

# **UniServe Science**

**Proceedings of  
Scholarly Inquiry in Flexible Science Teaching and  
Learning  
Symposium**

**April 5, 2002  
The University of Sydney**

# UniServe Science

**UniServe Science** was established in 1994, under a grant from the then Committee for the Advancement for University Teaching (CAUT), with considerable help from The University of Sydney, to act as a national clearinghouse for the dissemination of information about teaching software in the experimental sciences in Australian universities — specifically in the disciplines of Biochemistry, Biology, Chemistry, Geography, Geology, Physics and Psychology. That grant was for three years. UniServe Science is now fully funded by The University of Sydney and has added Computer Science, Mathematics and Statistics to the client base.

**UniServe Science** aims to enhance the quality of university science teaching in Australia by collecting, maintaining and disseminating information on up-to-date and innovative teaching materials. UniServe Science publishes *CAL-laborate*, an international journal, prepared in collaboration with the United Kingdom Science LTSNs and the Swedish Council for the Renewal of Higher Education. *CAL-laborate* is published in June for the Life Sciences and October for the Physical Sciences and Geosciences and is available online from <http://science.uniserve.edu.au/pubs/callab/>. UniServe Science also conducts an annual national conference which focuses on the enhancement of tertiary science teaching and learning. The conference has two components: the First Year Experience Discussion Forum; and the Tertiary Science Teaching Symposium. The Pearson Education UniServe Science Teaching Award, which is made at the annual Symposium, recognizes teaching that improves student learning outcomes via the innovative and integrated use of information technology. Notes from the FYE forums are available online from <http://science.uniserve.edu.au/disc/fye.html>.

Papers for the 2002 Symposium, 'Scholarly Inquiry in Flexible Science Teaching and Learning' have been reviewed to meet the Department of Education, Science and Training standard for research conference publications.

The full papers were peer reviewed by at least two members of a national review panel that was chaired by Associate Professor Ian Johnston, Director, UniServe Science. For those papers deemed to be worthy of refereed publication, authors were provided with feedback from the reviewers and asked to make appropriate changes.

The Symposium was attended by academics from across Australia and the proceedings is distributed nationally and internationally in print and from the Web (<http://science.uniserve.edu.au/pubs/procs/>).

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Published by: UniServe Science, Carlaw Building (F07), The University of Sydney, NSW 2006  
<http://science.uniserve.edu.au/>

Editor: Anne Fernandez

ISBN: 1 86487 490 2

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Pearson Education Australia was a proud sponsor of this UniServe Science symposium. Pearson Education supports UniServe Science's aim to promote the use of technology in science teaching and learning.

## Scholarly inquiry and flexibility

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### The changing role of UniServe Science

As many of our readers will know, UniServe Science was established in 1994 by the Department of Education, Employment and Training (as it then was) through the Committee for the Advancement of University Teaching. It was to be part of a nationwide network of clearinghouses, UniServe Australia, whose job it would be to offer support and advice to teachers in Australian universities, particularly about the use of Information Technology. The concept was modelled on the Computers in Teaching Initiative in the UK (which has latterly been transformed into the Learning and Teaching Support Network). Right from the start international links were established, specifically with the UK and Sweden.

The original funding was for three years, the hope, at least on the part of CAUT, being that the network should become self-funding. Some hope. Although other universities seemed willing to make use of the services of the network, they were not willing to fund it from their own, ever-tightening resources. When the funding stopped the network withered and the various nodes went off in their own directions. UniServe Science was able to survive owing to support from The University of Sydney, and has been running completely on that support for six years. It means however that we have become one part of the local infrastructure, and our long-term survival, if it exists, is irrevocably bound up with the needs and interests of The University of Sydney.

Where then does that leave our national focus? So far as we are concerned, it is still there, but of necessity it is a smaller part of our business. This is reflected in several changes. We have, for example, found that our national newsletter no longer fills a need. It is being discontinued. We will, however, still produce our international newsletter, *CAL-laborate* which attracts articles from Australia, the UK and Sweden.

Of immediate interest here are the changes that have taken place in our annual national workshops (or symposiums, as we will call them from now on). Whilst our other national activities have contracted somewhat, these have increased. For the last three years we have hosted a two-day conference, the first of which is a First Year Experience Forum and the second is the Symposium. The First Year Experience Forum has taken the place of the show-and-tell element of the workshop and allows for discussion of teaching and learning issues pertinent to the needs of first year students and the academic staff who teach them.

This is also the second year that the Pearson Education UniServe Science Teaching Award has been made. This award recognizes teaching that improves student learning through the use of information technology. It is also the second year that papers in the Symposium Proceedings have been refereed.

Right from the very beginning we believed one of the main reasons for our existence on the national level was to promote a sense of community among tertiary teachers of science. We know we have done that in the past. We aim to keep doing it in the future.



## What happened at the symposium

The theme of this year's symposium was *Scholarly Inquiry in Flexible Teaching and Learning*. This followed on from previous workshops: *Education Research* in 2001, *Evaluation* in 2000, and *Flexible Learning* in 1999. We felt that these issues are still right at the forefront of where important work is currently being done, and worthy of a follow-up symposium.

There were two very different keynote addresses. Beryl Hesketh is Dean of Science at The University of Sydney. Calling on her background as an academic cognitive psychologist, and her experience in the field of training in the business world, she spoke on the 'Science of science teaching and learning'. In her talk she highlighted an interesting dilemma in the area of training and transfer: the disparity between methods of training that foster long-term retention and transfer and those that students rate highly and find enjoyable. See page 3. On the other hand, Paul Francis is an astronomer at the Australian National University, who has developed a technique of using role-playing games, borrowed from the corporate world, in science lectures. His talk also demonstrated by his method of delivery, how an enthusiastic delivery can enhance the lecture experience. For further details see page 7.

There were ten contributed papers from all over the country, and even one from a university in Thailand. There were also twelve posters, short papers or abstracts of which are included in this Proceedings. Following a 'tradition' established last year, the posters were divided into those which could be given in standard poster format, and four special ones which were presented as show-and-tell sessions. This proved popular last year in that it allows developers of extended software packages or formally structured innovative teaching techniques to have enough time to show their wares.

