

Vol. 15, March 2000

In this issue . . .

From the Directors	2
<i>Ian Johnston and Mary Peat, UniServe Science</i>	
Articles	
Web-based Learning and Generic Skills Development	3
<i>Ron Oliver, Edith Cowan University and Catherine McLoughlin, The University of New England</i>	
Towards a Method for Evaluating CBL in Chemistry: Interaction Maps and Profiles	8
<i>Tony Wright, Slavica Pavlinic, Paul Buckley and Judy Edwards, Massey University, NZ</i>	
Personal Reflections on Interactive Multimedia in the Nineties	13
<i>Rob Capon, The University of Melbourne</i>	
Conference Reports	
Chemical Education into the New Millennium	16
<i>Greg Klease and David Druskovich, RACI Chemical Education Division</i>	
GeoSciEd III	16
<i>Kaye Placing, UniServe Science</i>	
Reviews	
Epsilon Mathematics Courseware – Calculus and Linear Algebra	18
<i>Don Taylor, The University of Sydney</i>	
Introduction to Statistics	19
<i>Julie Hansen, Queensland University of Technology</i>	
Interactive Journey through Physics	20
<i>Walter Kalceff, University of Technology, Sydney</i>	
Teaching Development Reports	
Development and Evaluation of a Model-building Tutorial – How to decide what worked and what didn't!	22
<i>Debbi A. Weaver, Peter J. Harris and Lea M. D. Delbridge, The University of Melbourne</i>	
InterLearn: A Software Tool for Increasing Interaction in On-line Courses	27
<i>David Murphy, Monash University</i>	
WebBytes	
9 On-line Database of Interesting Practice in Geography, Earth and Environmental Science in Higher Education.....	12
<i>Helen King, University of Southampton, UK</i>	
10 Virtual Field Trips: Maximising the Learning Experience	15
<i>Patrice Rey, Monash University</i>	
11 Problem: how to organise a subject being held in the summer vacation. Solution: web site it!	21
<i>Kenneth Brown, University of Technology, Sydney</i>	
Resource Page	31
Calendar of Events	<i>back cover</i>



From the Directors

Things are changing round here.

In the July 1999 newsletter (Volume 13) we foreshadowed our belief that the time had come for *UniServe Science News* to publish refereed articles. We asked for your comments and didn't get any opposing the idea. Mind you, we didn't get any supporting it either, but that's neither here nor there. We'll go ahead.

We have already started setting up an editorial group and drafting the guidelines for submission of manuscripts. This will take us a while to complete but we hope to have the first refereed article in the November 2000 issue.

So, please watch our web site (<http://science.uniserve.edu.au/newsletter/referee.html>) for information about submission of manuscripts. Over the last two years or so we have been asking people if they would be willing to act as a referee for papers submitted. We will be contacting those of you who have said yes, to establish your availability and the range of topics/disciplines you would be comfortable managing. If there are others who would be interested in this activity, please let us know.

The move to refereed manuscripts also sees us moving towards subscriptions for the newsletter. Our funding base no longer permits us to publish extensively for the higher education sector. If we are to continue to produce our newsletter we will need to set up a subscription facility. We will continue to send one copy of the newsletter to each of our contacts, as we have always done; but the

difference is that now, those of you who have been asking for your personal copy of the newsletter will be able to have it at an annual cost of \$33.00, including postage. Our subscription information will also be on the Web (<http://science.uniserve.edu.au/about/subscrip.html>) – so, again, watch that space!

Actually, this charge will be like a subscription to UniServe Science itself. Ever since we were established by the Council for the Advancement of University Teaching, there has been pressure on us to become self-supporting, at least partially. As times get ever harder, that pressure increases. We hope this move will ease the pressure just a little.

And lastly: don't forget our annual workshop *Evaluating the New Teaching Technologies*, to be held on Friday, April 28 at The University of Sydney. Incidentally, in case any of you noticed, there was a bit of a mix-up about whether it is *Technologies* or *Techniques* we were going to be talking about. It is indeed *Technologies*, but, let's face it, in the kind of thing we will be talking about, the two are very closely entwined anyway.

At the same time, because there has been a lot of attention paid lately to the First Year experience, and since we know that many of you attending our workshop are interested in this area, we will be holding a discussion forum on *Improving the First Year Experience* at the same location on the preceding day: Thursday, April 27, 2.00–5.00 p.m.

We hope to see you at one or both of these.

Subscriptions to **UniServe Science News**

You can now receive your personal copy of *UniServe Science News* and other UniServe Science publications. The cost of subscribing to *UniServe Science News* will be \$33.00 a year (3 issues) in Australia and \$45.00 for overseas readers. Subscription commences October 2000. Full details are available from our web site at <http://science.uniserve.edu.au/about/subscrip.html>

Refereeing of Articles for **UniServe Science News**

Commencing with the November 2000 issue, UniServe Science will include refereed articles in its regular newsletter. Academics are invited to submit manuscripts of articles for refereeing. Full details of the criteria and procedures are available from our web site at

<http://science.uniserve.edu.au/newsletter/referee.html>

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Web-based Learning and Generic Skills Development

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This report is a shortened version of a paper presented at ASCILITE 1999 and published in the conference proceedings.

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Introduction

In today's information-oriented and technology-based society, people everywhere are beginning to take more holistic views to teaching and learning than has previously been the case. Evidence of this in Australian universities is readily apparent when one scans their web pages. Not too far from the top of the information pile, it is usually quite easy to find descriptions of each university's distinctive aims for the development of their graduates' skills and knowledge, and the processes by which these aims will be achieved. And in most cases, there are broad-brush descriptions of the development of generic skills, those skills that students need to become successful learners and successful practitioners in their fields of study and work and in other aspects of their life (Dearing Report, 1997).

But what these generic skills actually are and how individual teachers can successfully target their development are broad and complex issues. These issues are set to become even more prominent as the processes and products of university teaching and learning evolve through increased use of information and communication technologies.

Defining generic skills and competencies

Defining the full range of generic and transferable skills that are useful (or essential) for university students is an exhaustive process. It is almost as exhaustive as finding agreement in the terms which might best be used to describe the set. In the context of this paper we use the term *generic skills* to describe the transferable skills that are considered to be essential life skills for people both in and out of the workforce.

There has been interest in the concept of generic and key skills as outcomes of education for many years now. It was perhaps the Finn Report (1991) which introduced this concept into Australia. The Finn Report used the term *key competencies* to describe 'certain essential things that all young people need to learn in their preparation for employment'. The subsequent Mayer Committee (1992), further clarified the concept of employment related key competencies in compulsory education and training.

Many questions still surround the concept of generic skills. They are described by a number of synonyms including personal, transferable, generic, common, work and employment related skills. Are they skills or are they competencies, capabilities or learning outcomes? The key skills that are reported as important outcomes of schooling tend to be broad and extensive. In university teaching, the



skills set is often narrowed to focus on those that are not, or cannot, be taught as discrete components of coursework. At the same time, those skills sought by university education assume learners are numerate and literate as a consequence of the requirements of university entrance.

The generic skills included in the mission statements of most universities tend to include higher level aims relating to critical thinking, inquiry and a capacity for lifelong learning. Such skills described in the literature for university graduates include:

- skills that students need to develop to become successful and self-sufficient learners e.g. information literacy, metacognitive skills (Bruce, 1998);
- the development of intellectual and imaginative powers, understanding and judgement, problem solving skills, critical thinking skills and an ability to see relationships (Ramsden, 1992);

- personal and interpersonal skills needed for communication, cooperative and collaborative teamwork, and leadership (Ashcroft and Foreman-Peck, 1994; Gibbs et al., 1994); and
- skills required for successful work practices including time management, task management leadership and self evaluation (Gibbs et al., 1994; Blumhof et al., 1996).

Bennett, Dunne and Carre (1999) offer an elegant model to conceptualise generic skills in the higher education sector by suggesting a framework comprising 4 broad managerial skills. These authors argue that the important key skills are fundamentally those associated with being able to manage self, others, information and task. They propose that such a model can be applied “to any discipline, to any course and to the workplace and indeed to any other context” (p. 77). Table 1 displays this framework and shows the various elements within.

<p>Management of Self</p> <p>Manage time effectively Set objectives, priorities and standards Take responsibility for own learning Listen actively with purpose Use a range of academic skills Develop and adapt learning strategies Show intellectual flexibility Use learning in new or different situations Plan/work towards long-term goals Purposefully reflect on own learning Clarify with criticism constructively Cope with stress</p>	<p>Management of Information</p> <p>Use appropriate sources of information Use appropriate technologies Use appropriate media Handle large amounts of information Use appropriate language and form Interpret a variety of information forms Present information competently Respond to different purposes/contexts and audiences Use information critically Use information in innovative and creative ways</p>
<p>Management of Others</p> <p>Carry out agreed tasks Respect the views and values of others Work productively in a cooperative context Adapt to the needs of the group Defend/justify views and actions Take initiative and lead others Delegate and stand back Negotiate Offer constructive criticism Take the role of chairperson Learn in a collaborative context Assist/support others in learning</p>	<p>Management of Task</p> <p>Identify key features Conceptualise ideas Set and maintain priorities Identify strategic options Plan/implement a course of action Organise sub-tasks Use and develop appropriate strategies Assess outcomes</p>

Table 1. A framework for the development of key skills (Bennett, Dunne and Carre, 1999)

Developing key skills

By their very nature, generic skills are difficult to teach through formal instruction. Traditionally the development has been attempted through 3 main types of learning activity: integrated approaches; stand alone approaches; or approaches where key skills are developed in parallel with the conventional curriculum (Drummond et al., 1997 cited in Bennett, Dunne and Carre, 1999). Many writers question whether it is really possible for the learning taking place in university settings to be transferable to vocations and the work place. One school of thought suggests that through situating learning in meaningful contexts, this transfer can be facilitated (Brown, Collins and Duguid, 1989). Contemporary thinking is that university learning can be significantly strengthened through workplace-based practica and applications (Seagraves, Kemp and Osborne, 1996).

Much of our work at Edith Cowan University has explored the use of technology to support the implementation of situated learning environments and inherent in much of this work has been the development of learners' key skills (Herrington and Oliver, 1997). Our recent exploration of problem-based learning environments (Oliver, Omari and Stoney, 1999) has furthered our interest in this area and provided the impetus for this paper and line of inquiry.

A web-based learning setting

In the introductory multimedia course in our undergraduate programme, we have embraced a web-supported problem-based learning environment by which the students engage and interact with the course content. The system involves learners working in collaborative groups to explore the solutions to open-ended and ill-defined problems related to the weekly course content. From these activities we have observed learners developing a raft of generic skills through their interactions and activities in the web-based course.

We have developed an on-line database-driven system to support a problem-based learning approach. The system has been described in several papers as has its capacity

to engage and motivate learners (e.g. Oliver and Omari, 1999; Oliver, Omari and McLoughlin, 1999). The system supports problem-based learning by providing a means for students to collaborate on set problems, to share resources, to post solutions and to compare and review answers from other groups. This style of problem-based learning involves a number of activities and tasks that appear to provide strong support for the development of a number of key skills. The activities which the students are required to undertake each week include:

- **Information Seeking** The tasks require students to seek information from appropriate sources to create an answer that reflects current thinking and knowledge. The students are able to use the Web as an information source but have to isolate from among the myriad of resources available, those that are relevant and helpful.
- **Critical Thinking** Having obtained relevant information, the students are required to apply this to the immediate setting to explore the options and possibilities available in developing a solution. The students have to examine the information, consider the scope of their inquiry and decide the parameters in which they are going to work.
- **Collaboration** Each group has a number of members. The problem solving task requires members to organise themselves into productive teams who share the workload, undertaking separate tasks and maintaining tight deadlines and schedules from one week to the next. Such activities demand that students consider the requirements of others, be adaptive, responsible and flexible.
- **Problem Solving** Each task is different and needs to be tackled in varying ways. Students need to use their initiative and intellect to consider the form the solution will take and to consider ways in which the solution can be expressed concisely and succinctly.

