synergy

A forum for the discussion of teaching and learning at The University of Sydney

Institute for Teaching and Learning
The University of Sydney

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Innovations in Teaching & Learning: The College of Sciences & Technology

Don Napper, Pro-Vice-Chancellor, College of Sciences & Technology

Although the faculties constituting the College of Sciences and Technology (CST) are quite closely knit in a disciplinary sense, there exists considerable diversity in the nature of the expectations required of CST students on graduation. The graduates of three faculties (Architecture, Engineering and Veterinary Science) must be ready to practise their professions from day one. Our teaching and the students' learning in these faculties must satisfy not one but two sets of criteria: our academic visions as to what should be the irreducible minimum knowledge, skills and attributes possessed by such graduates and simultaneously the requirements that are set by the respective professions.

Such external pressures are less evident for the remaining three faculties (Agriculture, Rural Management and Science). Even in these more generalist faculties, however, there can exist less overt professional requirements, such as occurs with graduates in Chemistry with respect to accreditation by their professional body, the Royal Australian Chemical Institute.

I have mentioned the foregoing professional component of many CST courses because both politicians and society at large often take for granted that, come what may, universities will continue to produce graduates who allow society to function smoothly, for example, graduates who are able to design bridges that do not fall down or are able to ensure that Australia remains free of both 'mad cow disease' and 'foot-and-mouth' disease. To date, this assumption has proven to be valid and our teaching and learning has withstood well such pragmatic testing.

Universities, however, receive scant recognition for the critical role that they play through their teaching in maintaining and developing the web of graduate skills essential for the smooth operation of a postgenomic digital society.

Given the wide range of expectations of graduates from their courses, it is not surprising that the CST faculties and departments have adopted a plurality of approaches to teaching and learning. This is apparent not just from the range of curricula evident within the College but in the diversity of approaches to course delivery. The nature and extent of the adoption of new technology for teaching and learning also varies greatly. In this, the College has been well served by UniServe Science.

Don Napper

There have been many innovative developments in teaching and learning in CST in recent times and some of these are presented in the articles that follow. The Department of Computer Science, for example, has been a world leader in the use of Problem Based Learning for teaching First Year IT courses and this mode of teaching is now diffusing across into Engineering and Veterinary Science. The Faculty of Veterinary Science has moved to a lecture-free final year program where the focus will be on teaching clinical skills and professional practice. The Faculty of Engineering is intent on imparting some of the 'softer' human skills to its undergraduates by providing, for example, training in leadership and entrepreneurship. The Faculty of Science has taken the initiative in providing voluntary courses for research students that expose them to areas far beyond research, such as the commercialisation of Intellectual Property.

The examples presented in this issue of Synergy reflect the kinds of effort and innovation focussed on teaching and learning which are taking place throughout the CST. All of this indicates that the CST takes pride in its teaching and is serious about enhancing the learning outcomes of its Science and Technology students.

Innovation in First Year Computer Science: Report from the trenches

Judy Kay, Basser Department of Computer Science

Judy Kay

This paper describes the *processes* involved in teaching innovations for first year Computer Science. In particular, it describes the role of a trial that preceded the full implementation of a radically different approach to teaching. The paper concludes with a reflective summary.

Starting in 1995, we worked towards several major changes in the teaching of the first year units. The main innovations were:

- converting a monolithic first year to a sectional structure - this was intended both to give students the sense of being in a smaller class and to ensure that the teaching staff for each section worked with the small cohesive team of 5-6 people with responsibility for just that section;

- adaptation of Problem-Based Learning to the teaching of introductory Computer Science units within a conventional degree structure;

- introducing group-based learning, a core aspect of Problem-Based Learning and an important way to help first year students build effective learning partnerships and friendships with each other;

- introduction of explicit teaching of generic skills such as: how to work in a group, plan and monitor learning, communication skills;

- integration of software engineering foundations into the first year (aspects like code quality and correctness measures, programming by contract, pragmatic and economical testing);

- a shift in programming paradigm, from a procedural to object-oriented programming language explicitly supports team programming so group work is a natural match for the paradigm.

Although many of these aspects are particular to our discipline, this paper focuses on the processes used to make this major innovation. These should be broadly relevant to anyone contemplating major changes in their teaching. Details of other aspects, including reports, papers and resources, are available at http://www.cs.usyd.edu.au/~judy/PBL/

Managing the change

In 1995, we began planning a change in programming paradigm. Since this would involve a large investment in developing new teaching resources, we decided that this gave us a good opportunity to review the whole approach to teaching and management of the course. Here are the major stages in the process of making these major innovations.

Early 1995: We formed a small group to drive the change. (This group included Kathryn Crawford, Allan Fekete, Tony Greening and Jeffrey Kingston). At this stage, our research convinced us that Problem-Based Learning offered the potential to significantly improve each student's ability to tackle the problem solving that is at the core of programming.

Mid-1995: Our proposal for Problem-Based Learning met considerable opposition in the departmental Teaching Committee. However, the Teaching Committee approved a trial of PBL for 1995. The Committee identified questions to be answered by the end of one semester of the trial. These related to learning outcomes, affective aspects, resource issues and overall levels of staff support.

Late-1995: The group decided that affective aspects should be assessed independently by the education specialist. We applied for and received a Teaching Quality, Teaching Development Grant.

1996: The PBL trial ran, with a random sample of volunteers.

Mid-1996: The results of the first semester of the trial were reported (see: http://www.cs.usyd.edu.au/~judy/PBL/report_dept.html\) The Teaching Committee approved the move to a PBL format for 1997. It also chose the programming language.

1997: The first full implementation, combining PBL and the object-oriented programming paradigm. This was accompanied by three days of staff development for tutors, a launch for the whole department and support from Professor Napper, heading the College, and members of our Foundation for Information Technology.