## Pearson Education UniServe Science Teaching Award

This was the second time this award has been made. This year there were seven entries, and the judging panel, Associate Professor Bob Hewitt (chair), Professor Shirley Alexander (UTS), Professor Richard Gunstone (Monash) and Lori Hales (Pearson Education) again had an extremely difficult job in making the final decision but in the end they were unanimous.

The winners were an inter-university team headed by Robert McLaughlan (UTS) and including Denise Kirkpatrick (UNE), Holger Maier (Adelaide) and Philip Hirsch (Sydney). The project involved the construction of a cross-disciplinary electronic role-play simulation ('e-sim'). The particular project that that team worked on was an exercise in decision making concerning environmental management of the Mekong region in South East Asia: but the technique can be used in many other discipline areas. (See page 13 of this Proceedings for a fuller description.) Our most sincere congratulations to the winning team, and to the other entrants.

# The science of science teaching and learning

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In this paper I will outline why we need a scholarly and empirical investigation into current and new methods of teaching and learning in science, highlight the relevance of research in allied areas such as cognition, learning, and self-regulatory theories, and compare the short and long-term effectiveness of approaches.

## The need for a scholarly and empirical approach

Over the past decade there has been an increasing emphasis on student evaluation of teaching and learning, and a plethora of methods have been developed to assess student reactions. Involving students in the feedback process and taking into account their views is essential, and the trend toward doing this is to be welcomed. However, there is very little experimental research comparing different methods of teaching, using hard performance data as the criterion to accompany the information obtained from student evaluations. Research on IT and Teaching tends to be based on show-and-tell case studies, which provide useful ideas for ways in which to introduce IT, but little hard data about the effectiveness in terms of improved learning on the part of the students. We need hard evidence of the value underlying whatever teaching and learning methods are popular. In this paper, I draw primarily on research that has been undertaken in cognitive psychology and that has been related to training. Although I suspect that the issues apply equally to teaching and learning in the higher education sector, we do still need to assess this.

## The dilemma

I have written previously about a dilemma in the area of training and transfer (Hesketh, 1997). Drawing on the research of Bjork (1994), we know that the methods of training that foster long-term retention and transfer, are often not the methods that students find most enjoyable. Conversely, the methods that students enjoy and rate positively, such as, for example, clear goals, do not necessarily develop independent structuring and learning skills that foster transfer and retention.

In the 1990s the USA Academy of Science was concerned about the limited uptake in industrial training of knowledge arising from experimental psychology research on cognition and learning. The Academy funded a review chaired by Professor Bjork to investigate why industry was not using the latest research findings in the fields of cognition and learning in the design of their training programs (Druckman and Bjork, 1994). Although an oversimplification of the findings from this review, it did appear that both trainers and trainees were ‘addicted’ to courses that are enjoyable. The use of the word ‘addicted’ helps to highlight the time dilemma in training.

Enjoyable courses make trainees feel good during and immediately after the course, and because trainees feel good and provide positive reactions in feedback at the end of a course, trainers also feel good. Very few companies collect hard data so there is little evidence that enjoyment correlates with performance. Furthermore in much of the applied training research there is very little long-term follow-up to explore whether skill and knowledge learned during training transfers back into the work place or is retained after a delay. This means that there is little evidence that the methods of training preferred by trainees lead to long-term skills that foster transfer. Without follow-up research, employers will never know that their training is not working, nor that it might even be bad for them and their employees. On outlining this dilemma to a group of industrial trainers, one described the courses that were run as ‘cigarette’ courses. Employers and employees knew that they



may not have positive outcomes in the long run, but behaviour was maintained because of the current enjoyment – hence the addiction analogy.

## Transfer of training paradigm (Bjork, 1994)

A standard methodology used in experimental studies on cognition and learning in training and transfer is to compare different methods of training (say method A and method B) in terms of performance immediately after training and then again after a delay, or to compare performance on a task that is similar to the one used in training with performance on a transfer task involving different deep (far transfer) or surface (near transfer) features (Hesketh and Ivancic, 2002; Hesketh, 1997).

A stylised summary of the outcomes of many studies of this sort point to the fact that methods which show superior performance immediately and on the task similar to the training task, tend to be comparatively less effective after a delay and on a transfer task. Conversely, the methods that at first appear to be less effective on the training task, often show superior performance when tested after a delay or on a transfer task.

The methods which appear less effective on a training task, but which demonstrate superior outcomes on transfer (Bjork, 1994) include:

1. **Varying the conditions of practice** This might include exposing learners to a range of different examples that challenge them, with changing and slightly unpredictable features, compared with exposure to a limited range of examples all of which use similar features and provide consistent information. Challenging and varied examples may attenuate performance shortly after training, but show enhanced performance on transfer tasks.

2. **Providing contextual interference** Kintsch (1994) has shown that providing an ‘advance organiser’ that is consistent with the subsequent information results in superior immediate knowledge of the information it foreshadows. In comparison, an advance organiser that is inconsistent leads to poor knowledge of the information it foreshadows. However, where an advance organiser is inconsistent, this leads to superior performance on novel information, in part because the participants exposed to the inconsistent advance organiser had to develop their own structure for the material. What transferred was their superior meta-cognitive skill of being able to develop their own structure. Note, however, that this finding only applied to higher ability participants. Lower ability participants were not able to develop their own structures for this particular task.

3. **Distributing practice on a given task** There is a long history of research showing that massed practice results in superior immediate performance, but when re-engaging with a task, initial performance is lower than participants exposed to chunked or spaced practice. By spacing the practice learners have the opportunity to practice recall and relearning every time a new block of information appears. What appears to foster transfer is their superior skill in practising memorising or relearning during the breaks between spaced practice. The phenomenon has been described as the transfer appropriate principle (Morris, Bransford and Franks, 1977). If one wants learners to be able to memorise, reason or solve problems in the long term or on a transfer task, then they need to practise memorising, reasoning and solving problems during training. The cognitive processes required for transfer need to be used during training.