Outcomes

We have used this system in several units now involving relatively large numbers of students. In each instance we have been surprised and



delighted with the learning which has been achieved. It is patently clear to us that the problem-based learning model provides very powerful contexts for learning the course content. The activities encourage the learners to interact with the course content, to read and explore beyond the immediate setting and to reflect on what is being read. At the same time, the learning activity encourages and supports many other useful tasks. A close examination of these tasks suggests a high degree of incidental learning is occurring in the form of key skills.

When the activities and tasks undertaken by the students exposed to this form of learning environment are examined in the light of the model proposed by Bennett, Dunne and Carre (1999), its capacity to support generic skills development immediately becomes evident.

The learning setting helps and encourages learners to practise and develop key skills across the full range of managerial skills.

- **Management of Self** The activities require students to complete a large and unstructured task within a set timeframe and within a number of constraints and limitations. The activities require learners to plan their steps, explore the domain and work towards a goal. In the process, they need to confront unexpected outcomes and hurdles, reflect and judge their progress and use a variety of learning strategies to develop their solution.
- **Management of Others** In the group setting, students are required to work with others and maintain a good working relationship throughout the semester. On a day-to-day basis, they need to be cooperative and adaptive to the group's needs, defend their own stance, negotiate and give and accept criticism.
- **Management of Information** In this regard the activities require students to apply the various technologies to seek information and to deal with the large amounts obtained. They need to interpret the information and deal with the multiple perspectives presented. They have to then create a succinct summary requiring reflection and critical thinking.
- **Management of Task** Finally in terms of managing the task, these activities compel students to identify sub-tasks and to

conceptualise what is being asked and how it can be dealt with. The activities require the learners to instigate and carry out the course of action and to reflect on the outcomes and directions.

The capacity of our on-line problem-based learning system to support the development of such a large set of generic skills suggests many more contexts and applications for its use. While our initial rationale for its development and design was to promote learning in discipline areas, its capacity to promote learning in other key areas makes it more valuable again. In our previous research we have explored the forms of learning enhancement achieved in the context of discipline content and skills. We are now very much encouraged to pursue our inquiries of the use of this teaching strategy to promote the development of generic skills.

Summary and conclusion

Problem-based learning has long been proposed as a powerful and flexible form of learning for university settings. The support for PBL has come from many quarters and for many reasons. It offers the flexibility to cater for a variety of learning styles and the means to create meaningful and authentic settings in which to situate learning. It provides the opportunity to create engaging and stimulating student-centred learning activities. With problem-based learning, the focus moves from dealing with content and information in abstract ways to using the information in ways which reflect how learners might use it in real-life.

The combination of the use of the Web as a means of supporting problem-based learning has in our experience provided enormous benefits to our teaching and learning programmes and to the extent and forms of learning achieved. It has provided many opportunities for students to undertake activities which have the prospect to develop their generic skills. It is not yet clear from our work how well the various skills are developed, nor is it clear what forms of intervention might be needed to more fully assist their development. We are looking forward to exploring these issues in future variations and implementations of our on-line learning systems.

References

Ashcroft, K. and Foreman-Peck, L. (1994) *Managing Teaching and Learning in Further and Higher Education*. London, UK: The Falmer Press.

Bennett, N., Dunne, E. and Carre, C. (1999) Patterns of core and generic skill provision in higher education. *Higher Education*, **37**(1), 71–93.

Blumhof, J., Honeybone, A., Pearlman, D. and Pinn, K. (1996) Tackling the problem of skills development in a modular degree programme: the Skillswise Project. In G. Gibbs (ed.), *Improving Student Learning: Using Research to Improve Student Learning*. Oxford, UK: Oxford Centre for Staff Development, 328–339.

Brown, J., Collins, A. and Duguid, P. (1989) Situated cognition and the culture of learning. *Educational Researcher*, **18**, 32–42.

Bruce, C. (1998) The phenomenon of information literacy. *Higher Education Research and Development*, **17**(1), 25–43.

Dearing Report (1997) *Higher Education in the Learning Society*. London: HMSO.

Finn, B. (1991) *Young People's Participation in Post Compulsory Education and Training. Report of the Australian Education Council Review Committee*. Canberra: Government Publishing Service.

Gibbs, G., Rust, C., Jenkins, A. and Jaques, D. (1994) *Developing Students' Transferable Skills*. Oxford: The Oxford Centre for Staff Development.

Herrington, J. and Oliver, R. (1997) Multimedia, magic and the way students respond to a situated learning environment. *Australian Journal of Educational Technology*, **13**(2), 127–143.

Mayer, E. (1992) *Key Competencies. Report of the Committee to advise The ACE and MOVET on Employment Related Key Competencies for Post Compulsory Education and Training*. Canberra: Australian Government Publishing Service.

Oliver, R. and Omari, A. (1999) Replacing lectures with on-line learning: Meeting the challenge. In J. Winn, (ed.) *Responding to Diversity: Proceedings of the 16th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education*. Brisbane, Queensland University of Technology, 257–264.

Oliver, R., Omari, A. and McLoughlin, C. (1999) Planning and developing a problem-based learning environment for large on-campus classes using the WWW. In G. Cumming, T. Okamoto and L. Gomez (eds.) *Advanced Research in Computers and Communications in Education. Proceedings of ICCE99*. Amsterdam: IOS Press, 720–727.

Oliver, R., Omari, A. and Stoney, C. (1999) Collaborative learning on the World Wide Web using a problem-based learning approach. In J. Chambers (ed.) *Selected Papers from the Tenth International Conference on College Teaching and Learning*. Jacksonville: FCCJ.

Ramsden, P. (1992) *Learning and Teaching in Higher Education*. London: Routledge.

Seagraves, L., Kemp, I. and Osborne, M. (1996) Are academic outcomes of higher education provision relevant to and deliverable in the workplace setting? *Higher Education*, **32**(2), 157–176.

ASCILITE AWARDS 1999

Best Web Project

Winner:

A multi-layered simulation in Political Science
The University of Western Australia

Runners-up:

Skills for Learning Online
Charles Sturt University
The InterLearn Software Tool
Monash University

Best CD-ROM

Winner:

AN@TOMEDIA
The University of Melbourne

Special Award for comprehensive and flexible online environment

PlatformWeb
University of Western Sydney

See page 27 of this newsletter for a report on *InterLearn*

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Towards a Method for Evaluating CBL in Chemistry: Interaction Maps and Profiles

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Software for the different areas of science education is appearing at a very rapid rate. We need to be able to evaluate it, either for its suitability for our course, or if we are authoring it, for revision and development.

The primary thing we want to know when evaluating a piece of software is how useful, in terms of learning, the software is for the students who will be using it. The strongest data will therefore come from students using the software. Appropriate analysis of the data will then give information about how well the software matches the needs of different groups of students and allow judgements about whether or not it will be worth implementing the software in the course, and for the software authors, information about revisions that might be necessary.

The important components of the evaluation are therefore the data collected and the method of analysis subsequently used. In this paper we describe the preliminary findings of a study based on a data collection technique that has received only scant attention for software evaluation.¹ The main emphasis of the paper however lies in the analytical method being explored. We believe that this analysis offers promise of a robust and convenient way for analysing qualitative data.

We rejected a traditional quantitative study methodology because such studies rarely achieve the aim of a properly constructed and controlled test.² Also, and more importantly, such studies usually fail to pin down the successes and deficiencies of the CBL tasks.

The obvious way to address this latter issue is to use a qualitative data collection technique that looks carefully at the student doing the task. Stimulated recall interviews³ in which data is collected via videotapes while the student is engaged with the task, and subsequently used as the basis of a reflective interview (immediately on completion of the task), is a useful technique for such studies. The technique combines the attributes of observational methods with those of interview methods.

We have used the technique previously to probe a range of commercial CBL software which we had introduced to our courses.⁴ One of the major difficulties with interview techniques lies in the method for analysing the data. In our first study we used a method of analysis based on judgements about student understanding in relation to the learning objectives of the tasks. While the conclusions were convincing, the analysis was difficult and time consuming.

In this study, the analysis involves classifying the individual interactive events that occur, according to the performance of students. We show that this approach can be developed into a useful method for evaluating the software which looks promising for a wide range of types of CBL.

The method allows judgements about:

- the relative value of different pieces of software;

- parts of the software where formative revision is necessary; and
- which groups of students will benefit most from using the software.

The study

Following the preliminary study described above,⁴ we decided to author tutorials for the major areas of difficulty in our first year classes. The first such tutorial covers organic stereochemistry.

The aim of the tutorial is to develop and refine students' concepts of stereochemistry following their introduction in the lecture course. It contains a series of questions giving students practice in applying the concepts to progressively more complicated organic molecules. In parallel with the series of exercises is an extensive glossary and a range of simpler ancillary exercises. Students can either consciously navigate their way through the tutorial, or allow the computer to do the navigation based on their responses.

In this study, the tutorial was evaluated during its first delivery by performing stimulated recall interviews on a group of 11 volunteers, some working individually and some in pairs. The groups were selected from

the volunteers with a variety of different abilities and interests. The primary aim of the evaluation was to gather data for revising the tutorial for subsequent years.

To help with the interviews, an observation log of the student performance was taken. This log was then used to identify important points in the task performance to be discussed in the subsequent interview which was aimed at uncovering the student's thoughts during the performance.

Analysis

In the analysis described here we have chosen to focus on a particular group of student-computer interactions. These are the ones in which the interaction results from the student using his or her knowledge about stereochemistry. This group of interactive decisions is easy to identify and is distinct from the navigational and other interactions involved in the performance.

The next step in the analysis was to map the interactions for each student (or pair of students). These interaction maps (Figure 1) are useful because they give a quick guide to how the student has used the tutorial.

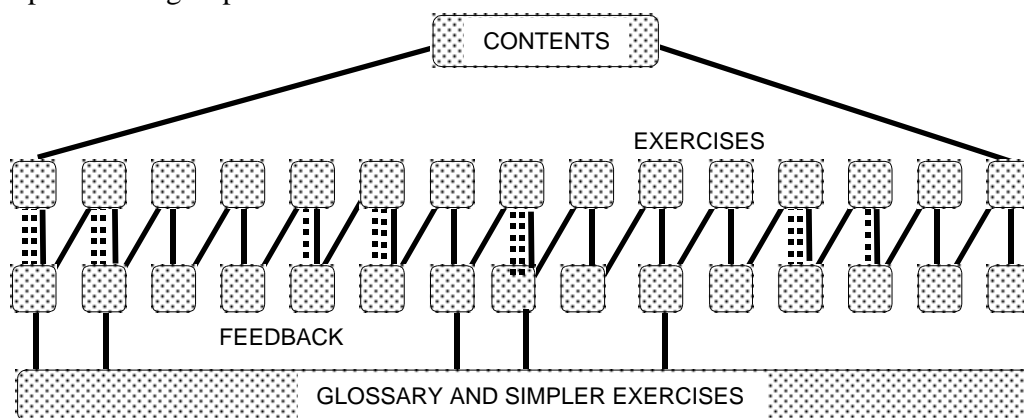


Figure 1. Map of a student's progress through the stereochemistry tutorial. The dotted lines show where the student gave unexpected responses and moved to-and-fro between the exercise and the feedback.

The most noticeable feature of these maps was that each task performance gave a different map, emphasising the variety of usage needed to match the needs of students.

The maps also produced useful information for formative evaluation of the software, focussing attention on the specific items that challenged students and points of possible revision.

Profiles

Interactivity as it relates to computer based learning is receiving wide-ranging attention.⁵ We have chosen to analyse a small subgroup of the interactions involved in the task performances we have examined, those that involve students making a decision that relates to the chemical learning objectives of the task.



Careful study of these interviews revealed that the interactions fall into six categories (see Table 1), three of which involve the student making the expected decision, and three giving the unexpected decision.

Reflection on the categories led to a further classification based on whether or not the decision leads to a useful learning opportunity since the provision of useful learning opportunities is an obvious goal of CBL software.

Thus, for example, if the student gave the unexpected response and the subsequent interview showed that they got adequate feedback to correct their ideas, then this was classified as a useful learning opportunity.

It was easy to further subdivide this category on the basis of whether or not the student was struggling with the concept or the application of the concept. This is a useful distinction because the type of feedback required is different for the two possibilities.