1998: On-going refinement and development of additional resources.

2000: shift in programming language (Java) with attendant changes to teaching resources.

2001: new equipment, new labs, new textbook and many other new teaching resources trialled, new approach to recruiting and training tutors from senior undergraduates, introduction of a mentor programme.

The innovations continue. Over the four years' experience teaching this at first year level, we have refined our understanding of the conceptual difficulties students face in their learning. Lagging behind this is our growing understanding of how to address these difficulties. Some of the big ideas, such as the object model, were relatively easy to teach senior students but pose serious difficulties for beginners. We can expect on-going tuning and change.

Another important change that has been creeping up on us relates to student ownership of computers. Until recently, we have assumed that students would do much of their computing work on campus. But now, a large majority of our students have quite powerful computers and they want to be able to work on computing assignments at home. Our recent shift to Java facilitates this.

The trial

The most contentious element of the innovation was the introduction of Problem-Based Learning. For this aspect, one of the most critical elements of the innovation process was the trial. It was intended to give:

- assurance that the students studying in the PBL format were no less competent at programming than main group students;

- evidence that the additional generic skills were being learnt;

- data about students' attitudes and perceptions towards PBL.

Outcomes from the trial were:

- on core programming skills, the PBL group achieved at the same level as the main class — even though the examination was written by the lecturers of the main class;

- affective aspects had the PBL group dramatically ahead — for example, the PBL group was generally confident of their ability to solve programming problems where the main class was generally not.

Professional Practice: Adding context to veterinary education

Henry Collins, Faculty of Veterinary Science

Henry Collins

The Bachelor of Veterinary Science (BVSc) course has been considerably modified in response to suggestions from graduates, employers and current students. The resources of the Faculty were insufficient to support a totally problem-based approach as in Medicine and Dentistry, so the new course, introduced in 2000, remains traditional during the first two and a half years and problem-based from Semester 2, Year 3. Several subjects have been removed from the early years and the remainder restructured and integrated. The total amount of formal teaching, especially lectures, has been reduced in all years and more opportunities provided for flexible learning. One major innovation is a 'lecture-free' final year. Another is the introduction of a program in Professional Practice (PP).

One of the main aims of the PP program is to provide a valid professional context for learning in the basic veterinary sciences. The program enables students to achieve many of the Basic Attributes of Veterinary Graduates. Separate units of study in PP occur in each of the first three semesters and are obligatory. The main themes of these units could be summarised as: Orientation and opportunities (PP1A, S1, Yr1), Introduction to practice (PP1B, S2, Yr 1) and Contribution to practice (PP2, S1, Yr2). The 2000 cohort of students has just completed the first three units.

The first aim of PP1A is to help new students adjust to the university, faculty and veterinary profession, and to studying in the new environment. Current cohorts of veterinary students have very diverse backgrounds and experience – about 20% are from overseas, 20% are local full-fee paying students and the remainder come straight from school or from other tertiary education. Some have been reared on farms or worked with horses; others have had no physical contact with large animals. New students are first encouraged to build a supportive network of peers – 'bonding' starts in Orientation Week during a visit to the Camden campus. The emphasis during the first few weeks of the semester is on welcoming students into the Faculty and profession as 'junior colleagues'. Second year students mentor first year students.

Nearly all newly-enrolled students have a 'passion' to be vets; the mean time between first wanting to study veterinary science and entering the faculty is about 10 years! However, most have only a limited perception of the opportunities provided by a BVSc degree. PP1A aims for a better understanding of how the profession arose, its role in the community, and the current opportunities for, and conditions of, employment of graduates. All students are brought 'up to speed' with respect to effective learning strategies, and use of the library and databases (Information Literacy). The basic concepts of Animal Welfare are introduced. Students complete a questionnaire that evaluates their ability in a range of skills including handling, restraining and examining animals, manipulative skills, information management, communication and personal financial management. They are expected to think about how they will correct any deficiencies in their skills and are encouraged to develop a veterinary lexicon. Complex veterinary scenarios are discussed in groups, facilitated by a student, to promote the need for learning about the non-scientific aspects of practice. Practitioners and other eminent veterinarians make a substantial contribution to the teaching. Assessment is by submission of a portfolio of work that also includes exercises in self-reflection (obligatory, but unassessed). Portfolios are evaluated by a panel of Faculty staff and unsatisfactory portfolios may be resubmitted. At present, information about the PP program is presented in manuals; in due course this will also be available online through WebCT.

During PP1B, in the second semester of first year, students attend Educational Support Practices (ESPs) in pairs. An ESP is a resource for study in the PP program. Over seventy veterinary practices in the Sydney Region have been enrolled as ESPs. At the practices the students prepare a Practice Profile (includes location, clientele, premises, services and roles of staff), and later record a consultation and analyse and evaluate the communication involved. During this unit the philosophical basis of Animal Welfare is examined in more detail and the concept of 'professional behaviour' explored. Information literacy is extended by instruction in the effective use of the Internet for finding and evaluating information. Again, the assessment is via a portfolio with both assessed and unassessed (self-reflection) sections. Students are also asked to report on their progress in achieving the skills listed in the self-evaluation questionnaire that they completed in Semester 1.

During PP2, second year students attend the same ESPs as previously and benefit as before from their association with practitioners and ancillary staff. In this unit students contribute to the further development of their practices. This year, in one exercise, students acted as consultants and reported on the 'public interface' of their ESP. This involved an evaluation of the promotion and marketing of services and the interaction with clients in the practice. In another exercise they reported on how information is managed and skills are developed in the practice. PP2 also explored aspects of the human-animal bond and included further sessions in Communication and Animal Welfare. The Communication sessions covered the management of grief and anger, and involved students in role-plays of practice situations. The portfolio for PP2 included reports on the projects as outlined above as well as reflective writing.