4. **Reducing feedback to the learner** The learning and behavioural literature has shown the value of feedback to help shape a particular behaviour to the desired goal. Frequent and regular feedback results in attainment of the performance goal more rapidly than intermittent or irregular feedback. However, on transfer, those exposed to the intermittent and irregular feedback tend to perform better. One mechanism for this may lie in the development during training of superior self-assessment skills. If feedback is intermittent, or if feedback is faded, the learner is required to develop his or her own standard, and to assess performance against that standard without external feedback. These meta-cognitive self-assessment skills can be applied subsequently to the delayed or transfer task providing them with an advantage over learners who were shaped exclusively by external feedback. It is interesting to note that one of the features differentiating novices from experts is the accuracy of their self-assessments. Experts know what they do and don’t know; novices tend to think they know

everything. Hence the process of fading feedback during training may be one mechanism for fostering the development of expertise.

**5. Making errors during learning** The literature on the role of errors in learning is controversial (Ivancic and Hesketh, 1995/6), in part arising from a body of opinion that learners should be protected from making errors because of the anxiety associated with the errors. However, where the motivational aspect of errors can be managed, making errors provides an ideal basis for checking the accuracy of the mental model or schema being used. Negative feedback associated with inappropriately applying prior knowledge to an inconsistent problem generates 'surprise', motivating trainees to examine why an attempt failed. This enhances sensitivity to structural features of the problem. Errors are also significant events, and help remind trainees of mistakes so that they can avoid them in future. Active error training can reduce confidence (Ivancic and Hesketh, 2000). We examined this on a driving simulator, and were able to demonstrate that participants who made errors during training trials were both better able to deal with a transfer task, and had reduced 'over-confidence'. In the context of driving, reducing 'over-confidence' particularly among young male drivers has positive safety outcomes. However, passive error training (or worked examples of errors) is preferable if high anxiety and lower self-confidence are to be avoided.

In summary, the research suggests that to reduce cognitive load one needs to provide:

- highly structured and error free learning environments;
  - instructional support;
  - clear advance organizers; and
  - regular positive feedback,
- ... but these features may inhibit transfer.

On the other hand, to enhance transfer, one needs to:

- vary the conditions of practice;
  - provide contextual interference;
  - distribute training on a given task;
  - reduce feedback to the learner; and
  - encourage errors during learning,
- ... but these may affect motivation and self-confidence.

Trainers need to make sound judgements about when to shift the nature of the training environment from being supportive to being challenging. In doing so the issues that need to be considered include:

1. **Stages of skill acquisition** During early stages of skill acquisition, before basic components have been automated, attentional capacity is taken up on the task, with little spare capacity for meta-cognitive processes. In later stages, once the basic skills have been automated, more challenging methods that foster appropriate meta-cognitive skills can be used.
2. **Ability levels** Trainees with higher ability tend to have more spare capacity to engage in relevant meta-cognitive tasks. Lower ability learners may need much longer to automate basic tasks, and may need more help in the structuring processes.
3. **Task difficulty** Easy tasks require less attentional resources, and hence one can move to challenging training conditions earlier.
4. **Self-efficacy** Self-efficacy is an expectancy that one can do a particular task. It is not identical to self-confidence. Self-efficacy is increased through successful performance, observation of others performing successfully, verbal persuasion and the avoidance of anxiety. The stage of skill acquisition, ability levels and task difficulty need to be taken into account (in an interactive way), to provide just the right level of challenge in order to enhance self-efficacy.
5. **Anxiety level of learners** High levels of anxiety are incompatible with self-efficacy and also occupy attentional resources inhibiting learning. The staging of challenging material needs to be managed very carefully to avoid inappropriate anxiety levels.

In the above discussion, an understanding is assumed of the concepts of skill acquisition and expertise. Within the cognitive literature, traditionally skill acquisition has been divided into three stages: 1. Declarative or factual stage during which learning is resource intensive; 2. proceduralisation, when facts become compiled; and 3. automatic, at which point only minimal resources are required. The stages are important in understanding the novice-expert shift. Among other differences, compared with novices, experts show the following features: 1. they are quicker to



identify a problem and read off the appropriate solution; 2. they have hierarchical and integrated knowledge structures; 3. they have more automated categorisation and decision skills; and 4. they are more accurate at self-assessing and using meta-cognitive skills.

## Solutions to the dilemma

Training needs to be tailored to the needs of the learner. I am not referring here to the concept of learning styles that has received comparatively little serious empirical research. Rather, it is the notion of the levels of skill acquisition and ability, and the ways in which these interact with task difficulty that should be examined in determining when to shift learning into a challenging mode. For each individual the challenge should be sufficient to require active processing and effortful learning, but not so challenging that anxiety is generated. It is important to ensure that basic skills have been automated, and that task difficulty is appropriate to ability and level of skill acquisition.

Another approach is to place the emphasis on learning goals rather than on outcome goals. For example, trainees can be told the value of errors, and how to learn from them. This places a focus on the process of learning as distinct from outcome or performance. Obviously one needs to also introduce outcome or performance goals, but timing and sequencing may be important.

Most importantly, more long-term follow-up evaluation is needed to avoid the ‘cigarette training’ trap. Carefully designed follow-up can provide a booster session for learners, and also signals the importance of the knowledge and skill covered during training. A blurring of training and evaluation may offer opportunities for this, and there are interesting new possibilities to introduce technology into evaluation and follow-up.

In my laboratory we have been studying some of these issues using a driving simulator, and in research on training fire-fighters to develop adaptive expertise. Future work will highlight the best ways of combining rules and examples to foster transfer and adaptability. The extent to which these ideas relate to higher education needs to be assessed and researched. However, I anticipate that our current research on rules and examples may help inform discussion about the best ways of combining problem-based learning with more traditional discipline approaches.

## References

- Bjork, R. (1994) Memory and metamemory considerations in the training of human beings. In J. Metcalfe and A. P. Shimamura (Eds) *Metacognition: Knowing about knowing*. Cambridge, Massachusetts: The MIT Press, 185-205.
- Druckman, D. and Bjork, R. A. (Eds) (1994) *Learning, remembering, believing: Enhancing human performance*. Washington, DC: National Academy Press.
- Hesketh, B. (1997) Dilemmas in training for transfer and retention. *Applied Psychology: An International Review*, **46**, 317-339.
- Hesketh, B. and Ivancic, K. (2002) Enhancing performance through training. In S. Sonnentag (Ed.) *The psychological management of individual performance in organization*. London: Sage.
- Ivancic, K. and Hesketh, B. (1995/6) Making the best of errors during training. *Training Research Journal*, **1**, 103-125.
- Ivancic, K. and Hesketh, B. (2000) Learning from errors in a driving simulation: Effects on driving skill and self-confidence. *Ergonomics*, **43**(12), 1966-1984.
- Kintsch, W. (1994) Text comprehension, memory, and learning. *American Psychologist*, **49**(4), 294-303.
- Morris, C., Bransford, J. and Franks, J. (1977) Levels of processing versus transfer appropriate processing. *Journal of Verbal Learning and Verbal Behavior*, **16**, 519-533.