Type of Interaction	Usefulness	Comments
1. UNEXPECTED response – adequate feedback – flawed concept	USEFUL, powerful learning	Student is able to change or develop their concept on the topic. Can have a negative affective outcome if it occurs too frequently.
2. UNEXPECTED response – adequate feedback – flawed application	USEFUL, powerful learning, students learn to apply their knowledge	Student knows the concept and learns how to apply it.
3. EXPECTED response – considerable thought required – adequate feedback	USEFUL, positive learning outcome	Student refines his/her concept or applies ideas to a new application.
4. EXPECTED response – quick, confident	NOT USEFUL for learning	Student already confident on the topic. May enhance student confidence.
5. EXPECTED response (guess) – inadequate feedback	NOT USEFUL for learning	Student uncertain about response and does not receive adequate help.
6. UNEXPECTED response – inadequate feedback	NOT USEFUL and a sign of a serious mismatch of task and student need	

Table 1. Types of interaction and the learning opportunities they provide

In terms of learning opportunities, the expected response is not necessarily useful. If the student gives the response confidently, without careful thought, no useful learning will occur. It is probably a good thing to have a number of such events during a task because the student’s confidence is supported. However too many and the task wastes the student’s time.

However, an expected response which requires careful thought is probably a useful learning opportunity because the student has to either modify their concept or discover a new application. Either possibility can be readily confirmed in the interview. These two categories are readily distinguished in the interview and are usually categorised by the

time the student takes to give the response: The quick response matching an “expert” response to the question.

The two categories which caused the most ill-feeling amongst the students were those in which they either gave the unexpected response and then did not get sufficient feedback to develop their ideas on the topic, or gave the correct response but were not confident of the answer, and did not receive enough feedback to learn from the experience. This latter category represents a particularly important learning opportunity being missed because the exercise has focused the student’s attention on an area of their uncertainty and then failed to help them learn from it.

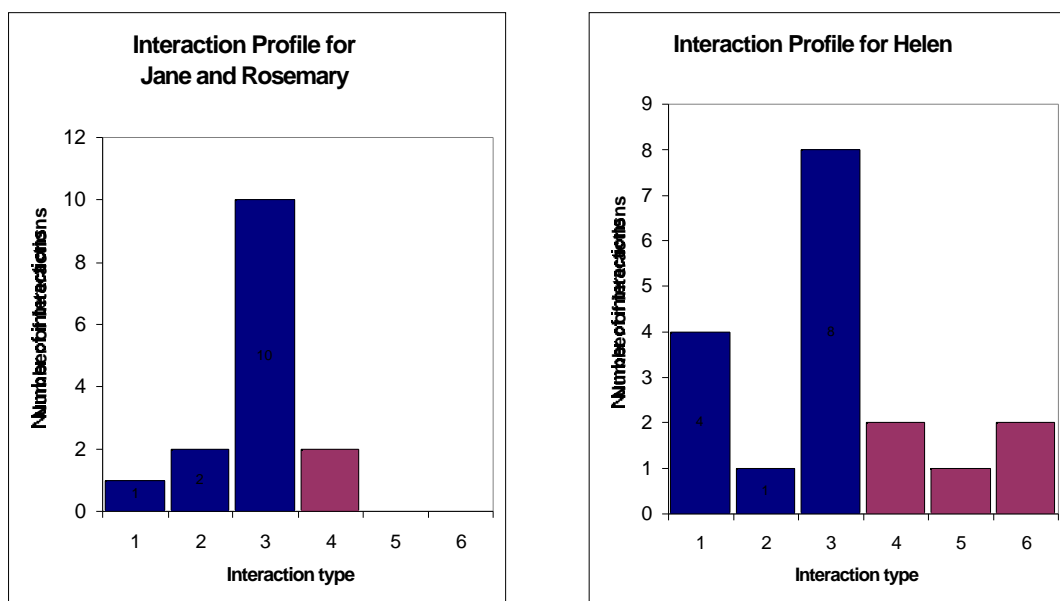


Figure 2. Profiles of two task performances on the stereochemistry task (Fictitious names have been used.) Categories 1 – 3 represent USEFUL interactions, 4 – 6 represent NOT USEFUL interactions. (See Table 1)

Having classified the interactions, they can be plotted to give a profile of the student's performance on the task (Figure 2).

The pair of students, Jane and Rosemary, were capable students who understood most of the concepts. For them, the tutorial was most useful for refining their understanding and application of concepts. In contrast Helen was

struggling with some of the concepts and, as might be expected, the number of non-useful interactions was increased.

The method of analysis has also been applied retrospectively to similar data collected for some commercial pieces of software used in our course (Figure 3).

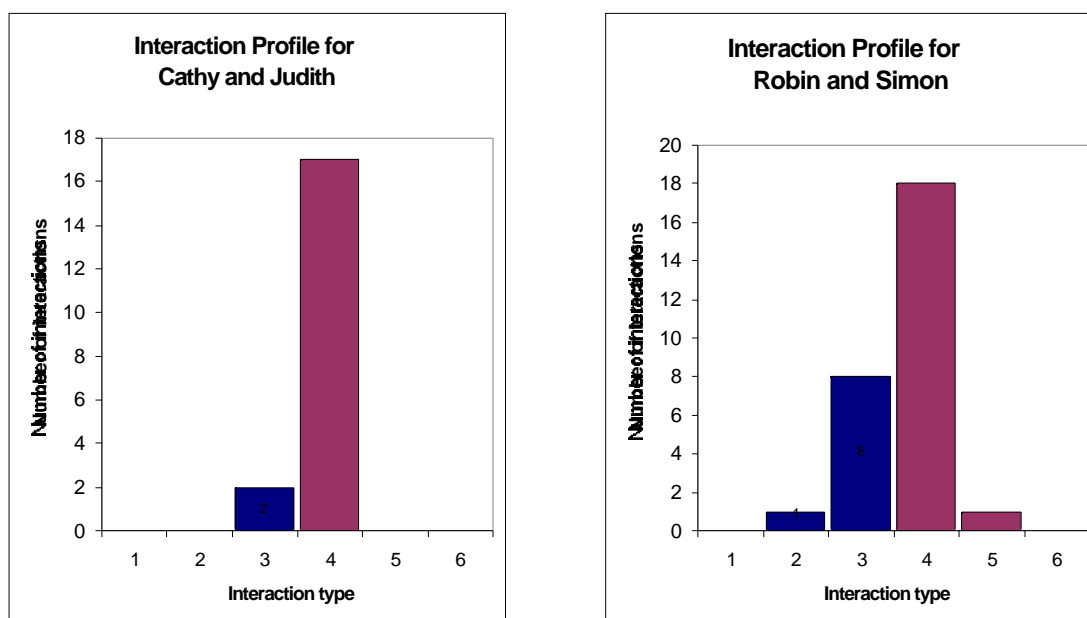


Figure 3. Interaction profiles for task performances on a laboratory simulation and a molecular shape tutorial

Cathy and Judith, both capable students, were using a simulated experiment that was part of the laboratory course and Robin and Simon, also capable, were using a tutorial on

molecular shape. The major conclusion of the earlier study was that the software in most cases did not match the learning needs of the students and this can be seen in the profiles. In



both cases the non-useful interactions outweighed the useful interactions and there were very few of the most useful interactions in categories one and two.

These examples are important because they establish that a range of profiles can be expected when different pieces of software are examined using the method. However the sample analysed so far is too small for confident conclusions or comparisons of pieces of software.

Our analysis indicates that the profiles will provide useful information:

- for judging the appropriateness of software for particular courses;
- for deciding how widely useful the software will be for different groups of students; and
- to authors for formative evaluation of software.

The interaction maps and profiles give complementary information about student

performance on a CBL task. We are currently exploring the use of these tools for a range of different types of software to establish their wider utility.

References

- ¹ Harvey, J. (1998) *Evaluation Cookbook*, Learning Technologies Dissemination Initiative, Heriot-Watt University, <http://www.icbl.hw.ac.uk/ltidi/>
- ² Reeves, T. (1993) Pseudoscience in Computer Based Learning, *Journal of Computer-Based Instruction*, **20**, 39–46.
- ³ O'Brien, J. (1993) Action Research through Stimulated Recall Interviews, *Research in Science Education*, **23**, 214–221.
- ⁴ Pavlinic, S., Buckley, P. D. and Wright, A. H. (2000) Students using Chemistry Courseware – Insights from a Qualitative Study, *Journal of Chemical Education*, in press (February). <http://www.massey.ac.nz/~wwifs/staff/wright.htm>
- ⁵ Sims, R. (1999) *The Interactive Conundrum I: Interactive Constructs and Learning Theory*, Proceedings of ASCILITE '99, 307–314.



WebByte No 9

On-line Database of Interesting Practice in Geography, Earth and Environmental Science in Higher Education

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Over the last few years the Geography Discipline Network, based at Cheltenham and Gloucester College of Higher Education in the UK, has built up a database of abstracts on interesting and effective teaching, learning and assessment practices in Geography. With the establishment of the Geography, Earth and Environmental Sciences Subject Centre at the University of Plymouth (the successor to the CTI Centres – see *UniServe Science News* Vol. 14 – and other teaching and learning programmes in the UK) the database is to be expanded to include all three disciplines embraced by the Subject Centre.

The database contains abstracts of Higher Education teaching, learning and assessment practices mainly from the UK but also from North America and Australasia and includes exercises to improve student learning used in lectures, tutorials, laboratory classes, practicals and field courses; methods of assessment;

examples of IT; and resource-based learning support.

Academics who wish to contribute to this database should submit an abstract of 200–500 words to the author or to the database manager via the web site. The abstract should contain the following information:

- title of abstract;
- contact details – name, department, institution, telephone/fax number and email address;
- main features – what was the initial prompt/problem? what is the practice trying to achieve? how were your practices changed? what are the gains and losses?;
- relevant references where applicable; and
- keywords.

The database can be accessed via the Web at <http://www.chelt.ac.uk/el/philg/gdn/resdata.htm>

Personal Reflections on Interactive Multimedia in the Nineties

Rob Capon, The University of Melbourne

The following observations are drawn from over a decade championing educational multimedia at The University of Melbourne.

Since taking up an academic appointment in the School of Chemistry at The University of Melbourne in 1988 I have been a passionate advocate for the use of electronic technology in undergraduate teaching: electronic lecture presentations; animations; interactive computer based tutorials; and more. For want of a better term all these techniques might be broadly classified as interactive multimedia. Not wishing to claim technological foresight, I was extremely fortunate to be in the right place at the right time. Desktop computing capable of multimedia delivery was coming of age, and The University of Melbourne possessed a corporate vision that clearly identified a role for interactive multimedia. To support this vision the University established an Interactive Multimedia Learning Unit (IMLU) charged with enabling the effective use of multimedia technology in the educational arena. Those of us with even a modest interest or ability were readily captured (intellectually if not physically) and benefited immensely. As might be expected this was not always a smooth road. Being pioneers in the uptake of an evolving technology it is not surprising that mistakes were made, and with hindsight different strategies might have achieved our goals more directly.

Quite apart from technical challenges, one hurdle to overcome was the conservative culture so prevalent in academia. In time and with some effort even those who clung with an almost religious fervor to the “chalk and talk” methods of the fifties have come to accept the paradigm shift. This success should not be underestimated and warrants some elaboration. “Chalk and talk” has been the dominant vehicle for delivering education (certainly in the sciences) for many decades. It is a stable and mature technology, easily mastered, that empowers academics as they leak out knowledge at a comforting pace. By contrast interactive multimedia in all its guises is a rapidly evolving and challenging tool. Academics need to constantly acquire skills and explore new and improved techniques. This can be very demanding, especially in an era where academic workload is at an all time high. That the move away from “chalk and talk” became so pervasive is testimony to the power of interactive multimedia to inspire staff and students, as well as the ability of more adventurous colleagues in demonstrating how to benefit from these tools in a very practical sense. It has also been greatly assisted by the University adopting an aggressive commissioning of state-of-the-art infrastructure and the provision of staff training and grants to support curriculum development. As a result, faculties, departments and staff across the university have widely embraced the use of interactive multimedia (which now is often redefined to mean the Web). Of course the challenge is not over, as the technology evolves so must staff skills, as well as upgrades to hardware and software resources. One of the less expected aspects of this technological shift (at least for me) has been

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the emergence of a new culture of educational professionalism. Many of my colleagues feel empowered to query their teaching outcomes, and to improve these outcomes by augmenting and upgrading their teaching styles with interactive multimedia.