The first year PP units were well received by the students in 2000, although there were some criticisms and suggestions that resulted in minor changes. Several benefits arose from the introduction of PP. The 2000 and 2001 cohorts of students have developed a particularly good relationship with staff. They are encouraged to provide feedback on their educational experiences and are making substantial contributions to the further development of PP and the new BVSc course. The involvement of Faculty staff from a variety of disciplines in marking portfolios and especially in reading the reflections of students on their university experience has changed their perception of the qualities of our students and improved the staff : student dialogue.

Planning is underway for the PP units in Year 3. Practitioners have been very supportive of the introduction of PP and their closer association with the Faculty will benefit everyone. The new partnership raises the possibility of establishing an Educational Trust that would recognise the contribution of practitioners and benefit practices.

Problem-Based Learning in Engineering Mechanics

Lynne Bilston, School of Aerospace, Mechanical and Mechatronic Engineering

Lynne Bilston

Two of the most important skills for professional engineers are problem-solving and the ability to work effectively in a team. Their working careers will involve both of these on a daily basis, even if they move into non-technical fields such as management. These two skills are high on the list of characteristics wanted by employers of our engineering graduates.

But how do we take students, most of whom are fresh from the rigours of the HSC, and instil in them these all-important skills? In the Department of Mechanical and Mechatronic Engineering, we have introduced "Problem-Based Learning" techniques into two of our first year mechanics units of study, Statics and Dynamics, in an attempt to encourage the development of these skills, integrated with technical skills acquisition.

Course Organisation

In these units of study, lectures no longer form the dominant learning exercise, although short lectures are still given as needed. The main learning activities are, instead, a series of problems and projects which are carefully structured to lead students through the new technical material week by week. In the early part of the year, these projects are only one class session long, and worked on in pairs by the students, in class. This gives new first year students time to adjust to the new learning paradigm without placing undue stress on them. As the units of study progress, the

problems get more realistic – more complex, less well-defined, and longer. They may require the students to do additional research outside of class. Two of these projects are given in the latter half of the semester, the projects typically run for 3-4 weeks, and students work on these in groups of 4.

These "realistic" projects are usually framed as a small consulting engineering job. For example, this semester in Dynamics I the students are doing a safety audit on a roller coaster. This requires them to be able to calculate all the mechanical variables for the roller coaster throughout the ride, thus learning all about energy methods in engineering mechanics. They also need to find out what kinds of acceleration are acceptable for human passengers, what makes a roller coaster ride fun, and they learn how to divide up the work between themselves, and plan the project. This kind of project also brings together ideas from many different fields, and provides interest and motivation for the students.

In both the short problems and the longer projects, students must draw conclusions and make recommendations based on their calculations. This is a critical part of any professional engineer's job, and one students often find quite difficult initially, as it requires a deeper understanding than just putting a number into the right formula. It is very important that students learn to critically examine the results of any engineering calculations they do, and the assessment is designed to encourage this important skill.

Printed materials on group work methods as well as verbal feedback from the tutors are provided throughout the semester, and each group is required to keep a detailed logbook of their group meetings, which is like taking formal minutes at a meeting. They write a technical project report summarising their findings on the project, and a group report in which they reflect on how their group worked, and what would have improved their efficiency, as well as assessing their peers' technical and groupwork skills. As the unit progresses, the students are given less detailed instructions, and must start to work out for themselves what the tasks are, and then organise themselves to make sure everything is done. These kinds of organizational and time management skills will be invaluable not only for the rest of their university career, but beyond.

These units of study have now been running for 3 years, and have evolved over that time into what is described above. Initially, we underestimated the level of student anxiety when faced with a new learning paradigm, and set a long project at the start of the semester, with only a few lectures. Upon observing the level of student anxiety, we have changed the structure to give much smaller, well defined problems earlier in the semester to allow students to build up their confidence, before being given longer, more realistic projects in the latter half of the semester. We have also introduced some tutorials in addition to the problem-based learning workshops for the same reason. This balance appears to be working well.

Student responses on class evaluations show that many find the units of study to be motivating, interesting, and enjoyable, and they perceive that the course has helped them to improve both their problem-solving skills and ability to work effectively in a team. Indeed, some of the students become very enthusiastic about the projects and do all sorts of extra reading and research, something that was unheard of in the previous lecture and tutorial based classes. This is quite different to the student

evaluations of the lecture/tutorial classes which existed before.

Not surprisingly, however, the reaction to group work was mixed. Many students thought it was very helpful, and really helped them to learn, while a small group of others noted that they thought it was the worst thing about the unit of study. These students also tended to comment that they thought they could do better on their own, and felt that their grades were being dragged down by other group members. These negative responses have decreased over the years, however, indicating that perhaps we are doing a better job of explaining why team work is so important for their education!

We have also compared the examination results from the new problem-based course to previous years' students who took a traditional lecture-tutorial course, and there is no significant difference. This confirms that the students are learning the technical skills just as effectively under the new regime, but with the added bonus that they are improving their problem-solving and teamwork skills at the same time.

Finally, I'd like to add that I have enjoyed teaching these new courses MUCH more than standing at the front of a large lecture hall with about 200 students in front of me, many of them with paper planes ready for those "boring bits" in the lecture. I will never go back to large lecture-dominated teaching methods, as problem-based learning is much more enjoyable for the staff as well as the students!

Dr Lynne Bilston is a senior lecturer in Biomedical Engineering from the School of Aerospace, Mechanical and Mechatronic Engineering. She has a strong interest in improving teaching and learning methods for engineering students, particularly using problem-based methods and realistic engineering projects. She recently shared a University of Sydney Teaching Excellence Award with Mr

Teaching and Learning in the Laboratory: Can we do it better?

