines) in small group tutorials. Instead of having pharmacology explained directly by a lecturer, students extract and research the concepts from carefully selected problems. As a student in a PBL Biology and Pharmacology program at McMaster University, I have experienced two years of this type of learning in combination with larger and more traditional classroom environments. I feel, therefore, that I can accurately compare the two systems of teaching and learning.

In my experience, I found that at times the small group tutorials were electric environments sparked with debate and new ideas, and at others they were low key and more subdued. In both situations myself and the other students had the opportunity to develop better oral and written communication skills, research and critical analysis skills, and self and peer evaluation skills. A demanding pharmacology laboratory course and the three work terms have further cultivated these skills and resulted in more efficient teamwork and experimental design abilities. I feel that these qualities make myself and other students in the program highly desirable to graduate supervisors and future employers.

Really the most valuable quality of PBL in my experience is its ability to instil (or sometimes inflict!) motivation and responsibility in students. If there is any change in the educational system it should be to change the attitudes of students and give them the opportunity to become responsible for their own education. PBL is one means by which to achieve this end.

465P THE CHALLENGES OF IMPLEMENTING THE NEW MANCHESTER MEDICAL PROGRAMME

Keith Burdett, School of Biological Sciences, 2.205 Stopford Building, Manchester University, Oxford Road, Manchester M13 9PT

We took the decision in 1991 to discard the old discipline-based preclinical medical course in its entirety and to have a new integrated course in place by October 1994. Discussions were initiated as a result of the General Medical Council's misgivings about factually overloaded courses that encourage short-term memorising. However our deliberations gathered momentum when we actively considered what some medical schools in North America, Australia and Holland had been doing with problem-based learning. Though there is no rigorous proof of its superiority, a problem-based system is appealing because it requires students to learn as adults. Properly presented problems can also illustrate the integration of disciplines that were formerly taught separately.

The new Manchester Medical Programme is new to Manchester. Our colleagues in McMaster, New South Wales and Maastricht gave a great deal of advice from their experience in the design stages, so our course is an adapted version of theirs.

The first challenge that the Faculty accepted was that the new course was Faculty property and individual departments were not in a position to block progress. The remit given to small design teams was to produce a course suitable for a predicted intake of 220 medical undergraduates; in fact the number rose to 250 and was further extended to include 80 dental undergraduates. The logistics of dealing with such large numbers on a brand new course that is not lecture based are considerable.

The examination system had to be completely changed to be compatible with the new learning format, changes that had to be approved by the university. Once regulations had been changed the schools needed to be informed well in advance so that their sixth formers knew what kind of course they would be applying for. Prospective students clearly found the concept of the new course exciting, but our experience in the first year of its implementation showed there was a considerable gulf between perception and reality. For the first six weeks of the 1994/95 academic year there was considerable tension and anxiety that progressively subsided as more and more students realised that could not only cope with the new system but could enjoy it as well.

Anxiety was also a feature of staff development. Subject specialists are no longer expected to be the founts of knowledge or even the focal points of student group work. Staff expertise had to be developed so they could listen in and, if necessary, facilitate discussions as students studied. The problems devised by the design teams are effectively patients on paper. Now that Year 1 is about to be re-run and Year 2 is to be implemented for the first time, staff at Manchester are redesigning Year 3, 4 & 5 so the problem-based approach will continue with real patients.

A. Markham, School of Health Sciences, University of Sunderland, Sunderland, SR1 3SD.

Views expressed during the workshop on problem-based learning (PBL) indicated considerable support for the concept that higher education should equip graduates to be major 'players' in their chosen careers, including the areas of scholarship, research, professional practice and management.

Graduates of the future should therefore be equipped with the ability to either adapt to or actively participate in change. In order to achieve this it was clearly stated that future graduates should be capable of the following: to be life-long and self-directed learners, to demonstrate the capacity for critical thought, to be good communicators and to have the ability to work constructively with others.

It was suggested and generally agreed that the days of didactic teaching and information overload were out dated and impractical. In order to achieve the above 'new' graduate status, a 'relatively' new style of education was championed in the form of PBL. Speakers and participants confirmed that PBL creates a stimulatory/electric small group teaching environment for students and tutors alike. This form of teaching provides each student with the opportunity to develop their own enterprise and transferable skills in conjunction with the opportunity to become responsible for their own education.

In terms of the introduction of PBL within academic institutions, it was suggested that resistance may result from overall resource implications and/or the perceptions of existing staff. The former may result from one or a combination of the following; a) the labour intensive nature of PBL, b) increased workloads especially in terms of the development of interdisciplinary programmes, c) the ability to fit into existing academic careers and the potential loss of research oriented activities and d) the provision of adequate library resources and information technology. These areas indicate potential logistical problems and the need for sound financial support, possibly relating to changes in the distribution of funds derived from income generation activities. The latter relates to the fears of teachers; the threat of entering a room containing 6-9 intellectual people, the possibility of being 'disrobed' of their perceived expert status and of being subjected to an environment in which they may not be able to provide all the answers. We were assured that, in the main, this perception was unfounded.

In addition to the above the areas relating to the loss of classical practical work and the role of assessment in relation to PBL were also expressed as areas of concern.

In conclusion, there was wide acceptance that the introduction of PBL would provide a means of coping with the burgeoning volume of information in pharmacology by placing the emphasis on student self-reliance and more importantly focusing on learning principles as opposed to the pure retention of facts.