In 1998 I had the good fortune to be awarded a Universitas 21 Fellowship, in recognition of my contribution to teaching and scholarship. This fellowship enabled me to travel in 1999 to Canada, UK and Europe, to meet academic staff, and talk on interactive multimedia (and the Web). I was of course very keen to compare notes and see how others overcame many of the same challenges we had encountered during the last decade. Not surprisingly the uptake of interactive multimedia was variable across different institutions and countries, and yet the challenges were very familiar – access to funds, training and time, professional recognition, and more. For those institutions slow to embrace interactive multimedia the concern most frequently raised was “*Where do we start?*”. Despite a decade of experience I was uncomfortable making specific recommendations, in that in many respects I still perceive our own efforts as merely a beginning – albeit a somewhat more advanced beginning compared to some. In order to arrive at possible *starting strategies* it is worthwhile reflecting on how we arrived at our current transit point.

In the early 1990s the impact of interactive multimedia on mainstream education was largely limited to courses taught by a handful of enthusiasts. Hardware was expensive and barely up to the task, limited in processing power, RAM, hard disk space and effective networking. Likewise, such authoring software as was available was expensive, labour intensive, and required significant training to attain competency (assuming you could get past all the bugs). Even if educational software was created the mechanisms for ensuring student access were limited. The Internet, CD-ROMs (players and burners) and even student ownership of reasonable computers were all several years away. In this climate enthusiasts were typically discipline based academics, such as a chemist, zoologist, botanist or physicist, operating largely on their own and with modest if any professional recognition. Faced with all the challenges of teaching, administration and

research, these individuals assumed the added burden of fledgling multimedia developer. Enormous commitments of time and energy resulted in, at least by today’s standards, modest advances. As oppressive as the process sounds, these were heady days and student feedback was a powerful driving force.

By the mid 1990s a curious transition took place. The development of educational multimedia had become more technically challenging, as the hardware and software became ever more powerful. While the software was more refined and included a number of noteworthy authoring environments (*MacroMind Director, AuthorWare* etc.), because it could do so much more, the training requirement was even higher. Academics masquerading as amateur programmers simply could not compete. At the same time programming educational multimedia became respectable. Multimedia units sprang up in many faculties, staffed by a new generation of educational programmers dedicated to interactive multimedia development. Traditional academics based in departments could feed ideas and content into these units, and depending on a range of factors may or may not see their ideas translated into useful resources. This period saw a shift of multimedia development from those who would implement it, academics, to those for whom the development process was almost an end in itself, programmers. Given the need for specialist technical skills this shift was inevitable, but the dislocation served to disengage departments from control over interactive media critical to their teaching obligations. For example, a lecturer faced with a course starting on Monday could not accept programming delays of even a day, let alone weeks or months, and programmers with little appreciation of the pressures of student contact could not understand why their completed resources, six months late, were not implemented. Of course there were exceptions, and some departments went so far as to employ their own programmers, under the direct control of academics (but that’s another story).

With the start of the new millennium the pendulum has swung back. Software tools capable of creating interactive multimedia are designed by skilled programmers to be used by academics. These authoring environments require a modest effort to master and yet

empower the user to create potent and effective teaching resources. **Discipline based experts (academics) are now capable of creating interactive multimedia on a routine basis.** The Web has emerged as an extremely powerful delivery medium for course material, and more. Perhaps most exciting of all, many of the multimedia based productivity tools used in scientific research have merged with the educational resources. The use of computers in society is rapidly assuming a holistic state, as they become routine tools with which to create and communicate knowledge – as they should.

The future for interactive multimedia (whatever that comes to mean) is very exciting. As one of those hardy soles who persevered to deliver electronic lectures in *HyperCard* off a Mac LC a decade ago, I look forward to applying my new supercomputer G4 Mac to the task of courseware development and delivery in the years ahead.

No longer the exclusive domain of enthusiasts or programmers, all academics are empowered as never before to be imaginative, innovative, creative and even provocative, not only in what they teach but how they teach.



WebByte No 10

Virtual Field Trips: Maximising the Learning Experience

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The Victorian Institute of Earth and Planetary Sciences (VIEPS) is a cooperative affiliation between La Trobe University, Monash University and The University of Melbourne. Students enrolling in Honours and Master programmes in any of the three member universities can choose within a portfolio of more than 40 VIEPS short courses.

Granite Geology is a 5-day VIEPS course which includes a 1-day field trip to Wilsons Promontory. This course is supported by a booklet and a virtual field trip, both available on the Web. The course familiarises students with the processes that control the generation, the segregation and the transport of granitic melts in the continental crust. Particular attention is given to the relationships between the mode of emplacement of granitic bodies and the characteristics of the regional finite strain field.

In this context, the virtual field trip (*Granites at Wilsons Promontory* at <http://www.earth.monash.edu.au/~prey/FieldTrips/WilsonsProm/wilsonsprom.html>) was designed to be a self-explanatory unit dedicated to a large audience, from the general public to post-graduate students, in Australia and overseas. This virtual field trip offers a colourful complement to the booklet related to this course, and improves the quality of its illustration. But this is not its only purpose.

We all have the tendency to illustrate our courses with slides that are carefully selected for their readability. We forget sometimes that those “textbook” slides often do not represent the field reality. In the field, students are exposed to outcrops that are often “noisy” and therefore less easy to understand and interpret. At the end of a day in the field, students are often overwhelmed by the profusion of confusing images. It is therefore important to help them to filter this information, and extract the useful signals from the background noise.

The main aim of this virtual field trip is therefore to provide students with the opportunity to “virtually” go back to the field and have a second look at a selected number of outcrops. It also gives them the opportunity to complete their field notes and sketches, and improve their field book by using printed versions of the photographs displayed on the web site. Virtual field trips will never replace the “real thing”, but they certainly can help to maximise the learning experience.

Other field trips have been developed to cover a magmatic shear zone in the Eastern Kimberleys (Western Australia) and an eclogite facies shear zone in Holsnoy (Norway). They are available at <http://www.earth.monash.edu.au/~prey/FieldTrips/Trips.html>



Chemical Education into the New Millennium

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The Chemical Education Division participated in the 11th Royal Australian Chemical Institute Convention held in Canberra in February 2000. The Convention theme was "Chemistry into the New Millennium" and the meeting addressed the future of research and teaching in Chemistry.

Most Divisions of the Royal Australian Chemical Institute participated in the Convention, which included some Convention Plenary lectures as well as a number of joint Divisional sessions. Chemical Education ran a full programme, with a different theme on each day. The themes were:

- Green Chemistry;
- Flexible Delivery of Chemistry Programmes;
- Chemistry Olympiad in the New Millennium; and
- Chemical Education in the New Millennium.

The Chemical Education Division and the Environment Division held a very successful joint symposium on the emerging area of Green Chemistry. In addition, a joint Physical

Chemistry/Chemical Education workshop on "The Advancement of the Australian Undergraduate Physical Chemistry Laboratory Curriculum" was conducted. This workshop was the first meeting of representatives from over 30 Australian universities participating in an innovative approach to design a new Physical Chemistry laboratory curriculum based on sound teaching and learning practices. The project is being funded by the CUTSD.

The talks presented during the Chemical Education sessions will be published in *Chemedica: Australian Journal of Chemical Education*. Information about the Convention and the Chemical Education Division can be found on the RACI home page at <http://www.raci.org.au/default.html>

The next meeting of chemistry educators will be in Brisbane in July 2001 when chemists meet for the 38th IUPAC World Chemistry Congress. This gathering of international and national chemists will also incorporate the 9th Asian Chemistry Congress.

Further information of IUPAC 2001 is available from <http://www.ccm.com.au/wcc/>

GeoSciEd III

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GeoSciEd III was held at The University of New South Wales, January 17 – 20, 2000. As this conference addressed many issues associated with the teaching of geology in both formal and informal settings, the 180 delegates, representing over 25 countries, included educators from universities, colleges, museums, government organisations, national parks and specialist centres. Secondary teachers were encouraged to attend with many

being financially supported by the Minerals Council of Australia.

Keynote speakers included Professor Michael Archer, Director of The Australian Museum in Sydney, Ian Clark, University of South Australia and Programme Convenor for the conference and Rosemary Hafner, Board of Studies NSW. Michael Archer used examples from the ongoing research at Riversleigh with its rainforest flora and fauna to indicate how a

study of the “deephime” can tell us much about the future of the planet and the areas of concern for its conservation. Ian Clark spoke on “New Ways to Teach Geology”. As an Inspector on the Board of Studies, of NSW, Rosemary Hafner has been responsible for the development of the new Stage 6 Science syllabuses that have been introduced into all NSW schools this year. She outlined the process undertaken in the development of each syllabus and the change of focus and features of the Earth and Environmental Science syllabus in particular.

The conference attracted over 75 papers and 20 posters in the following strands: K–12 teaching content and skills; undergraduate teaching to large numbers; the role of field excursions; innovations in teaching aids; the use and success of outreach programmes; and the electronic classroom.

The presentation on “The Use of the Web in the Teaching of the Geosciences at Australian Universities” by UniServe Science can be viewed on-line at <http://science.uniserve.edu.au/disc/geol/geosced/>. UniServe Science would welcome any additional links that would make this summary more complete.

Steven Croft and colleagues from the NASA Classroom of the Future presented a case study based on a collaborative problem-based learning experience which is held exclusively in an on-line electronic environment. The course web site at <http://davem2.cotf.edu/essc3/classroom/classroom.html> illustrates how they have used a graphic depicting the web-based collaborative environment with virtual spaces that are used for discussion and collaboration.

A common theme through many papers was alternative delivery methods that are being incorporated into geoscience teaching. These included poster sessions, portfolios, research-like experiences, action-based research and concept maps. Nancy Jonsson, College of Southern Idaho, described a portfolio as “a thoughtful collection of journal and magazine articles about the latest research and discoveries in the earth sciences”. She expects her students to use the Web extensively, but not exclusively, for articles and virtual field trips to extend their geological experiences.

On Tuesday, delegates were invited to attend the inaugural meeting of IGEO (International Geoscience Education

Organisation) where a constitution was formally adopted and the first committee elected. The committee consists of Chris King (UK), Nir Orion (Israel), Ian Clark (Australia), Laure Wallace and Mary Dowse (USA), Alan Morgan (representing the next host country, Canada) and one representative from every other country involved in IGEO.

A tour to the Blue Mountains and Jenolan Caves provided a welcome break to the normal conference proceedings on Wednesday. The conference also featured a number of pre- and post-conference excursions to local areas of scenic and geological interest. The excursions included the Great Barrier Reef, Central Australia, Kangaroo Island, Canberra and New Zealand – a great opportunity for the many overseas visitors.

At a post conference workshop entitled “Using Geological Maps and Computers in the Classroom” participants had an opportunity to experience some of the excellent teaching activities available through the Australian Geological Survey Organisation (AGSO). You might like to investigate the “Cairns Emergency Management Plan” from the information available on-line at <http://www.agso.gov.au/map/cairns/exercise.html>

Social activities were an important ingredient of the conference, ranging from a didgeridoo “welcome” on Sunday evening, to a fabulous harbour cruise on Thursday night (probably the balmiest night we’ve had all summer). The trivia extravaganza at the conference dinner encouraged people to get to know each other through audience participation, including a Maori haka, the Vegemite song (with ukulele accompaniment), and particularly impressive renditions of national anthems from Mozambique, the Philippines and Japan.

The theme for GeoSciEd IV will be Geoscience Communication at the start of the 21st Century and will be held in Calgary, Canada from August 10–14, 2003. For further information and updates, visit the web site at <http://www.science.uwaterloo.ca/earth/geosced/>

A memorable quote used by Michael Archer in his keynote address – “Civilization exists by geological consent ... subject to change without notice”, Will Durant, American historian, 1885–1981.