Simon Barrie, Institute for Teaching and Learning,
Ian Jamie and Scott Kable, School of Chemistry
Mark Buntine, Department of Chemistry (Adelaide University)

APCELL Workshop

Why do we teach science in the laboratory, how do we do it, and are we effective at doing it? These are important questions for academic teaching staff in the physical sciences and they require serious attention by practicing teachers. Laboratory-based teaching and learning is a fundamental component of the physical sciences curriculum in general and of the chemistry curriculum in particular. This is especially true in physical chemistry courses, where, laboratory-based teaching and learning is vital in reinforcing and making concrete abstract material. There is recognition, however, that students are not always finding their laboratory courses to be interesting and motivating, and that, as a learning experience, the courses could be improved.

The need and opportunity for a collective effort involving the resources of multiple institutions was recognised, and funding obtained, from the Committee for University Teaching and Staff Development (CUTSD, now AUTC). So the Australian Physical Chemistry Enhanced Laboratory Learning (APCELL) project commenced in early 2000. APCELL has bought together diverse physical chemistry educational expertise and resources from across 30 Australian universities. APCELL is overcoming the resource constraints of individual university chemistry departments by treating the participating institutions as a single meta-department. It has, as its aim,

the development of a protocol for the design of teaching experiments, based upon sound pedagogical tenets. The result will be a suite of experiments that will facilitate improved student learning.

Through consultation with colleagues in other chemistry departments and in curriculum development units, and a consideration of the literature, it was found that the availability of resources posed a serious barrier to such curriculum review, re-development and renewal, as well as conceptions and approaches to teaching on the part of some teachers. The resource limitations are in physical resources (e.g., apparatus), specialist expertise, pedagogical expertise and active student involvement. Discussions within the Australian academic community revealed that individual institutions were making attempts to address this issue, but it was also apparent that no single institution could overcome the multiple barriers to the implementation of effective teaching and learning methods.

In planning a strategy to overcome these impediments, the project team drew upon the research literature on laboratory teaching and learning, curriculum and academic development, and curriculum change. The methods employed in the APCELL project were selected on the basis of engaging academics in reflecting on their own decisions about teaching and design of laboratories. The project method identified the need to engage participating academics at the level of their underlying ideas about teaching and learning, rather than at the level of teaching behaviours. The project aims to

use processes that will encourage participating academics to design their laboratory teaching from a learner-focused perspective rather than a teacher-focused perspective. Importantly, the project allows the outcomes of this reflection to be distributed throughout the community.

This strategy required that the project start with the participants' own ideas and conceptions of teaching, and for the participants to reflect on and challenge these, in developing the parameters for a laboratory curriculum 'template'. This template forms the core of the APCELL project. Rather than prescribe 'good' teaching practice, it aims to promote a consideration of existing teaching practices from a learner-focused perspective.

The development of the criteria that are embodied in the 'template' was the first stage of the process. The second stage of the process was the development, submission and review of laboratories for inclusion in the APCELL database. This culminated in an Experiment Workshop, held at the University of Sydney, where staff and students from the participating institutions came together to engage in an inquiry into the student learning experience of the submitted laboratories. During the workshop both teachers and students participated as learners and both contributed 'learner' evaluation data to the inquiry. At the same time the template itself was peer-reviewed and evaluated as a tool to support the review process. An extremely important aspect of this process was the inclusion of students. Many academics found that their conceptions of student approaches to experiments were challenged. Also important was getting academics back into the laboratory to allow them to experience the experiments from the perspective of a student. This again challenged their ideas of the learning experience. The student participants also found that their ideas of the philosophy and implementation of teaching experiments were open to question. It is not an overstatement to say that the workshop was a pivotal point in the project and that

both staff and students, some of whom came with a certain degree of scepticism, went away with an exciting level of enthusiasm for the project.

Besides the personal and professional development of the participants of the workshop, the outcome of the workshop was the refinement of the 'template'. The next stage of the process will involve the dissemination of the revised template, along with the tools (student surveys etc), guidelines and criteria for the peer review and submission process, and the experiment database itself. This will be published on the existing APCELL website at : http://www.apcell.org/. It is envisaged that these products will further support research-led teaching investigations and inquiries, both in chemistry and the other sciences.

The tools and methods developed in the project are already being used in curriculum development, but the most important resource for further inquiry and research is the people who have participated in the APCELL project. The staff and students from the participating universities are keen to pursue the ideas and new insights they have encountered and more importantly, they have a network of colleagues to support them in this.

In conclusion, the APCELL project has developed a protocol for preparing physical chemistry undergraduate experiments. The philosophy of APCELL and implementation of the protocol has been accepted enthusiastically by a significant number of the physical chemistry teaching community and is leading to the production of a valuable resource for that community. The methods employed in the project are applicable to all areas of laboratory-based education and it is envisaged that the project will be expanded beyond its original compass.

Simon Barrie, Mark Buntine and Scott Kable are Directors of the APCELL Project. Ian Jamie is an Associate Director.

Reflections on Assessment

Rosanne Taylor, Faculty of Veterinary Science and
Tania Gerzina, Faculty of Dentistry

As many people in the University community now know, the Institute for Teaching and Learning (ITL) runs a one-year, part-time Graduate Certificate in Educational Studies (Higher Education). The twenty-three members of

Rosanne Taylor,
Tania Gerzina and
Christine Asmar

university staff who are currently enrolled have actively engaged with a range of issues in higher education, with the central focus being on student-focused approaches to teaching.

One of the central themes in the course is that of Constructive Alignment, the proponents of which argue among other things for the need to align, in an integrated and consistent way, all elements of a unit of study: aims, student learning outcomes, teaching methods and above all assessment. Below, two current participants in the Graduate Certificate (both in the sciences) discuss how they have applied their enhanced understanding of teaching and learning in practice, with respect to assessment.