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## Using role-playing games to teach science

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### Introduction

Anybody who has done a course at a corporate training centre will have been struck by the dramatic contrast between their teaching methods, and those generally employed in undergraduate science lectures. In most undergraduate lectures, the teacher stands at the front presenting a stream of information, which the students copy down. Occasional questions are asked, but the students are essentially passive throughout. In corporate training centres, most classroom time is devoted to role-playing simulations, business games and discussion sessions. Students are active throughout, and speak for more of the time than their teachers.

Why do corporations spend big money on such unorthodox teaching methods? Abundant research shows that students taught in conventional lectures, even those who perform very well in conventional assessment, are often quite unable to apply their knowledge effectively in real-world situations (e.g. Ramsden, 1992). Conventionally taught students tend to rote-learn; they fail to integrate their new knowledge into their prior assumptions, and they rarely think through the implications of what they learn (e.g. Mazur, 1997).

In this paper, I describe my attempts to adapt one of these corporate teaching techniques, role-playing exercises, to undergraduate science lectures. These techniques are occasionally used in academic disciplines such as law and environmental management. In a typical exercise, students will play the roles of competing parties in some dispute, and will learn about different points of view and mediation. Role-playing exercises have not previously, however, been widely used to teach mainstream science: it's a bit hard to have competing positions on the solubility of nitrogen, or to mediate between different views on the third law of thermodynamics ...

All scientists know that research is an exciting, sociable, chaotic and deeply human enterprise. This is not how our undergraduate students perceive it. Surveys (e.g. Loss and Zadnik, 1994) show that most students think that science consists of endless dull laws and facts, brought down from the mountain on stone tablets for them to memorise in solitude. My goal was to expose students, even in first year, to the real experience of being a research scientist.

### Case study: The climate of Venus

Perhaps the easiest way to explain my technique is to give an example. In this section, I will describe how I prepare and run an exercise, designed to teach a class of forty first year Australian National University (ANU) astronomy students about the Greenhouse Effect and how it affects planetary climates.

#### Pre-lecture preparations

I decide on a scientific problem that I want the students to solve (in this case, the question of why Venus is so much hotter than the Earth). Rather than present the problem and its answer in class, I divide the answer into a number of separate clues. Each clue is written up as a separate briefing paper. I include many red herrings in the briefing papers, to train students in recognising and extracting relevant information.



### **Lecture preamble**

I start the lecture off by explaining the scientific problem to the students. I tell them that Venus should be very similar to the Earth: it has a similar size, orbit and chemical composition. Observations, however, show us that Venus is actually quite different from the Earth: it is bone dry, has a temperature of over 400 degrees Celsius, an incredibly dense atmosphere and clouds of sulfuric acid.

‘Pretend that this lecture is a research conference, and that you are the world’s experts on planetary atmospheres, gathered here together at enormous expense by NASA, to figure out why Venus is so hot. I’d like you to divide yourselves up into groups of three. One person from each group should come down to the front and get one of these briefing papers.’

Groups of three seem to be optimal for these exercises: any larger and the less articulate group members cease to play any effective part. This is smaller than the optimal size for larger scale problem-based learning (e.g. Michaelson, Fink and Black, 1996). Most of my students seem to prefer doing these exercises in small teams to working as individuals.

‘Each group of you are world experts on some branch of science. Just as in the real world, no single group of you has enough information to crack this difficult mystery alone. You will have to exchange information with the other groups to devise a complete picture. Take a few minutes to read your briefing papers. Come and bug me if you have any questions. A warning: everything in these papers is true, but not all of it is relevant! You should try and pick out the key facts.

Once you’ve got your briefing paper figured out, you should go out and talk with the other groups. Try and put together the clues to figure out why Venus is so hot. Just as in the real world, you are allowed to lie, cheat, steal and indulge in espionage. But remember: if you do it to them, they’ll probably do it to you!

In the real world, whoever was first to figure out a mystery like this would win a Nobel prize, fame, tenure, grants: all the good things in life. We cannot give you that: however, if you get the answer first, you will win one of these glow-in-the-dark stars!

To win the prizes, you must come down to the front and present your complete theory to everyone. Just as in the real world, you don’t get the prize by coming up with the correct answer. You just have to come up with an answer that your peers will accept. OK! Get Going!’

### **While the exercise is running**

The initial class response is generally stunned silence. Slowly groups read their briefing papers. Many classes need encouragement to start discussing their papers out loud, rather than reading them individually in silence.

I wander around the class, listening in on groups and offering advice, clarification and encouragement. At first, it is often necessary to tell groups that:

‘You don’t know enough to figure this out for yourselves. Go out and talk to some of the other groups, and see if they know anything that helps fill the gaps in your story.’

Once one or two groups start wandering around, accosting other groups and demanding to know what their clues are, the whole class rapidly gets the idea, and breaks up into anarchy. The noise level rises dramatically and animated discussions start throughout the room. When I first ran these exercises, I was afraid that the class might just start gossiping, playing games or otherwise mucking around, but in practice this has never been the case. It may look like anarchy (I once had an ANU

security guard come in to try and break up what he thought was a riot) but if you listen in, you find that the students are actually focussing very strongly on the exercise.

The atmosphere in class is wonderful: lots of excited chatter, students racing around interrogating each other and debating the science. Many of the overheard conversations really sound like academics in discussion:

‘So, if the oceans boil, that will release the carbon dioxide. But why should they boil in the first place?’

‘But won’t it combine with the sulfuric acid first?’

‘Those bastards from Caltech won’t share their data with us.’

Once the exercise is up and running, I’m almost redundant: the students are answering most of each other’s questions. Indeed, it is sometimes difficult to persuade the students to leave at the end of the session.