Epsilon Mathematics Courseware – Calculus and Linear Algebra

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This package is essentially a set of lecture notes for first year calculus and linear algebra transcribed to CD-ROM for *Windows 95/98/NT*. A full installation requires about 180Mb of hard disk space; alternatively, the program can be run from the CD-ROM. The navigation engine is *Asymetrix ToolBook*, which is installed along with *Epsilon* as part of the initial setup. This allows the authors to include interactive exercises and to illustrate the material with graphics, animations and sound bytes.

A graph drawing program *GraphMAX* is provided and can be accessed through the *Toolbox* menu. This menu also gives access to the *Windows* calculator, tables of formulae (standard derivatives, integrals and trigonometric identities) and a glossary.

There is no printed documentation but the small help file is all that is needed to use the program.

Epsilon covers many of the topics found in first year mathematics courses but it is nowhere near as comprehensive as the CD-ROMs that accompany the calculus texts by Hughes-Hallett et al. or Stewart. On the other hand, the simplicity of the interface and the alignment of the material with a typical Australian syllabus may make it an attractive supplement for students wanting additional exercises and explanations.

Basically the CD-ROM takes the form of a book in which pages are turned by clicking the navigation bar. It contains 21 chapters grouped into 4 sections: Numbers and algebra; Calculus; Matrices and linear systems; and Vectors and vector calculus. Exercises are interspersed throughout the modules and each chapter consists of a *Concepts* section followed by *Applications* and concludes with a set of additional exercises. Most problems can be done by following the patterns in the text. The navigation bar includes a “contents” button that lists the subsections within the *Concepts* portion of each chapter but there is no general

search engine. The interactive exercises are not bug-free. Quite often I received the error message “Not a valid OpenScript term” when attempting a problem.

The Calculus section begins with functions, limits and continuity and concludes with differential equations and functions of several variables. The linear algebra sections cover matrices, determinants, linear transformations, vector functions, eigenvalues and eigenvectors. Despite the name of the package there are no definitions to be found. Limits and continuity are defined intuitively. At times this leads to rather sloppy definitions. For example, instead of “if x is close to a , then $f(x)$ is close to $f(a)$ ” I would prefer to see something like “ $f(x)$ can be brought as close as we please to $f(a)$ provided x is taken close enough to a ”. In the definition and in all examples of definite integrals, only continuous functions are considered. There are no proofs and the style and the notation is often pre-tertiary: $\text{cis}(\)$ is used for $\cos(\) + i \sin(\)$, and there are occasional references to pronumerals.

Each chapter has an audio introduction and there are sound bytes throughout each module giving the pronunciation of key mathematical terms. In all there are 53 sound clips.

The section on matrices has excellent animations illustrating the definitions of matrix multiplication, determinants and cofactors.

A major drawback is the Glossary. It is hard to know why the distributors bothered to include it. It is surely an embarrassment to the authors of the main package. It is trite, often wrong, uninformative and badly written. There are no links (in either direction) between it and the main text. It should be ignored.

In the accompanying printed notes it states that the material is intended to be a supplement to other study resources. On the other hand, the readme.txt file on the CD-ROM and the *Epsilon* web page at <http://www.maths.monash.edu.au/Research/publications.html> suggest that it could

be used as the only source for the material covered. In fact it is the prescribed text at the Caulfield campus of Monash University, where it was developed. Unfortunately, the user cannot modify the package and so it is not possible to adapt it to meet local conditions. This may not be a problem for the *Concepts* sections but the *Applications* tend to draw on a much wider range of background knowledge in physics and engineering and this could limit its usefulness.

In summary, it is a compact offering of additional material for first year mathematics and pre-calculus which will be most useful in service courses that have a similar syllabus.

[Developers' comments

This software was primarily designed for first year Engineering students, some studying by distance education. It was certainly always intended as a supplement, but never as a set of lecture notes (in fact, there are separate outline notes available on the Web).

We hoped that by using neat screen design, providing many interactive exercises; using animations, graphs, buttons, hotwords, photographs and sound clips; we could cater for new learning styles through a lively presentation, quite different from what may be achieved in most lectures, tutorials, or printed study material. We aimed for clarity and brevity. To have adopted the *modus operandi* of "transcribing lecture notes" would have guaranteed failure. We didn't do so.

Although some publishers currently produce CD-ROMs that seem to be very little more than transcribed textbooks, we saw no point in making such a limited use of interactive multimedia tools. Students use pen, paper, calculator and the *GraphMAX* package while using *Epsilon*. (Very few use the Glossary, but it was included in version 2.0 because some student reviewers of version 1.1 requested one.) Engineering students do have a wider knowledge of physics and engineering that we feel should be drawn on, in illustrating the wide range of applications of both the language and techniques of calculus and linear algebra.

Error messages have been reported appearing in some systems which had a previous version of runtime *ToolBook* installed. Reinstalling the new runtime version fixes all these small problems.

One of our many editorial decisions was that we were unlikely to advance the understanding of these students by presenting - definitions. The title of the courseware has calculus connotations, and also signifies that this is our *small* contribution to mathematics education. We certainly wish to make improvements for future versions, while maintaining the spirit and design choices inherent in the current software. The very favourable reviews by our students are encouraging us to do so.

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(See page 26 for product information)

Introduction to Statistics

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Introduction to Statistics is an interactive multimedia tutorial in introductory research methods and statistics, covering sampling and measurement, summarising and visualising data, correlation, standard scores and the normal curve, the logic of statistical inference, and basic statistical tests (chi-square, t-tests and their distribution-free analogs). This would be an excellent self-paced learning resource for students working either alone or with a tutor.

The demonstrations would also make wonderful illustrations in lectures and tutorials.

The package can be configured for multiple users on either a stand-alone computer (PC or Mac) or a network. Designated tutors can create password access for individual students, devise customised study plans, and monitor students' progress. Password access allows students to use the program independently, bookmark sections for later reference, test their



understanding of each section, and view their progress.

The user-friendly interface requires minimal computer skills. A guided tour shows students how to navigate the package, access the glossary, index, and study plans, and create their own bookmarks. All these features are readily available from virtually anywhere in the program.

This is an excellent learning tool, with clear explanations, well-chosen examples, memorable graphics and interactive exercises designed to help students understand the basic concepts taught in introductory statistics. Sandy MacRae, the developer, has also expertly targeted common misconceptions and difficulties that befuddle students. Some of the many high points include: the interactive section on graphing data; comprehensive treatment of correlation (including Relatedness not equality); an integrated approach to distribution-dependent and corresponding distribution-free tests; and a simple, non-mathematical treatment of standard error.

Although the focus is on conceptual understanding, there are also interactive exercises to help students master statistical formulae and computation, including a walk-through interactive demonstration of the

(computational) formula for correlation, and ‘necessary skills’ tutorials on basic algebra, reading statistical formulae, and using statistical tables.

Installation notes

This review was based on a stand-alone installation on a Macintosh Performa 6300, with not too many installation problems. This can be managed by someone with reasonable computer literacy, as long as they follow the instructions carefully. Installation on a network would require the help of the network administrator.

The program ran smoothly with only two small glitches.

1. The Glossary file had to be manually located each time I tried to access it. The program was searching for the wrong file.
2. In tutor mode, the list of users’ names was written in white text on a white background, so that only the currently highlighted name could be seen. As a consequence, I kept trying to register the same students over and over!

(See page 26 for product information)

Interactive Journey through Physics

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Although this package is designed for use by students at an introductory tertiary physics level, it contains numerous simulations, animations and video clips that also make an excellent resource for lecture demonstrations and tutorial discussions. Each topic is provided with review problems in a variety of formats to cater for the different learning styles of individual students, and a plain-text log file can (optionally) be saved to monitor progress. Very useful features of *Interactive Journey through Physics (IJTP)* are the scientific calculator (with a “Constants” pop-up menu for common values such as the electron charge, etc.) and a built-in spreadsheet.

The material is presented in four modules: Mechanics; Thermodynamics; Electricity &

Magnetism; and Light & Optics, each beginning with an overview video clip of a “talking head” introducing the physics content to be covered. Units within a module also contain an overview video, highlighting some interesting application of the concepts covered in the unit. Finally, topics within units begin with a topic review (consisting of rather uninspiring text/diagrams in a scrollable window), and generally proceed to animations, videos, simulations, problems and MCAT questions. (Australian users of *IJTP* may wonder about MCAT – this is the Association of American Medical Colleges Medical College Admission Test.)

The topics covered are standard to most junior physics courses, but it is disappointing

that there is no mention of Kirchoff's laws, Thévenin's theorem and ac circuits. The material presented is engaging and accurate, with the videos, simulations and problems (with solutions) bringing physics to life in a way that a textbook cannot rival.

IJTP can only be run (in 640x480 mode!) from the CD-ROM, the installation program copies a "shortcut" to the executable file and there is no "uninstall" feature. The package requires *QuickTime*, but the version provided is very outdated; accidentally installing it over a later version on my PC made the program inoperable, with any attempt to open it resulting in the dreaded "blue screen of death".

Navigating through *IJTP* can be frustrating. For instance, there is no "next" arrow (only "previous"), and videos, animations, problems

and so on, could do with more descriptive names than Animation 1, Animation 2, etc. Clicking on a video button opens the video player, but another mouse click is required to play it. Text is sometimes obscured on screen by other text or figures.

In summary, although I have no doubts that *Interactive Journey through Physics* is a very useful teaching aid, I could not recommend its purchase until the very clumsy interface is updated to match modern expectations.

[Supplier's comment

Pearson Education is happy to offer technical advice for this product. Contact your local Pearson representative or call (02) 9454 2384.]

(See page 26 for product information)



WebByte No 11

Problem: how to organise a subject being held in the summer vacation. Solution: web site!

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Subject 91124 Coastal and Marine Ecosystems is a second year option for the coastal and marine sub-major at the University of Technology, Sydney. This subject whilst a second year subject is taught intensively during the summer vacation between years 1 and 2. As with all our vacation-taught subjects, there have been problems with getting information to prospective students during this period. Students must apply well before the end of the previous semester (pre annual examination, pre vacation) and be supplied with details on how to get to Jervis Bay where the subject is taught, what to bring, timetable, and all the other miscellaneous 'instruction' to make a field taught subject successful.

What makes the field based subject so successful, apart from the glorious aspects of the Jervis Bay environment, with 5 or 6 days, of rain or shine, insect attack or sun-stroke, is the intensity of the course. Not quite army, but breakfast at 0700, then a lecture at 0800, another lecture follows the evening meal. The hours between are filled with either 'field skills' or a mini project. An examination is

held when students return to Sydney (by week 4). Subject complete!

Lectures are 'PowerPointed' and copied to the web site along with all diagrams, tables and additional readings. Students therefore can access the material *before* the excursion! The web site is not merely a directory of instructions and forms, but is becoming increasingly interactive with revision questions, current students' field data, a depository of data collected from previous years, discussion groups and much more.

Yes it is a 'little' more work for staff in busy October to update the site, but the rewards speak for themselves. As the students are conditioned in first year to use the Web, there are no hassles about application forms etc. It is all there! Deposits and forms are collected before examinations and holidays. The students' response — *why aren't there more subjects taught this way?*

The URL for the web site (password protected) is:
<http://www.science.uts.edu.au/subjects/91124/>.



Development and Evaluation of a Model-building Tutorial – How to decide what worked and what didn't!

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Introduction

Students in biological sciences often have problems understanding the concepts involved in operation of control systems. We have found that they are very good at rote learning diagrams supplied in lectures, but have a great deal of trouble relating this to real world systems. Additionally, teaching difficult concepts in a manner which is engaging to students has always been a challenge. This project is a direct response to student and staff difficulties with the teaching of biological feedback control.

Understanding control of blood pressure

The incentive for development of this program came from a desire to replace a practical class in which students investigate the control of blood pressure in a hands-on practical class using anaesthetized animals. This class was very successful in teaching experimental techniques, and ways of investigating acute blood pressure interventions, but was less successful in assisting students to understand the overall operation of the blood pressure control system. In line with the worldwide move to reduce animal experimentation, we initially replaced the practical class with a video session, but this proved less than helpful in teaching the concepts involved, largely due to the passive nature of the experience for students.