Dr Christine Asmar,
Graduate Certificate Co-ordinator, ITL

Rosanne Taylor

Assessment has been a major focus of the Graduate Certificate in Higher Education this year and in trying to put the new ideas into practice, I keep coming back to the question, "How should we best assess to support quality learning?" I have been trying to change student perceptions of what is "really important" to learn in veterinary neurophysiology by modifying

the way students are assessed. Students consider this topic difficult and believe it is best learnt by rote memorisation and recall. As one student said; "Neurophysiology is hard and complicated, and it's only worth 15%, so I memorised the parts that might be in the exam". Consequently there was little impetus for students to pursue better quality learning outcomes (abstraction of meaning, construction of relationships between parts or reinterpretation of knowledge) and the capacity to integrate and apply information was never tested. This led students to ignore these components, so even though they appreciated the need to apply this knowledge to solve clinical cases in the future, few attempted to approach their learning from this perspective. Clearly the nature of the assessment tasks (multiple choice and short answer exam) had a detrimental impact on students' learning approaches and outcomes.

After this insight struck me, I decided to modify the assessment tasks to encourage students to engage actively with the material and develop their own, complex understanding of the material, in keeping with a constructivist approach to learning. Clearly students had to be prepared for this change, so I devoted class time to linking aspects of neural processing and applying key concepts to real life problems. The assessment was an open book test with a choice of questions (e.g. falling cat landing on its feet) that required students to identify pathways for information processing and describe how they functioned together to enable the animal to perceive and respond to the stimulus. The divergent nature of the questions meant that each student constructed a unique, personal view of the

problem. Their answers were exciting to read as students produced their own highly original concept maps, skilfully depicting the complexity of the system and their depth of understanding, suggesting that they had actively engaged with learning in this topic. Marking their work was more interesting and challenging (due to the variation), but no more time consuming than the usual exam.

The feedback was positive and as one student reported "There was a huge difference in my approach to study. Instead of concentrating on cramming what was going to be in the paper it allowed for a complete overview, so we could see the big picture, which we will remember." Students perceived that the emphasis was on relationships and application rather than recall of specific details, and were confident that they would be rewarded for demonstrating these learning outcomes. However some students had difficulty in adapting because the expectations were so different to those for other topics and Units they were taking, emphasising the importance of encouraging change in assessment practices across the Faculty.

Tania Gerzina

"…To fathom a new view on my world, to never know where the boundaries are". So a student recently defined "learning" to me. The analysis of interviews with students, such as inspired this observation, formed the essence of the first project in the Graduate Certificate in Educational Studies (Higher Education). At that interview the student's words seemed esoteric but of course their perception was actually advanced. The Certificate so far has clearly illuminated the most important ingredients of elegant, effective teaching and learning, among those: academic rigor, student-focus and the quest for an improved teaching and learning model.

In Dentistry, where we have embarked on a brilliant new program educating bright and

enthusiastic students, my main responsibilities until recently have been in assessment. In taking on further duties in curriculum, my horizon has broadened. In the family of disciplines that is Dentistry, the application of the knowledge supporting evidence-based clinical diagnosis and management is happily married to the practice of fine, precise skills required for proficient patient care. At the foundation of the curriculum is the development in our students of the ability to self-assess both their knowledge and their skills sensitively and accurately.

Assessment in Dentistry is designed to highlight to students those parts of the curriculum which we know to be central to successful patient care which aims to yield the best possible clinical outcome. To achieve those goals, the curriculum is problem-based and is built on well-validated clinical competencies - assessments are constructively aligned to those tenets. The Graduate Certificate has provided the academic support for these principles in an atmosphere of collegiality and mutual respect. It has been easy to embrace the quest for a better model when teachers are there to show us how.

I have now understood that student's definition.

Dr Rosanne Taylor is a senior lecturer in animal and veterinary physiology. She is chair of the Faculty of Veterinary Science Teaching and Learning Committee, and she is a collaborator on a TIF-funded project to evaluate student perceptions of learning context, approaches to learning and learning outcomes.
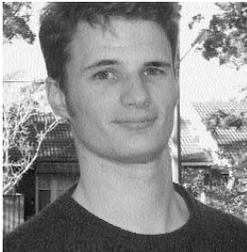
Dr Tania Gerzina is Associate Dean (Curriculum) in the Faculty of Dentistry.

Readers wishing to know more about Constructive Alignment should consult:

Biggs, J. (1996) Enhancing teaching through constructive alignment. Higher Education. 32:1-18

Engineers and Education: Some thoughts

James Ward, Department of Chemical Engineering

James Ward

Ask most engineers what it is that they do and they will reply along the lines that they apply knowledge through a well-defined process in order to change the world. Engineering is controlled by certain inexorable truths: Newton's laws of motion, or the laws of thermodynamics, for example. These ideas are uncontested and apply across the gamut of areas within which engineers are found.

What is an engineer like myself to think when entering the seemingly haphazard world of education? In February I began a Master of Engineering (Research) degree, looking at how undergraduates view leadership in the context of engineering. I had to immerse myself in the literature of the education arena. The more I read, the more I could see parallels between education and engineering.

Engineers do not operate solely in the realm of the known and absolute. Projects may have similar underlying themes, but each is different in some subtle way. If this were not true, we would not need engineers; instead we would have a cookbook that would cover everything, and it would never need to be changed. Engineers are used to dealing with overarching principles, and they will admit that they cannot know exactly how they will apply these principles until they actually do so. So it is in education. The principles exist, but it is up to the practitioner to enact them as he or she sees fit.