### **Ending the exercise**

The students seem reluctant to conclude that they have a complete answer (even when they do), and so I normally have to encourage one or two groups to come up to the front and present their theories. In most cases, the first group to come up is confused about some details and is voted down by their peers (though I still give them glow-in-the-dark stars). A good answer is normally obtained by the second or third try.

I will then spend some time debriefing the students: pointing out any subtleties that they missed and expanding on the crucial points. All the briefing papers, and a full explanation of the correct answer, are posted on the Web for them to read.

### **Evaluation**

These role-playing exercises are very much an experiment still in progress. I am therefore concentrating on formative, not summative evaluation. The only summative evaluations carried out are the ANU’s standard end-of-course student questionnaires. These tell us that the course (which uses roughly one role-playing exercise per week) is very popular: it regularly receives the highest student ratings yet recorded at the ANU.

#### **Built-in evaluation**

When running these exercises, you spend nearly all your time in class listening to students, not talking. This is a form of built-in evaluation, and is one of the greatest benefits of this technique. On several occasions, this has allowed me to pick up and correct major student misconceptions at an early stage: misconceptions I would not otherwise have picked up until marking the examinations.

Listening in revealed a number of pitfalls with this technique:

- Students clearly have an implicit faith that anything their lecturer tells them must be relevant. As a result, they tended to fall for all the red herrings in the briefing papers. Warning them in advance that red herrings are present seems to fix this problem.
- The whole exercise must be completed within a single lecture. If I attempt to spread an exercise over multiple lectures, I find that students lose both the plot and all motivation between sessions. If necessary, the exercise should be simplified until it fits comfortably within a single time slot.
- Many students treat these exercises as ‘collect the six pieces of paper’ games, unless you forbid groups from showing their briefing papers to other groups: they must verbally describe what they know. This seems to force groups to concentrate on understanding the science, rather than simple paper collection.



### **Minute papers**

In all my classes, I use the well-known evaluation technique of minute papers. At the end of the last lecture of each week, I ask students to scribble on a piece of paper (a) what was the most important thing they learned this week, and (b) what was the most important unanswered question this week left them with. The minute papers were not intended as a method of evaluating the role-playing exercises.

Nevertheless, it turns out that the minute paper responses give very useful information. Normally, most students say that the most important thing they learned that week was some part of the syllabus we'd just covered. In the week when I run the first role-playing exercise, however, around 30% of students give very different responses. Here are some examples of the most important things they thought they had learned:

‘The way that as a group of people, we as humans try and answer the way things are using a collection of seemingly unrelated facts.’

‘Astronomy isn't all stiff attitudes and boring theories.’

‘The best way to learn is to ask questions. Never accept an answer or a theory without thinking it through, and if you disagree, without argument.’

‘There are no right answers, only theories based on observations.’

I conclude from these responses that these exercises are indeed changing the attitudes towards science of at least some of the students.

### **Focus groups and open-ended questionnaires**

On many occasions, the students were asked to fill out open-ended questionnaires. These gave them the chance to say what they found good and bad about the role-playing exercises.

I was worried that there might be a disaffected minority of less articulate students, who found the exercises intimidating but whose discontent had been missed by the other forms of assessment. I therefore asked Dr Chris Trevitt, from the ANU's Centre for Educational Development and Academic Methods (CEDAM), to conduct focus groups with my students. These focus group discussions were held during tutorials. They were not announced in advance, to prevent self selection of those participating. Chris was given instructions to search for a disaffected minority, as well as probing the good and bad points of the role-playing exercises. He took notes on a white-board, and with the permission of the students, taped the whole discussion. The tapes were only released to me after the end of semester, when all student marks had been finalised. The tapes turned out to be far more useful than the notes taken. I feel that this is inevitable: only the person responsible for the experiments, and who has agonised about the details of how they are run can pick out from the vast mass of discussion the most relevant points.

No sign of any disaffected minority was uncovered. The focus group discussions, however, combined with the open-ended questionnaires, provided a great deal of information about why the students thought that the role-playing exercises were an effective technique. I will let the students speak for themselves:

‘You weren't just receiving the information, we were sitting down and working it out for ourselves.’

‘It was personalised, it was your own ideas rather than dictating somebody.’

‘Rather than rote-learning facts, we got to see the processes unfold and evolve (which makes them easier to remember in the long run).’

‘You had your own sorts of breakthroughs when you found out another piece of information and it was like Oh Wow! This fits in with this, and now we know this, and ... You actually felt quite intelligent.’

‘We enjoyed these tasks more because it gives us the sense that we’re the first ones to discover these things, and it gives us a sense of pride in what we were doing, whereas if we read it out of a book we wouldn’t get the same sense of pride.’

‘It really helped to expand our own ideas.’

‘It compressed an awful lot of information into a single exercise.’

Students repeatedly emphasised two themes that surprised me:

- Many mentioned that they liked the role-playing exercises because it ‘made them feel intelligent’. People were forced to come to them for information and they got to play the role of the expert. This seems to be a new and very fulfilling experience for them. This suggests to me that lack of student self esteem is a big problem in these classes, and is not addressed well by conventional teaching techniques.
- They really appreciated the prizes (glow-in-the-dark stars, or lollies). They acknowledge that the prizes were a joke, but still – they really liked them. I’m not sure that I understand the psychology behind this.

## Other users’ experience

I publish all my exercises on the Web (Francis, 2002), and they have now been used in around 20 universities, science centres and high schools around Australia, in the USA and the UK. They have been used in classes as large as 150 and as small as 10. Different exercises have been used at every level from Year 10 to postgraduate.

Almost all users report similar experiences to those that I have presented here. These exercises do seem to work well for a wide range of student types. There are two reported exceptions:

- One lecturer at a prestigious west coast US university reported that her students became very political and combative while running one exercise, so much so that the science was almost forgotten. This has not been my experience, or that of other US lecturers.
- At the ANU, we find that third year undergraduates find it harder at first to get into these exercises than first years. We hypothesise that they are simply more used to traditional teaching techniques.

## Conclusions

These role-playing exercises are still an experimental technique, but one which, I feel, shows promise. You can find other descriptions of these exercises in Francis and Byrne (1999), Francis (1999) and full copies of them all on the Web (Francis, 2002).