It was then decided to develop an interactive computer tutorial, to be used in conjunction with lectures and other classes. The major aim in designing this tutorial was to concentrate on the underlying concepts of reflex control of blood pressure, not to provide a data-rich replacement for lectures or textbooks.

Principles used in software design

The pedagogical principles and interface design issues considered in development of our

interactive programs have been described previously (Weaver et al., 1996; Kemm et al., 1997). Many of these principles and issues are relevant to the present project involved with control system investigation. The program has been designed to be used in a collaborative learning environment, where students work in small groups of two to three, with a tutor present. Our experience has shown this to be very effective at provoking discussion of the learning issues.

Targeting the curriculum need

The initial stage in designing the tutorial involved identification of specific needs. We analyzed students' answers to an examination question on the control of blood pressure and identified their major misconceptions. This allowed us to target the areas of greatest difficulty, and to design accordingly. We found students displayed difficulty understanding the concepts of feedback control in general, and the signalling sequence of reflex control (i.e. detection of imbalance must occur before reflex correction can take place).

Model construction

The major feature of this program is a model-building exercise, where students use the tools provided to construct their own model of a reflex system. They are able to test their model at any stage, and receive substantive and specific feedback on their choices. This approach allows students to test different scenarios, and so gain a deeper understanding of the concepts involved.

The model represents a neural circuit which will allow a person to maintain the blood supply to the brain when they change posture. Students are given a palette of components of the nervous system, which they can position onto a background diagram of a human body. These components consist of receptors (signal detectors), input (afferent) neurones, processors



(interneurons), and output (efferent) neurones (see Figure 1). These components are fully manoeuvrable, and the neurones can be

stretched or rotated as required to make appropriate connections.

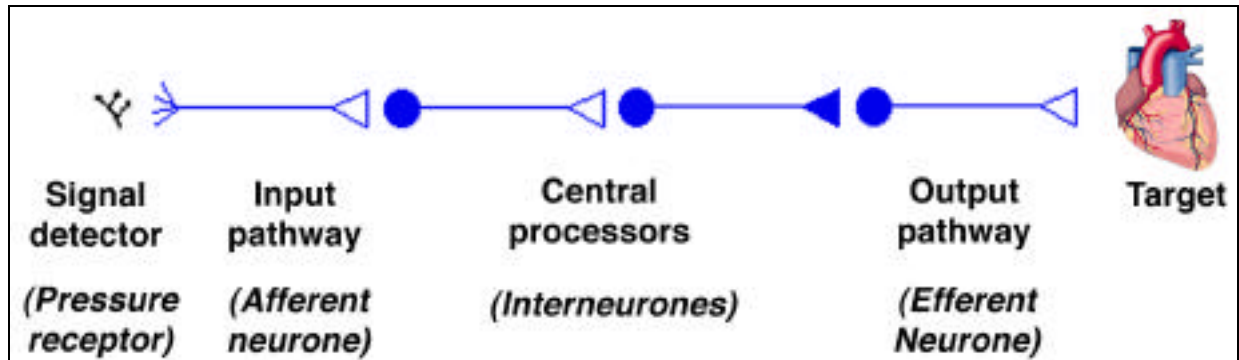


Figure 1. Model-building components

Students can test their model for completeness and correctness at any stage. They will receive feedback in the form of a simple animation of an electrical impulse travelling around the system, and releasing chemical neurotransmitter where appropriate, followed by specific textual feedback. The textual feedback is always in the format of a positive statement (what is correct so far), followed by a statement about what is not yet correct, and a hint about what to consider next.

The completed model is very complex, albeit a simplified real-life model (see Figure 2), and we anticipated that students would find this task challenging. Some attributes of the model were limited e.g. choice of neurotransmitters, and questions were set at the end of the tutorial to prompt consideration of these. At all stages, our aim was to concentrate on the concepts involved, and then to introduce detail later, to avoid overloading the students at any one stage.

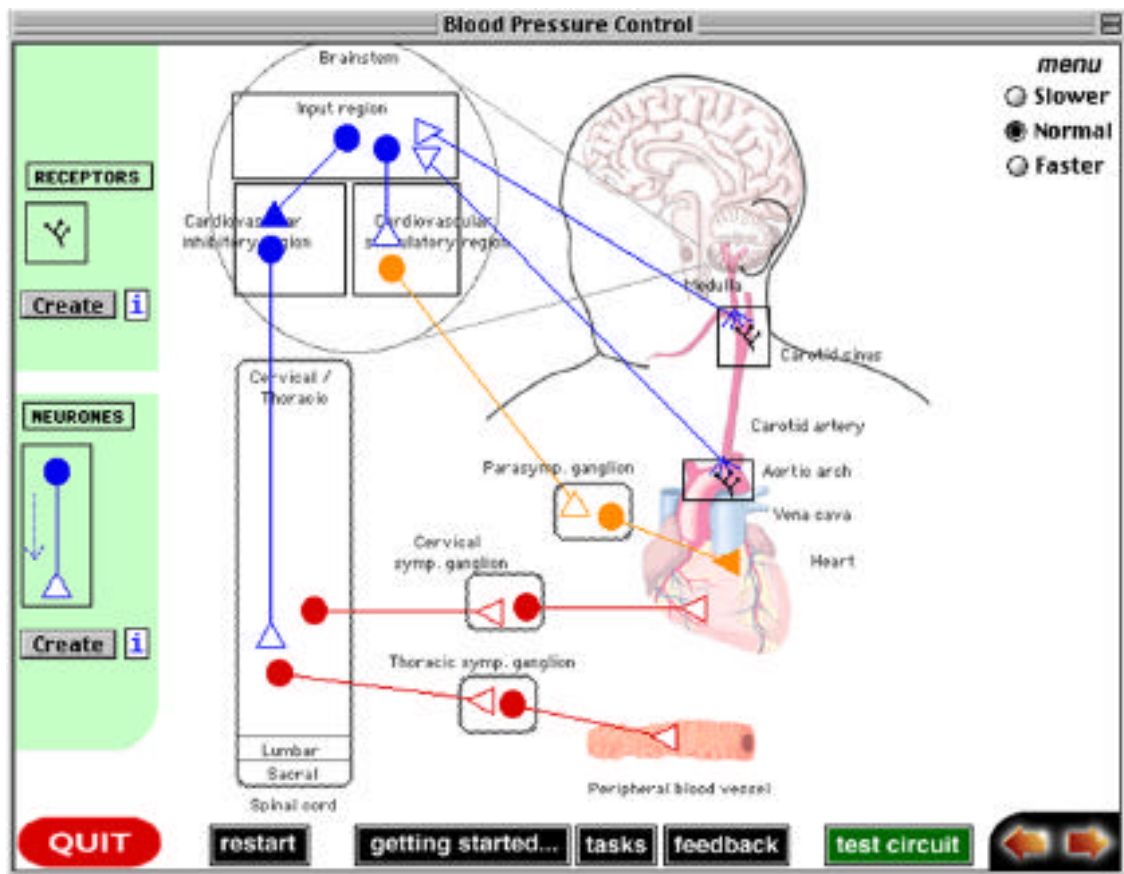


Figure 2. Completed model on screen, showing complexity of parallel output



Implementation and evaluation

The first draft of this program was tested on 200 Medical students at The University of Melbourne in 1998. Students were working in groups of two or three, in scheduled classes, with at least one of the developers present as an observer in every class. Written questionnaire responses were collected from every student. At the same time, electronic audit trails of student progress through the model construction were collected. These audit trails were matched to questionnaire responses.

The audit trails collected selective data only, to limit the amount of information to be evaluated to a manageable and interpretable amount. Instead of every mouse click, we tracked student viewing of feedback panels, so that we could map exactly which path was taken to reach the complete model. This also allowed us to identify areas of greatest difficulty, as seen by repeated viewing of feedback panels, or repeated attempts to get past a particular stage.

Analysis of evaluation data

Observations of the class by the developers confirmed our expectation that students would find the model-building task challenging. Students generally took some time to familiarize themselves with the program, but were able to complete the given tasks in the time provided. Some students experienced difficulty in getting started, and these students quickly became frustrated, and became less likely to read instructions or textual feedback. The level of difficulty of the model, and lack of familiarity with the symbols used, was such that they were overwhelmed by so much new information.

Questionnaire analysis

The questionnaire responses were generally consistent with the observations of the developers, i.e. the students enjoyed the interactive task of constructing their own model, and reported a sense of achievement on completing this, although most experienced some difficulty, especially in getting started. We had not anticipated that students were unfamiliar with the symbolism commonly used to represent components of the nervous system,

and therefore they had trouble at first distinguishing the functions of the different components of the neural circuit.

Students enjoyed the animated sequences, with many comments that they appreciated the visual representation of the electrical impulse travelling around the circuit, although many found the textual feedback less clear. Typically, they asked for more directional hints (“Tell me what to do!”), which is something we were consciously trying to avoid. Importantly, most students reported that they used the textual feedback in constructing the model, even if most of them still experienced difficulties along the way.

The most commonly reported difficulty was in getting started. This problem was perceived as an early cognitive overload, where students were faced with learning the symbolism used, how to use the tools provided, and how to interpret the feedback before they could begin to construct their model. This has been dealt with in subsequent versions of the program (see below).

Students were also asked for their suggestions for improving the tutorial, and many took this opportunity to provide some excellent feedback. Several of these proposals have since been incorporated into the tutorial design.

Audit trail analysis

Collection and analysis of electronic audit trails allowed us to track the paths taken by students through the model-building exercise. We collected information of the numbers of groups/pairs of students that viewed any particular feedback screen more than three times. This was used to indicate difficulty in moving past a particular model-building stage (see Figure 3).

It was possible to identify sites of common confusion in the model construction process, where repeated viewings of feedback panels significantly above background levels could be detected. By matching the audit trails with the written questionnaires, we could identify the cause of the spikes in this diagram, which indicate that 10 or more groups of students were revisiting the same feedback panels three or more times. Generally, the peaks in the early stages of model construction (input pathway stage) correspond with the difficulties reported by students in getting started. High



numbers of repeat viewings in the central processing stage correspond with the high level of complexity of the model in this stage, and with the complicated anatomical terms used. Once students reached the output stages of the model, they had learnt how to use the tools and to interpret the feedback, and so peaks of repeat

viewings in this stage generally indicated particular feedback panels which were confusing or ambiguous. It can be seen that at many stages (47 out of 97), all student groups found that viewing of any particular feedback panel less than 3 times (signified by empty columns) was adequate.

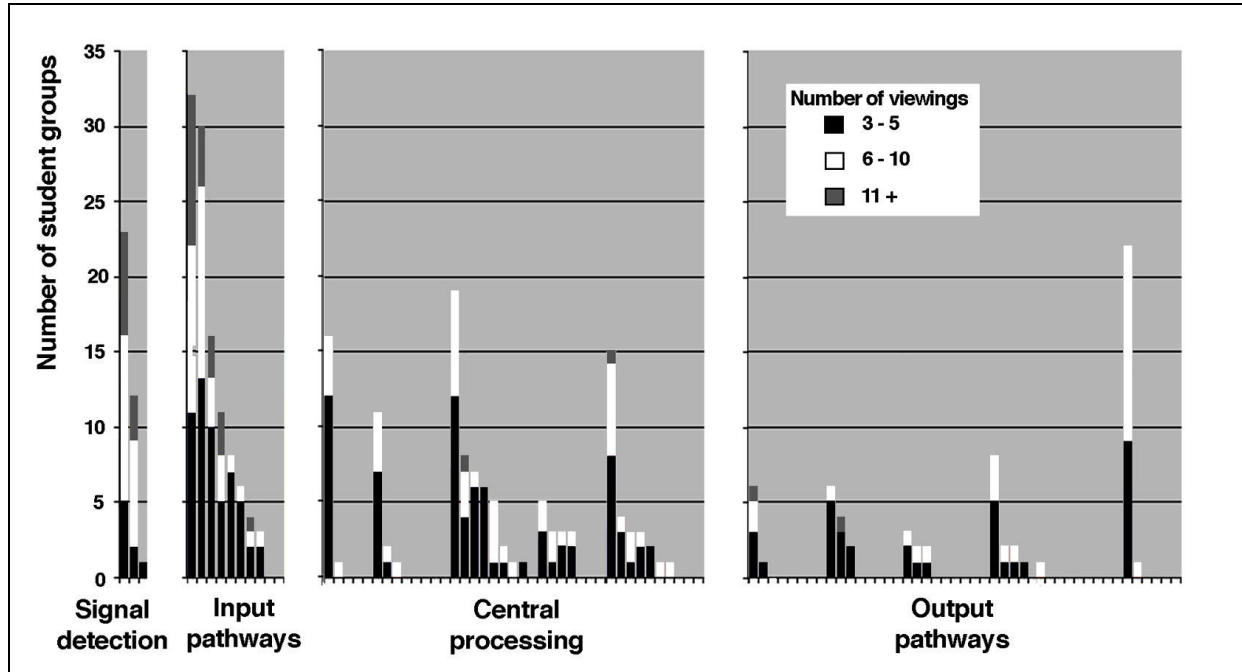


Figure 3. Frequency plot of number of student groups returning for repeated (>2) viewings of feedback panels during the model construction, segmented into 4 stages.