Engineers understand that there is no absolute or best solution to a problem. There are many ways that "best" can be evaluated, based on the opinions and perceptions of those doing the evaluating.

No engineer would dismiss the opinions of a client; those opinions would be addressed as the solution was developed. Feedback from the client is sought throughout the entire process. Educators respond in a similar way to the needs and perceptions of their students.

At the heart of engineering is the idea of change. Engineers apply techniques and technologies so that they can change whatever is their object. These techniques and technologies are themselves in a constant state of change. What was considered effective a decade ago may not be now. Yet engineers do not become overwhelmed by the fact that the way they are currently practising will most probably become outdated. They do not give up learning about their field because they know that eventually the knowledge will become obsolete. In fact, it is the immersion in the topic and the practice of it, that allows them to be the agents that drive the change and make the techniques obsolete. Engineers are comfortable with change, both driving change and adapting to change. Education too is a dynamic field, with similar sorts of feedback systems.

I began my journey into the world of education expecting my existing skill set to be largely irrelevant. Yet more and more it is the similarities between engineering and education that strike me, rather than the differences. Both have underlying theories based on research; it is the human act of creative application that turns them into an art.

Mr James Ward is a postgraduate candidate (ME(Res)) and tutor in the Department of Chemical Engineering. He has developed a leadership course for 1st and 2nd year engineering undergraduates to commence in Semester 2, 2001.

The EQA Working Group

Simon Barrie, Institute for Teaching and Learning

In 2001 the ITL convened the Evaluation and Quality Assurance (EQA) Working Group. The EQA group works to support faculties in implementing aspects of the University policy on The Management and Evaluation of Teaching and in making the best use of institutional and faculty level teaching and learning quality assurance data.

The EQA working group has representatives from the different faculties who were nominated by their Deans. The members of this group are:

> Agriculture, Mick O'Neill
> Architecture, Terry Purcell
> Arts, Marie-Therese Barbaux-Couper
> Conservatorium of Music, Ross Gilbert
> Dentistry, (Represented by Medicine)
> Economics, Michael Jackson
> Education, Robyn Ewing
> Engineering, John Currie
> Health Sciences, Roger Adams
> Law, Patrick Parkinson
> Medicine, Graham Hendry
> Nursing, Sue Armitage
> Pharmacy, Erica Sainsbury
> Rural Management, David Roberts
> Science, David Livesey
> Sydney College of Arts, Brad Buckley
> Veterinary Science, Rosanne Taylor

In particular the EQA Working Group is intended to provide faculties with support in interpreting their SCEQ results and planning effective responses to the teaching and learning issues identified in these. This might encompass:

- support in identifying particular strengths and weaknesses and developing strategies to effectively address these
- support in identifying relevant issues to investigate further, and the formulation of collaborative research strategies to effect such investigations
- support in interpreting results and in identifying potential contributing factors
- support in making use of the students' open response comments and consideration of the issues identified in these.

The EQA Working Group also provides an additional forum for consultation between the PVC (Teaching and Learning) and the faculties on relevant issues.

So far this year the EQA group meetings have considered the following topics:

- What processes and strategies might different faculties use to disseminate, and then engage with, the SCEQ data? The group identified a range of faculty-based strategies to complement existing ITL web-based dissemination strategies.
- The group considered comments from faculties on the document "Recognising and Rewarding Good Teaching at the University of Sydney; Changes to the Teaching Performance Indicators for 2002".
- The group also discussed the faculties' responses to issues identified in the SCEQ results. In 2001 many faculties are focussing on improving student learning experiences and outcomes through:

  1. First year student orientation programs
  2. Programs for at risk students and
  3. Unit of study goals and outcomes.

  The ITL is providing support to several faculties in addressing these issues.

- The group has also provided a forum to support faculties in preparing the 'Self Evaluation Reports on Academic Quality Assurance Systems' outlined in the Academic Board Resolution on the Management and Evaluation of Teaching.

Resources developed by the EQA group are posted in the Overview section of the Institute's Teaching Evaluation and Enhancement web site at : http://www.itl.usyd.edu.au/teval/. If you have a question or would like to get involved in your faculty's teaching evaluation and quality assurance initiatives, please contact your faculty representative on the EQA Working Group.

Developing Cognitive Dexterity in the Faculty of Rural Management

Tony McKenzie, Faculty of Rural Management

I would like to share some of the ideas steering curriculum change in the Faculty of Rural Management, in particular, our belief in the importance of fostering what I would call 'cognitive dexterity.' We can define this as one's ability to switch between immediate, operational thinking, and one's metacognitive monitoring of that thinking.

Tony McKenzie

Embedded in the curriculum are a number of Capabilities. For example, Capability 8 is: to hold a perspective that acknowledges local, national and international issues. The Faculty Guide suggests that Capability 8 can be interpreted literally, or more generically:

The literal view. When the Faculty composed Capability 8… it wanted to emphasise the interconnectedness of the forces influencing farm production and decision-making at all levels of [geo-political] organisation.

A more generic view. We can also think of this capability in terms of 'systems' and 'subsystems'.

To help students understand this we ask them to imagine a cave in a rainforest. The cave experiences a microclimate. The temperature and moisture conditions experienced by a moss on the floor of the cave are influenced by the extent of exposure or protection from the climate of the region. Students are asked to consider how long it will be before global warming will impact on the regional climate, and then on the cave microclimate.

In ecosystems, and in systems thinking generally, a subsystem like a microclimate (local level) is, in its developed form, in a stable state of inputs, transformations and outputs. Subsystems are components of their parent systems, participating in the larger system's inputs, transformations and outputs (regional climate). But the parent is itself a subsystem, because it participates in turn in the processes at the next higher level of complexity (global climatic patterns).