When I first published this technique, I was expecting that people would borrow my basic idea, learn from my experience, but that they would write their own exercises, better suited to the courses they teach. I do not find these exercises hard to write; the preparation time is little greater than for a conventional lecture. Instead, most people use my exercises unmodified. I am only aware of one person who has written his own role-playing exercises. I’m not sure why people are doing this: I’d be interested in any suggestions. There may be some way to make these things easier to write. Alternatively, it may be necessary to publish books of them suitable for different disciplines.



## Acknowledgements

I would like to thank Marjan Zadnik for motivating me to experiment with non-traditional teaching methods, and Kathleen Quinlan, Chris Trevitt and the other staff at CEDAM for their unstinting support and encouragement. The whole physics department at the ANU is the most supportive hotbed of radical teaching ideas any academic could ask for. But most of all, my thanks go to all the students who cheerfully survived these teaching experiments, and were so generous with ideas, feedback and encouragement.

## References

- Francis, P. J. (1999) Using role-playing exercises to teach astronomy. *The Physics Teacher*, **37**(7), 436-437.
- Francis, P. J. and Byrne, A. P. (1999) The use of role-playing exercises in teaching undergraduate astronomy and physics. *Publications of the Astronomical Society of Australia*, **16**, 206-211.
- Francis, P. J. (2002) *Classroom role-playing exercises for astronomy and physics*. [Online] Available: <http://msowww.anu.edu.au/~pfrancis/roleplay.html> [2002, April 3].
- Loss, R. D. and Zadnik, M. G. (1994) The backgrounds & expectations of first year university physics students. *Australian & New Zealand Physicist*, **31**(8), 195-201.
- Mazur, E. (1997) *Peer instruction: A user's manual*. Upper Saddle River, New Jersey: Prentice Hall.
- Michaelsen, L. K., Fink, L. D. and Black, R. H. (1996) What every faculty developer needs to know about learning groups. In L. Richlin (Ed.) *To improve the academy*, **15**, 31-58.
- Ramsden, P. (1992) *Learning to teach in higher education*. New York: Routledge.

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## Developing scholarship through collaboration in an online roleplay-simulation: Mekong eSim, a case study

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*Abstract: Mekong e-Sim was designed to create an authentic learning environment in which students from different disciplines work together to learn about the complexities of environmental decision-making. The version of Mekong e-Sim that is reported here involved students of the subjects Asia-Pacific Development (geography), Technology Assessment (technological developments and impacts in engineering) and Environmental Engineering. During the Mekong e-Sim, students collaborated to adopt different stakeholder roles and initiate and respond to major events relating to economic and environmental development in the Mekong region. Key tasks included responding to topical news events, making submissions to public planning inquiries, writing reports and debating development issues in the Mekong region. Through their participation in Mekong e-Sim, students developed understanding of the complexities of decision-making, appreciation of the range of perspectives associated with environmental management and developed subject specific skills and understandings. A description of the design and evaluation of the Mekong e-Sim is provided in McLaughlan et al. (2001). The development of the teaching project was a collaborative, cross-institutional teaching development that brought together staff with a range of skills and expertise.*

*Despite the fact that there has been increasing attention to scholarly values in universities in recent years there has been little consideration of what this might look like. This paper uses the case of the development and teaching of Mekong e-Sim to investigate scholarly teaching, particularly the process and practice of scholarship and teaching in a team situation.*

### Introduction

In recent years the professionalism of teaching has received increased attention. In part this was supported by the quality assurance activities of the early nineties and increased external pressure and support for a focus on teaching in addition to the traditional valuing of research in academia. Debate about the scholarship of teaching and the nature of teaching as a scholarly activity has moved beyond the circles of academic staff developers to an emphasis on recognizing and rewarding scholarly approaches to teaching through promotion and probationary processes in universities. Government initiatives such as the CUTSD and CAUT teaching grants have been accompanied by institutional level teaching development grants which have sought to encourage and reward innovation in teaching, and attempt to position teaching as a scholarly activity with characteristics similar to those associated with research activity.

A common feature of the various interpretations of scholarly teaching is an intention to improve student learning. Literature on the scholarship of teaching focuses on teacher's engagement in a critical appraisal of their teaching with their peers; establishing a discourse of teaching and the dissemination of innovative practice (Boyer, 1990; Shulman, 1999). Hutchings and Shulman (1990) see scholarly teaching as including gathering evidence about one's teaching, drawing on current ideas about teaching and learning, inviting peer collaboration and review and making teaching public, or extending the sphere of influence by inviting public critique in order to continue the inquiry into student learning.

In this paper we analyse our involvement in Mekong e-Sim drawing on four dimensions of scholarship in teaching proposed by Trigwell et al. (2000):

- engagement with the scholarly contributions of others, being informed about the literature of teaching and learning generally and in one's discipline;



- reflecting on one's own practice;
- communicating what is known and practiced; and
- focusing on student learning as well as teaching.

While the preceding points identify characteristics of scholarly teaching from an individual perspective, Mekong e-Sim was a collaborative teaching project. Traditionally scholarship has been defined through research activities involving collaborative projects where scholars work together, engage in critical review of each other's work and develop joint solutions to problems. However, teaching has predominantly been seen as an individual activity. The Mekong e-Sim project provides an example of teaching following a scholarly model in which we collaborated to critically review each other's work and develop shared solutions to issues and problems related to teaching and learning.

The Mekong e-Sim team sought to create a learning experience that would provide students from different subject areas with opportunities to interact with each other and engage in collaborative learning activities designed to develop an understanding of the range of perspectives relating to a complex, environmental decision-making scenario and an understanding of factors influencing these perspectives. Mekong e-Sim was intended to provide a rich and authentic learning environment in which students would engage in meaningful tasks that directly contributed to their learning of substantive content and encourage the development of generalisable skills (e.g. decision-making, collaboration) and understandings (e.g. understanding multiple perspectives). Finally, the collaborative online tasks involved in Mekong e-Sim assisted in preparing students for the requirements of today's global industries where workers and consultants, involved in common projects, are geographically separated. The following section provides an overview of the features of the Mekong e-Sim project that exemplify characteristics of scholarly teaching activity.