(Total number of student groups = 93, total number of feedback panels = 88)

Program redesign in response to evaluation data

In response to student comment following the prototype testing, several modifications were introduced to the program. The major problem identified was the large cognitive load experienced by students in the early stages of model-building, which was found to originate from three separate sources.

The first area of difficulty was in the lack of familiarity with symbols representing components of the nervous system. We included an introductory screen with more information on these, with links to definitions, and simple animations of electrical impulses moving along neurones. This provided the necessary familiarization opportunity, not only with the symbols themselves, but also with the concept of connecting components and transmission and modification of electrical signals.

Secondly, many students found the use of anatomically-correct terms and fine structural detail of the model to be too complex for this introductory stage of their course, and distracted them from learning the underlying concepts involved in reflex control. In response to this, we simplified several stages of the model, and used terms to describe regions of the brain which better represented their physiological function. However, more detailed information was retained as links, so students may still access this information once they have consolidated their basic knowledge.

Finally, students reported difficulty in learning how to use the tools provided at the same time as they were attempting the task of constructing the model. To reduce this cognitive load, we introduced a 'playground' screen, immediately prior to the model-building screen, where students can rehearse using the tools representing components of the nervous system. Importantly, students are presented with a task of constructing a simple



feedback circuit on this screen, to provide direction for this practice exercise. This not only provides experience with selecting and modifying the tools, but also using these to construct a circuit, and interpreting the animation and textual feedback provided.

Once these major difficulties were dealt with, we then revisited the textual feedback panels, using the results of the audit trail analysis to indicate problem stages. Any peaks of repeat viewing of feedback panels which could not be related to the problems described above were interpreted to represent feedback which was either ambiguous, confusing or misleading. These feedback panels were identified and rewritten to provide more helpful diagnosis and prompting.

Conclusions

This process of implementation and evaluation has proved invaluable in learning where students are experiencing difficulty with using this program. In particular, the matching of electronic audit trails with written questionnaire responses has enabled us to identify precisely where these difficulties arise, and allowed us to accurately address these problems.

Evaluation of this program is ongoing. We have tested the modified version on second

year Science students in 1999, with encouraging results. We will be repeating the evaluation on Medical students in 2000, concentrating on measurement of learning outcomes.

Acknowledgements

Funding for the development and initial evaluation of this project was provided by CUTSD (Committee for University Teaching and Staff Development), with funding for ongoing evaluation being provided by the Department of Physiology, The University of Melbourne.

We also wish to thank the students of the Faculty of Medicine, Dentistry and Health Sciences at The University of Melbourne, for their ongoing and cheerful assistance in evaluating this program.

References

Weaver, D. A., Petrovic, T., Harris, P. J., Dodds, A., Delbridge, L. M. and Kemm, R. E. (1996) Interactive tutorials designed to encourage deeper learning practices, *Making new connections ASCILITE '96*, eds. A. Christie, P. James and B. Vaughan, 501–515. Adelaide: University of South Australia.

Kemm, R. E., Weaver, D. A., Dodds, A., Evans, G., Gartland, D., Petrovic, T., Delbridge, L. and Harris, P. J. (1997) Designing and Evaluating an Interactive Hypothesis Testing Tool to Aid Student Understanding – Gastric Acid Secretion and Its Regulation. *ASCILITE '97 What Works and Why*, eds. R. Kevill, R. Oliver and R. Phillips, 324–330. Perth: Curtin University of Technology.

International collaboration

UniServe Science is proud of its efforts to foster collaboration, both national and international. Internationally this has resulted in the development of strong ties with the Computers in Teaching Initiative Centres (CTIs) (currently being replaced by Learning and Teaching Support Network Centres (LTSNs)) in the United Kingdom and the Council for the Renewal of Higher Education in Sweden. *CAL-laborate*, our international newsletter, is a product of this association. Collaboration with Sweden was reinforced, when the Council visited UniServe Science in November 1999. The discussion covered: software and web site reviews; the notion of a central refereed electronic repository for web site information; the different learning experiences of students in the two countries; the public use of institution-based self-assessment modules; mirroring of overseas sites; and accreditation of academics. A Memorandum of Understanding between UniServe Science and the Council was signed as an acknowledgement of the strong ties and the determination to continue to encourage and support collaborations.

Product Information

Epsilon Mathematics Courseware - Calculus and Linear Algebra is available from
AAMT inc.
PO Box 1729
Adelaide SA 5001
Tel: (08) 8363 0288

Interactive Journey through Physics is available from
Pearson Education Australia
Unit 4 Level 2
14 Aquatic Drive
Frenchs Forest NSW 2086
Tel: (02) 9454 2200

Introduction to Statistics is available from
BPS Multimedia
St Andrews House
48 Princess Road East
Leicester UK LE1 7DR
Tel: (0116) 252 9557



InterLearn: A Software Tool for Increasing Interaction in On-line Courses

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Introduction

Though considerable progress has been made with respect to the development of elegant and appealing on-line courses, the issue of interaction among participants in such courses has lagged somewhat. Such interaction is usually restricted to discussion groups, chat rooms and similar environments, often separate from core on-line learning materials. A challenge facing software developers is thus to design more integrated software, that embeds opportunities for interaction and collaboration within the learning environment. In confronting this problem, the Centre for Higher Education Development at Monash University has recently developed a software tool, *InterLearn*, that has been used successfully in one of its courses. A demonstration of the software can be accessed through <http://www.adm.monash.edu.au/ched/courses/GCHE/>.

Increasing interactivity

During the first semester of 1999, the Centre for Higher Education Development offered its Graduate Certificate in Higher Education (GCHE) to academic staff at Monash University for the first time. The course provided us with the opportunity to put into practice many of the ideas concerning flexible learning that we have been espousing to our Monash colleagues. We worked as a team (five academics contributed to the materials) over a period of about seven months to develop the first subject, with the support of a graphic artist, a programmer and an administrative resources person.

As the course was to be undertaken by typically busy academics with little opportunity to attend scheduled classes, it was decided that the bulk of study time would be on-line. This environment would be supported by a few days

of intensive face-to-face workshops, a couple of non-compulsory tutorials and printed study materials (a short Study Guide and a book of readings).

Our greatest challenge was that we were determined to emulate some of the workshop activities that we would use in typical face-to-face workshop sessions, some of which were of the type where 'a typical starting point would be for students to make notes on the same text, swap and criticize them in pairs, bring their conclusions on note-taking together in a group of four and so on'¹.

We were thus keen for participants to share their experience and understanding of key concepts within a framework of 'student-centred flexible learning'. As stated in the Monash Strategic Innovations Fund Guidelines, 'student-centred flexible learning places particular emphasis on interaction between learner and teacher and between learner and learner as a means of facilitating a shared, social construction of knowledge and understanding'².

Investigation of available software to support on-line learning revealed, however, that none fulfilled our aims concerning interaction. So as we designed and developed the course, we also set out to create our own software tool, now called *InterLearn* (from interactive learning on the Internet). *InterLearn* is built on a database structure, which allows student's individual activities to be stored and viewed on demand by whomever is given access to the material. Each student logs onto an individualised 'worksites', where they complete set activities and enter responses in dialogue boxes. The activities are labelled as either 'shared', meaning they are available for viewing by all course participants, or 'individual', meaning only the participant and the teaching team can access them. The way this operates in Designing for Learning, the first subject of the GCHE, can be illustrated by describing the first three on-line activities.

In Activity 2.1, participants are asked to interview someone about their learning experiences, and enter their findings in a

dialogue box that automatically stores their response for later viewing or modification. This is shown in Figure 1.



Figure 1. The first on-line activity

Similarly, Activity 2.2 asks participants to describe their own learning, and provide examples of 'good' and 'bad' learning experiences. The interactivity occurs in

Activity 2.3, which asks participants to use the 'Activity Search' button (see Figure 2), which allows searching of responses by student and Activity.

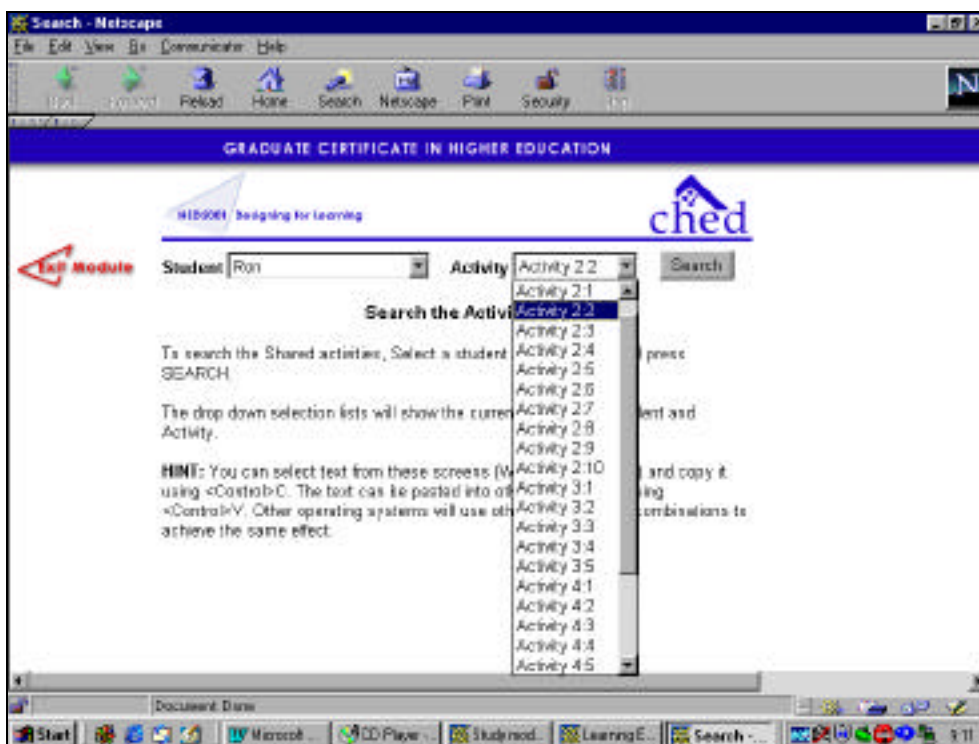


Figure 2. Using the 'Activity Search' function



Activity 2.3 requires participants to view the responses of other students to the first two activities, form an opinion of the essential

elements of effective learning, and post their comments in a dialogue box (Figure 3).



Figure 3. An 'individual' activity calling for use of 'Activity Search'

Further interaction between participants is available in an on-line discussion group, in this case using a *Netscape Collabra* Discussion Group, the standard adopted by Monash. It was our plan that the worksite interaction would stimulate participants to use the discussion group to extend their ideas and further share their understanding of the topics under study.