As students succeed in getting their mind around "local, national and international issues", they are demonstrating systemic thinking. The question is: are they also aware of engaging in systemic thinking? Can they see what they're doing, and name it, using more abstract language?

Capability 8, the closest thing we have to systemic thinking, is critical to effective management because, as I argued in an article in 1996, managers "have to operate in multiple contexts, move between different worlds of meaning, weigh up unlike things".

But how can we foster cognitive dexterity in our learners? One promising approach is through trying on their mental gym shoes so to speak. This means putting aside our own viewpoint in order to experience someone else's. Role playing someone else lets us experience two frames of reference, one nested in the other. This provides an opportunity for conceptual breakthrough because of the dissonance between the two ways of seeing. We believe that we are working in an important area here, one in which we are feeling our way.

At Orange, we try to make the most of learners' multiple frames of reference. Students are encouraged to have a nested appreciation of the Capability 8 skill statement. The course text invites them to view the move from a geo-political discourse to one of open systems as an iteration of common principles, but at different levels of generality and abstraction. The two frames of reference are juxtaposed. This hopefully leads to a shift in perspective and eventually to metacognitive awareness of what we are doing.

In the higher education literature there is widespread acknowledgment of the importance of deeper approaches to learning. Accepting the value of ever-deeper questioning is a mark of cognitive autonomy. Cognitive dexterity suggests facility in mentally shifting gears, so to speak, and the deeper we ponder, the more fluid our gear shifting.

New thinking

Introduction to Management is a gateway unit for most of the Faculty's degree programs. The organising principle for the unit's various strands of activity is that students are encouraged to see every element as contributing in some way to their own professional formation as rural managers. One student reported that he had not seen any value in a model of management styles when it was covered in class, but after using it to identify some perceived weaknesses in his own management skills, he acknowledged that the model had been very beneficial: "I now have a much more open-minded approach to the application of theoretically-adopted learnings," he wrote.

When I read the student's comments, it seemed that not only was he making new connections between disparate elements within the unit, he had also experienced a subtle shift in how he conceived the way ideas and frameworks ebb and flow, colouring each other. The course had apparently not only stimulated conceptual change in relation to its content, but also in the way he thought about the organisation of knowledge in general. It also caused me to shift my perspective, reflecting more widely on my own understanding. Perhaps his words were signs of an emergent idea; an idea before its time, about the way different kinds of ideas at different levels mingle to form an understanding.

This seems to me to be an educational outcome worth striving for.

Tony McKenzie is an educational developer with the Faculty of Rural Management. You can e-mail Tony at: tmckenzi@orange.usyd.edu.au His website is at:
http://www.orange.usyd.edu.au/pages_staff_members/tmckenzi/tmckenzi.htm

We did not systematically measure the difference in achievement of generic skills in communication and group work. Anecdotally, we could report achievements of the PBL group. Also anecdotally, when the 1997 cohort reached their senior year, staff felt that their group work skills and knowledge of basic software engineering approaches was dramatically better than with previous cohorts.

Another important part of the innovation process was that we carefully measured students' examination performances across cohorts. For example, we could compare performance for similar programming tasks (list traversal) in the conventional class in 1996 and the 1998 PBL class. The class average in 1996 was 63% where in 1998 it was 91%. A good part of this improvement is due to the change in programming language.

Another dramatic improvement was measured in exam performance on theory topics. For example, the mean mark on a time-complexity analysis task was 42% in 1996 where the 1998 class mean was 82%. This improvement seems likely to be due to PBL putting *learning in context*. Before the PBL course, many students saw this material as boring and irrelevant to their real interests in programming. With PBL, more students seemed to be able to see the utility of this theory and worked on this topic in the context of the programming tasks.

Staff surveys have been invaluable: they inform refinements to the teaching and they give excellent qualitative insight into the effectiveness of changes. Generally, staff who had taught for several years were extremely positive about the benefits of the innovations.

Finally, student surveys are a core source of data on how students feel about the units. For example, in 1997, we had substantial technical problems and difficulties with teaching resources. These headed the list of student complaints for that year. When these core problems were improved, the 1998 surveys reflected the improvement, with the prime complaints being about the amount of terminal access available. More recently, the surveys have become more stable but continue to confirm the teaching staff's perceptions of the need to develop more teaching resources to scaffold students in their first weeks of programming and in learning to work effectively in groups. They also confirm the common observation that some students do not want the learning responsibility that comes with PBL.

Reflection

At the time of these innovations in our first year teaching, our department was working under great difficulty. There was a desperate shortage of staff and difficulty in remedying this. At first, one might think this would stifle innovation. In retrospect, I am convinced that the innovation actually *helped* us through this very difficult time. When you are obliged to find ways around shortages and challenges, innovation is essential. At the same time, it is motivating to feel that you are exploring and refining ways to make substantial improvements.

The most controversial aspect of the innovation was the introduction of problem-based learning. Undoubtably, the 1996 trial served as the single most important part of the process in introducing that change. When we are challenged, we can point to this trial as a solid basis for use of PBL. (In fraught times, I remind myself that the trial indicated that PBL has so much to offer that it is worth persisting!) At the same time, the broader and on-going evaluation and refinement of the teaching and learning are also important.

Associate Professor Judy Kay received a Teaching Excellence Award in 1993 and a Group Teaching Excellence Award in 1999.

ITL Bookshelf

In each issue of Synergy we review selected teaching and learning publications which will be of interest to members of the University community. Materials reviewed in this and past issues of Synergy are available in the ITL's Resource Room (Level 3, Carslaw Building, F07). University of Sydney academics are invited to visit the Resource Room and to consult with ITL staff on their particular needs and interests.

**Kim McShane and Angela Brew, Bookshelf Reviewers. Email: synergy@itl.usyd.edu.au**

Change and Universities

Changing Academic Work: Developing the Learning University.
Martin, E. (1999).
Buckingham,UK: Open University Press and the Society for Research in Higher Education.