### **Understanding teaching through engagement with the literature**

While Mekong e-Sim had grown from team members' previous work with similar teaching strategies (McLaughlan and Kirkpatrick, 1999; Maier and McLaughlan, 2001), we also read widely in relation to the design and use of simulations and roleplays, the effective use of technologies in teaching, evaluation, collaborative student learning, effective design of assessment tasks, and alignment of teaching and learning. Those less familiar with the Mekong regional context of the e-Sim also developed an awareness of relevant issues. Our engagement with the literature is reflected in the design of Mekong e-Sim, the structure of activities and the use of a range of assessment strategies including peer assessment. Individuals shared their reading informally through face-to-face and email conversations and discussion and by disseminating key readings that were central to the project. A face-to-face meeting late in 2000 provided an opportunity to share understandings and establish a framework for developing the e-Sim and working together.

### **Reflection on teaching**

Members of the team were concerned with identifying the effectiveness of teaching through the e-Sim and the quality of student learning that resulted and we wanted to do this from the students' perspective. Consequently, we collected a range of data from students about their learning, their experiences during the learning activity and their perceptions of the project. We adopted a structured, planned approach to evaluating the effectiveness of the design, technology, learning activities and student learning through individual journals, regular meetings and reflective discussion. We systematically monitored the success of the implementation, fine-tuning the activity as necessary, and keeping formal records of the implementation with notations about future modification. We consciously adopted an evidence-based approach to our work using information from staff and student participants and sought to improve our teaching by seeing it from the perspective of student learning.

Team based educational developments are always challenging, Mekong e-Sim involved the collaboration across institutions of four academic staff and four groups of students. Managing the

multiple levels of interaction and engagement was not always easy. Our own experiences as we attempted to work effectively at a distance reminded us of the difficulties that our students were facing. We noted the experience of collaborating as teachers, reflecting on our joint planning, the processes of communicating asynchronously and at a distance, and of the various perspectives that each member brought to the team. Diary, entries focused on the interactions of the team, and individual's learning about collaboration and educational design. We were interested in identifying the factors that appeared to influence successful collaboration and project development, looking at ways of reconciling differences in teaching practice, values and cultures.

### **Communicating what is known and practiced**

The team made their experiences public through formal communication via conference presentations, institutional seminars, peer reviewed publication and submission to examination through events such as this; the Pearson Education UniServe Science Teaching Award review process. These processes required us to engage further with literature in the field, reflect on our experience, communicate our practice to others, consider the implications of our data and results, and to continue to critique each other's ideas. Additionally the process of peer review provided external feedback and brought new perspectives to our understanding of what had occurred. The development of this project began in 2000 and it was first implemented in 2001. Consequently our activities in relation to communicating our experiences and learning are just commencing. Already the process of developing papers for communicating about this project has assisted us in clarifying our understanding of what we are doing and opened the project up for comment and critique from others.

### **Investigating our teaching with a focus on student learning**

We decided that this project would be the site of planned and purposeful investigation of our teaching. While the teaching team shared responsibility for this, it was decided to include in the team a member from another university who was not involved in teaching the subjects that contributed to the project. This person was able to plan an approach to evaluation that included the collection of objective and relatively unbiased evidence and data, and brought an outside perspective to the project.

Teaching members of the team opened their teaching to interrogation by each other. The online environment in which the e-Sim was located provided a permanent public record of all online interaction, thus allowing all team members to see the comments and responses of their colleagues. The results of all evaluations were shared among the team, analysed and responded to. Beliefs about student learning and assessment were openly discussed and debated during the design assessment tasks and individuals' marking practices were shared through the comparison of student performance and analysis of learning. The focus of the Mekong e-Sim project was clearly on developing a high quality learning experience for students and our evaluation of the project investigated the quality of the student experience and their learning outcomes.

### **Developing Mekong e-Sim**

In developing Mekong e-Sim we responded to pressure for university teaching to meet institutional and student expectations of flexibility, and for university courses to prepare students for scholarly and professional practice. There is also an emerging expectation that professional university courses will address the social implications of practice (McInnes, Hartley and Anderson, 2001; Institution of Engineers, 1996), and integrate disciplinary knowledge with generic skills or graduate attributes (ATN, 2000).

It was in this context that we decided to collaborate to develop a cross-institutional, cross-disciplinary web-based roleplay-simulation. The Mekong e-Sim team comprised three teaching academics (who coordinated the subjects in which the project was located) from three different institutions and several disciplines and a fourth academic from another institution whose role was to provide educational design advice and plan and conduct evaluation. Previous experiences had



convinced three of the participants that online roleplay-simulations were effective techniques for actively engaging students in learning about multiple perspectives associated with decision-making in complex situations. Team members saw that added value could result from using an online roleplay-simulation to involve students across disciplines. The cross-institutional nature of the collaboration was a consequence of the interested individuals working in different universities.

Following initial conversations that indicated an interest and commitment to developing a cross-institutional project, a face-to-face planning meeting provided the opportunity to clarify how previous e-Sims could be adapted to support the learning objectives of three different subjects and to design specific features of what was to become Mekong e-Sim. Two of the academics had a well developed understanding of teaching and learning issues associated with the application of e-Sims among relatively homogenous cohorts of students studying a single subject (Kirkpatrick and McLaughlan, 2001) and to a limited extent multidisciplinary groups (McLaughlan and Kirkpatrick, 2001). Creating an authentic context for learning among geographers and engineers located across different institutions required a planned, systematic approach.

### **A scholarly team approach**

Benjamin (2000) and Martin (1999) highlight the importance of a scholarly team tackling shared problems and developing joint solutions to these issues. The design of Mekong e-Sim was clearly a shared issue and the resulting learning activity was a collaborative development. The team agreed that a primary goal of the e-Sim was to be the development of student appreciation of multiple perspectives about complex environmental and social issues and that this was relevant to the three subjects that were to contribute to the e-Sim. Individual team members identified issues within their own disciplinary and academic and institutional context that would need to be addressed or accommodated within the project. Discussion identified commonalities and differences in the curricula of the three subjects that had been identified as suitable for involvement in the project. While there was clear agreement among team members about the goal of the e-Sim, there was substantial discussion relating to exactly what it meant for students to develop an understanding of multiple perspectives and about the most appropriate ways of achieving this. For example: team members' opinions about teaching for an understanding of multiple perspectives varied from a belief that variation and complexity need to be explicitly identified and taught, that students should develop an understanding of variation by experiencing events from the perspective of an 'other' and that understanding of variation should be taught in a relational manner.