Evaluation and feedback

As teachers of a new subject being offered in an experimental on-line environment, we were understandably a little nervous about how the materials would be received and applied by the participants. We had spent time during the initial face-to-face sessions preparing them for the learning materials, and as subject coordinator I had started a series of weekly global emails, but we still wondered how they would respond to the activities and whether the discussion group would 'take off'. As it turned out, the outcomes exceeded our expectations – the quality of responses to the activities was high, and the discussion group started even before the first welcoming message from the

teachers was posted. As the semester progressed, it became decreasingly necessary for any of us on the teaching team to post on the discussion group, as the participants engaged in a series of fascinating threaded interchanges. For the most part the discussion group had a life of its own, with a heartening emphasis on teaching and learning issues.

A variety of approaches were used during the semester to obtain evaluative feedback from the participants. These included tutorial discussion, qualitative and quantitative questionnaire items, focus groups and the scanning of comments in activities, the discussion group and reflective assessment pieces. Where possible, adjustments were made to the study programme as the semester progressed.

The questionnaire at the end of the semester contained 23 quantitative items, with five-point Likert scales with responses ranging from 'Rarely' through to 'Almost all the time' for the amount of time the statement was applicable. Concerning items that particularly relate to the on-line materials and their interactivity, the results in Table 1 were obtained from 34 respondents (of a total class of 45).



	Questionnaire Item	Rarely	Some	About half	Most	Almost all
8	The on-line materials covered the important aspects of the subject.	0	0	1	19	12
15	The way this subject is taught is appropriate for the material.	1	0	4	13	16
17	The flexible nature of the course allowed me to study more conveniently than if it had been a conventional course.	1	1	2	6	24
18	The interactivity of the on-line materials fostered a sense of a 'learning community'.	1	3	8	11	10
21	Using 'Activity Search' to look at others' responses contributed to my understanding of the subject.	0	1	7	16	10

* Where totals are less than 34, not all respondents completed the item.

Table 1. Selected items from questionnaire

Participants were asked about the particular facets of the subject that they found useful.

“The ability to see other work and particularly peoples’ feelings and experiences written to the group.”

“I am particularly happy with the activity system adopted in the course under different modules. The activity system allows me to build my knowledge gradually in a very flexible way. It also allows me to share other’s experience and gain from their experience and knowledge. Another good reason is that I can practice what I learned from others in my own class and add that experience to activities.”

“... I find I have learnt skills and developed knowledge that I did not think was possible using a distance and flexible learning package. I have learnt that this can be attributed to weekly tasks that require myself, as a learner, to actively implement knowledge gained from reading relevant material, to build on learning from previous weeks and to incorporate prior experiences and reflection into current learning.”

On the basis of our experience, we thus claim that there is considerable room for improvement in terms of interaction in on-line courses, and that this can be achieved with simple software applications. We have also demonstrated that interactivity between students in on-line courses can be stimulated without necessarily adding substantially to the overall teaching load.

Finally, we must not forget that ‘it helps if the course is fun. The somewhat technocratic approach to course design ... should not mean that the product is laundered of that zest for life and learning so necessary to the human spirit’³. The final word can thus go to one of our students whose simple statement on Designing for Learning was ‘Practical and fun!’.

References

- ¹ Daniel, J. and Marquis, C. (1979) Independence and interaction: getting the mixture right, *Teaching at a Distance*, **14**, 37.
- ² Monash University (1999) *Monash Strategic Innovations Fund Guidelines*.
- ³ Daniel and Marquis, op. cit., 42.

UniServe Science PUBLICATIONS <http://science.uniserve.edu.au/pubs/>

- **UniServe Science News** is available on-line and in Portable Document Format (PDF)
- **Proceedings of UniServe Science Workshops** are available in PDF (Dry Labs workshop, Computer Assessment workshop, University Science Teaching and the Web workshop and Tools for Flexible Learning workshop)
- **UniServe Science QuicKards** summarise the software most commonly used in Australian universities for teaching first year classes and are available on-line
- **CAL-laborate** is a collaborative publication from UniServe Science, the UK CTI centres for Physics, Chemistry and Mathematics and the Swedish Council for Renewal of Higher Education and is available on-line and in PDF

On-line Journals

An increasing number of professional organisations and educational institutions are using the Web for publishing their journals and newsletters. Here is a selection of on-line journals that contain articles, reports and discussions concerning issues related to the use of technology in teaching, in particular, science teaching at a tertiary level.

Electronic Journal of Instructional Science and Technology (e-JIST)

is published by the Distance Education Centre, University of Southern Queensland. It is an international peer-reviewed electronic journal covering a wide range of areas including foundations of instructional science, practice of instructional design in education and training, instructional delivery technologies, evaluation of instructional design input, future developments, and reports or reviews of research and books.

<http://www.usq.edu.au/electpub/e-jist/>

Journal of Interactive Media in Education

addresses issues relating to theoretical and practical aspects of interactive media in education and the issues raised by its use. It aims to improve teaching and learning through better interactive media. "Through its innovative use of interactive Net-based media, JIME is an action research project which explores the changing face of academic publications."

<http://www-jime.open.ac.uk/>

UniServe Science News and CAL-laborate

are available in html and pdf format. UniServe Science News is published three times a year. CAL-laborate, the international newsletter for the physical sciences, is published by UniServe Science in collaboration with the United Kingdom CTI Centres for Physics, Chemistry and Mathematics and the Swedish Council for the Renewal of Higher Education (formerly known as Council for the Renewal of Undergraduate Education). CAL-laborate Life Sciences will be available in May, 2000.

<http://science.uniserve.edu.au/pubs/>

Australian Journal of Educational Technology

is the ASCILITE journal. Restricted access to current issue but archives of past issues are available on-line, also EdTech conference proceedings.

<http://cleo.murdoch.edu.au/ajet/>

Issues of Teaching and Learning

is the on-line newsletter from the Centre for Staff Development at The University of Western Australia.

<http://www.csd.uwa.edu.au/IssuesOfTandL.html>

Cause/Effect is a practitioner's journal for college and university managers and users of information resources, published quarterly by EDUCAUSE.

<http://www.educause.edu/pub/ce/cause-effect.html>

Compute-Ed is an electronic journal of learning and teaching with and about technology.

<http://computed.coe.wayne.edu/>

Bioscene is the Journal of College Biology Teaching. Recent years are available as pdf files, earlier years as scanned graphics.

<http://www.acube.org/bioscene.html>

On the Horizon is a strategic planning resource for education professionals.

<http://horizon.unc.edu/horizon/online/>

UltiBASE publishes original research, work-in-progress, personal reflections and interviews. While it focuses on teaching and learning in the Humanities, Social Sciences and Education, many articles are relevant to science teaching.

<http://ultibase.rmit.edu.au/>

Interactive Multimedia Electronic Journal of Computer-Enhanced Learning

is edited and produced by Wake Forest University. IMEJ contains articles about effective uses of technology in all disciplines within higher education.

<http://imej.wfu.edu/>

Active Learning is published twice a year with each issue dealing with specific topics in the learning technologies. Restricted access to the current issue, previous issues are available in either pdf or html format.

<http://www.cti.ac.uk/publ/actlea/>

Educational Technology & Society

is the Journal of International Forum of Educational Technology & Society. It contains academic articles on the issues affecting the developers of educational systems and educators who implement and manage such systems.

<http://ifets.ieee.org/periodical/issues.html>

International Journal of Educational Technology is an international refereed journal in the field of educational technology published on-line twice each year by the University of Western Australia and the University of Illinois at Urbana-Champaign.

<http://www.ecel.uwa.edu.au/ijet/>
and

<http://www.outreach.uiuc.edu/ijet/>

ONLINE-ED is a moderated electronic mailing list which aims to promote on-line education. Distributed each week during the semester, it includes an invited article plus information on related conferences, seminars and on-line events.

<http://www.edfac.unimelb.edu.au/online-ed/>

Calendar of Coming Events

Apple University Consortium Academic and Developers Conference 2000

New Millennium, New Technology, New Worlds of Learning
April 25 – 28, 2000, Wollongong
<http://auc.uow.edu.au/>

Improving the First Year Experience

UniServe Science Discussion Forum
April 27, 2000, Sydney
<http://science.uniserve.edu.au/workshop/fye/>
PhySciCH@mail.usyd.edu.au

Evaluating the New Teaching Technologies

UniServe Science Workshop
April 28, 2000, Sydney
<http://science.uniserve.edu.au/workshop/evaluate/>
PhySciCH@mail.usyd.edu.au

CATE 2000

Computers and Advanced Technology in Education
May 24 – 27, 2000, Cancun, Mexico
<http://www.iasted.com/conferences/2000/cancun/cate.htm>
calgary@iasted.com

AUSWEB2K

6th Australian World Wide Web Conference
June 12 – 17, 2000, Cairns
<http://ausweb.scu.edu.au/>
ausweb2K@scu.edu.au

STLHE 2000

Into the Millennium: The Changing Faces of Teaching and Learning
Society for Teaching and Learning in Higher Education
June 14 – 17, 2000, Ontario, Canada
<http://www.BrockU.CA/stlhe2000/>
stlhe2000@brocku.ca

Online Educa Madrid

Virtual Training in the New Millennium
June 15 – 16, 2000, Madrid, Spain
<http://www.online-educa.com/>
icefaustralia@icef.com

CAA 2000

4th International Computer Assisted Assessment Conference
June 21 – 22, 2000, Loughborough, UK
<http://www.lboro.ac.uk/service/fli/flicaa/conf2000/>
S.E.C.Clowes@lboro.ac.uk

ED-MEDIA 2000

World Conference on Educational Multimedia, Hypermedia and Telecommunications
June 26 – July 1, 2000, Montreal, Canada
<http://www.aace.org/conf/edmedia/>
conf@aace.org

ASET-HERDSA 2000

Flexible Learning for a Flexible Society
July 2 – 5, 2000, Toowoomba
<http://cleo.murdoch.edu.au/aset/confs/aset-herdsa2000/main.html>

ASA 2K

Astronomical Society of Australia Annual Scientific Meeting
July 3 – 7, 2000, Hobart
http://www.phys.utas.edu.au/physics/ASA_2000/Home_page.html
ASA2K@utas.edu.au

15th Australian Geological Convention

Understanding Planet Earth
July 3 – 7, 2000, Sydney
<http://www.science.uts.edu.au/agc/agchome.html>
Agc.Convenor@uts.edu.au

15th Australian Statistical Conference

July 3 – 7, 2000, Adelaide
<http://www.sapmea.asn.au/15ASC.htm>
15ASC@sapmea.asn.au

First Year in Higher Education Conference 2000

Creating Futures for a New Millennium
July 5 – 7, 2000, Brisbane
<http://www.qut.edu.au/daa/asdu/fye/home.htm>

ICME9

International Congress on Mathematical Education
July 31 – August 6, 2000, Tokyo/Makuhari, Japan
<http://www.ma.kagu.sut.ac.jp/~icme9/>
icme9@ma.kagu.sut.ac.jp

35th APS Annual Conference

The Brain Games – The Meeting of Minds!
October 3 – 7, 2000, Canberra
<http://www.psychsociety.com.au/news/canberra.htm>

ICCE/ICCAI 2000

Learning Societies in the New Millennium: Creativity, Caring & Commitments
November 21 – 24, 2000, Taipei, Taiwan
<http://icce2000.nthu.edu.tw/>
icce2000@tcfst.org.tw

Online Educa Berlin

6th International Conference on Technology Supported Learning
November 29 – December 1, 2000, Berlin, Germany
<http://www.online-educa.com/>
icefaustralia@icef.com

IWALT 2000

International Workshop on Advanced Learning Technologies
December 4 – 6, 2000, Palmerston North, NZ
<http://lutf.ieee.org/iwalt2000/>
C.R.Jesshope@massey.ac.nz

ASCILITE 2000

Learning to Choose: Choosing to Learn
December 9 – 14, 2000, Coffs Harbour
<http://multimedia.scu.edu.au/ascilite2000/>

ComBio 2000

Australian Society for Biochemistry and Molecular Biology
December 11 – 14, 2000, Wellington, NZ
<http://www.asbmb.org.au/combio2000.html>

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