For anyone in higher education depressed about the changes departments are undergoing or the changes to curricula they are having to make, this book is both a comfort and an inspiration. For those charged with the responsibility of leading academics in that change, it is a rich source of ideas. The book deals intelligently with the tensions we face, between for example, individualism and collaboration; between accountability and reward, and between the need to value the past while looking forward to the future. Elaine Martin skilfully brings together ideas from student learning and organisational learning research to show how real change in universities can occur if the principles of what we know about good learning and how it can be encouraged and nurtured are integrated into the process. The book is illustrated with examples of academics at all levels engaging with sometimes painful and radical change. Written in a delightfully lucid style making it a pleasure to read, this is in very many ways a wise book. AB
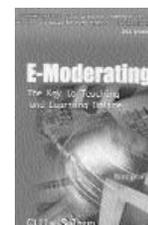
Online Teaching and Learning

E-Moderating: The Key to Teaching and Learning Online.
Salmon, G. (2000).
London, UK: Kogan Page.

If you work with learners online, you are an 'e-moderator' and part of a pioneering generation of educators developing new skills and expertise in electronic educational contexts. Experienced and novice e-moderators will find this text very useful. Salmon's 5 stage model of computer-mediated communication (CMC) in teaching and learning offers an effective framework for understanding how students will approach and engage in the task of online discussion. The model is research-based (Salmon carried this out at the Open University, UK), and her helpful explanation of the 5 stages is supported by many fascinating extracts from actual online discussions. While the focus is always on the student, implications for the 'e-moderator' are also raised. A large part of this book is devoted to 'Resources for Practitioners' and it sets out a very comprehensive listing of technical, learning and moderation strategies for the online lecturer. This book is recommended reading for all colleagues who are considering the incorporation of online discussion forums ('Discussions' in WebCT) in a Unit of Study. Interested colleagues might also like to visit the website which accompanies the book: http://oubs.open.ac.uk/e-moderating. KM

Assessment

Improving Assessment Practices: Working with Sessional Markers.
Coombe, K. & Clancy, S. (Folios 1 - 3), Coombe, K., McFadden, M. & Clancy, S. (Folio 4), (2001).
Wagga Wagga, Charles Sturt University.

These 4 short folios represent an outcome of a CUTSD-funded project undertaken by a staff team at Charles Sturt University. The project addressed issues associated with the increasing trend in universities to employing sessional markers. Each folio is written for a specific audience. Folio 1 (Designing Assessment Tasks) and Folio 2 (Supporting Sessional Markers) have been prepared for those who actually design the assessment tasks and organise the work context for the sessional marker/s. Folio 3 (Working Effectively as a Sessional Marker) is a 'must read' for all sessional staff, and it includes advice on how to collaborate with a teaching team, manage time and provide helpful feedback to students. Folio 4 (University Policy Issues) is designed for university 'line managers' and sessional staff supervisors. It tackles some of the issues associated with the employment of sessional staff. Although the folios primarily discuss sessional marking, in fact they offer all university lecturers succinct advice and practical strategies for improving the design, organisation and conduct of effective assessment in an accessible, easy-to-read format. KM

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2001 CONFERENCES

ODLAA - 'EDUCATION ODYSSEY 2001'
24 - 27 September, 2001
Open & Distance Learning
Association of Australia
OTEN; The University of Sydney
Australian Technology Park,
Sydney, NSW
http://www.oten.edu.au/odlaa/

LILLY CONFERENCE ON COLLEGE TEACHING FOR 2001
15-18, November, 2001
'2001: A Teaching><Learning
Odyssey'
Miami University
Oxford, Ohio, USA
http://www.muohio.edu/lillyconference/

6TH ANNUAL SEDA CONFERENCE FOR STAFF AND EDUCATIONAL DEVELOPERS
20 - 21 November, 2001
'Developing the Developers:
Professional enhancement for staff
and educational developers'
Staff & Educational Developers
Association
Manchester, UK
http://www.seda.demon.co.uk/man01.html

ASCILITE 2001
9 - 12 December, 2001
'Meeting at the Crossroads'
Australasian Society for Computers
in Learning in Tertiary Education
University of Melbourne, Vic.
http://www.medfac.unimelb.edu.au/Ascilite2001/

SRHE 2001 ANNUAL CONFERENCE
12-14 December, 2001
'Excellence, Enterprise & Equity:
Competing Challenges for Higher
Education'
The Society for Research in Higher
Education
University of Cambridge
http://www.srhe.ac.uk/indexevents.htm

HERDSA 2002 CONFERENCE
8 - 10 July, 2002
Higher Education Research &
Development Society of Australasia
Edith Cowan University
Perth, WA
http://www.ecu.edu.au/conferences/herdsa/

ITL PROGRAMS AND EVENTS

FIRST YEAR COORDINATORS' MEETINGS
October 17th & December 12
(1-2pm) Room 354, Carslaw
Building. Please bring your lunch.

DEVELOPING SUPERVISORY SKILLS: WORKSHOP 2
Thursday 20th September
(9.30am - 1.00pm) Sir Hermann
Black Room, University Staff Club.
Contact the ITL for registration.

THE VICE-CHANCELLOR'S SHOWCASE OF SCHOLARLY INQUIRY IN TEACHING & LEARNING
27 - 28 September, 2001
For information & registration, go
to: http://www.itl.usyd.edu.au/itl/Showcase2001/

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academic staff over 2 semesters. The 3-
day program forms part of the first
unit, so you would have to do that
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- a recognised qualification in
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3671 or visit our website at:
http://www.itl.usyd.edu.au

Please send details of conferences
on aspects of teaching and
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