Decision-making about the most appropriate method and principles for allocating roles to students was another site of debate. A central feature of roleplay-simulations is the adoption of personae and there was initial disagreement among team members about the value of different approaches to allocating personae. There were different opinions about whether students should take a role that was associated with their discipline and hence further develop their knowledge and skills or whether they should develop knowledge and skills associated with a new and unfamiliar role. It was agreed to adopt a combination of personae allocation strategies using the allocation of a persona to a group of students from a similar background and blended groups where students from different disciplines and courses would share a persona. Our investigation of the effectiveness of design therefore included consideration of the efficacy of each approach.

During the development of this collaboration we recognised that in order to integrate the shared online roleplay-simulation into our teaching practice it was critical to identify features of each academic and institutional context and the consequences of these on the collaborative project. Team members acknowledged the potential issues that could arise as a consequence of differences related to disciplinary norms and values, institutional organisational arrangements, marking and grading practices and student characteristics (McLaughlan et al., 2001). The collaborative nature of Mekong e-Sim required individuals within the team to be flexible and willing to change practices and preferences in order to develop a consistent approach to assessment within the e-Sim. A feature of

the collaborative project is that all students share a common experience (i.e. Mekong e-Sim) with the same set of scenarios and interactions. Past experience indicated that assessment tasks should be similarly weighted in order to promote goal alignment. Negotiating a shared approach to assessment stimulated reflection and debate about the role of assessment and specifics of practice.

Mekong e-Sim was designed as a cross-institutional learning activity that would require students from different courses in different universities to work collaboratively. This required careful attention to the design of groups and consideration of the different ways in which groups could be organized and the relative merits of various approaches. Significant discussion surrounded the design and planning of the strategies for the formation of groups and support for group interactions and dynamics. The team needed to consider strategies that would support the development of groups at a distance and techniques for maintaining and progressing small and large group development.

## Conclusion

In the process of developing and implementing Mekong e-Sim across three subjects in four institutions we attempted to adopt a scholarly approach to team teaching and development. We believe that our efforts have provided useful direction for the effective design of e-sims and insight into cross-institutional teaching collaborations. Students have provided us with rich information about the benefits of such activities and suggestions about ways in which they can be improved. We have questioned and at times revised our own beliefs and values in relation to teaching and learning. While we have learned much, and have a better understanding of many aspects of distributed learning supported by technology our experience has raised new questions for us. Mekong e-Sim was prompted by the interest and enthusiasm of individuals, we need to explore the ways in which such innovations can be supported and institutionalised. There is more to learn about how to design these activities so that they create a shared learning experience that accommodates contextual differences.

## Acknowledgments

This work has been supported by The University of Adelaide, the University of Technology, Sydney and the Australian Mekong Resource Centre at The University of Sydney.

## References

- ATN (2000) *Generic capabilities of ATN university graduates*. Australian Technology Network Teaching and Learning Committee report to DETYA, May 2000.
- Benjamin, J. (2000) The scholarship of teaching in teams: What does it look like in practice? *Higher Education Research and Development*, 19(2), 191-204.
- Boyer, E. L. (1990) *Scholarship reconsidered: Priorities of the professoriate*. Washington: Carnegie Foundation for the Advancement of Teaching.
- Hutchings, P. and Shulman, L. (1990) The scholarship of teaching: New elaborations, new developments. *Change*, (September/October), 11-15.
- Institution of Engineers (1996) *Changing the culture: Engineering education into the future*. Barton, ACT.: Institution of Engineers.
- Kirkpatrick, D. and McLaughlan, R. (2001) Evaluating Pollutsim: Computer supported roleplay-simulation. *Academic Exchange Quarterly*, 5(4), 99-106.
- Maier, H. R. and McLaughlan, R. G. (2001) Use of a roleplay/simulation in environmental engineering education. In L. Dawes, W. Bowles and A. Maeder (Eds) *Towards excellence in engineering education*, Proceedings of the 12th Annual Conference of the Australasian Association for Engineering Education, Faculty of Built Environment and Engineering, Queensland University of Technology, 374-379.
- Martin, E. (1999) *Changing academic work: Developing the learning university*. Buckingham: Society for Research into Higher Education and Open University Press.
- McInnis, C., Hartley, R. and Anderson, M. (2001) *What did you do with your science degree?* Australian Council of Deans of Science (ACDS), [Online] Available: <http://www.acds.edu.au/occas.htm> [2002, March 5]
- McLaughlan, R. and Kirkpatrick, D. (1999) A decision making simulation using computer mediated communication. *Australian Journal of Educational Technology*, 15(3), 242-256, [Online] Available: <http://cleo.murdoch.edu.au/ajet/ajet15/mclaughlan.html> [2002, March 5]



- McLaughlan, R. G. and Kirkpatrick, D. (2001) Peer learning using computer supported role play simulations. In D. Boud, R. Cohen and J. Sampson (Eds) *Peer learning in higher education: Learning from and with each other*, London: Kogan Page, 141-155.
- McLaughlan, R. G., Kirkpatrick, D., Hirsch, P. and Maier, H. R. (2001) Using online roleplay/simulations for creating learning experiences. *CAL-laborate*, 7, 23-25, [Online] Available: <http://science.uniserve.edu.au/pubs/callab/vol7/mclaugh.html> [2002, March 5]
- McLaughlan, R. G., Kirkpatrick, D., Maier, H. R. and Hirsch, P. (2001) Academic and institutional issues related to the planning and implementation of a multi-disciplinary roleplay-simulation involving collaboration across institutions. In G. Kennedy, M. Keppell, C. McNaught and T. Petrovic (Eds) *Meeting at the crossroads*. Proceedings of the 18th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education. Melbourne: Biomedical Multimedia Unit, The University of Melbourne, 407-415, [Online] Available: <http://www.medfac.unimelb.edu.au/Ascilite2001/pdf/papers/mclaughlanr.pdf> [2002, March 5]
- Shulman, L. (1999) Taking learning seriously. *Change*, 31, 11-17.
- Trigwell, K., Martin, E., Benjamin, J. and Prosser, M. (2000) Scholarship of teaching: A model. *Higher Education Research and Development*, 19(2), 155-168.

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