UniServe SCIENCE NEWS

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In this issue . . .

From the Director

I've been thinking about the future of university teaching quite a lot lately. Perhaps it's because I'm coming up to retirement at the end of the year (from my university position, that is, not from UniServe Science) which always encourages reflection. But three particular things happened lately which have got me thinking.

The first was a newspaper article which drew attention to the hard times both students and staff in our universities are experiencing these days[1]. It contained a quote which caught my eye:
'Years of shaving funds from the university system have undermined the university experience'.
Spot on. When I look back, it seems to me that for nearly 20 years now, the budget of my home department has tightened, relentlessly, year after year. Occasionally, extra funds were made available by Canberra – 'clawed back' was their chilling phrase – but always at the expense of more forms to fill out, more applications to write, more futures to mortgage. Staff numbers have gone down: student numbers have gone up. When I was a young academic I spent a lot of time thinking about my teaching, more perhaps, from the point of view of my research, than I should. Young academics cannot do that these days. Nobody has *time* any more to think much about what they are doing.

The second was the realization of the plight that my department is going to face next year. I am not the only one who is retiring. In the next 18 months, eight academics, out of a department of thirty, will go. That's more than 25%. Those that remain will have to keep up their research of course, and their teaching load will go up by 30%. And there doesn't seem to be much hope of any of those positions being filled. Now this is just one isolated example of course. But I've heard enough stories from all over to suggest that many other departments have had comparable 'restructurings' within the last few years, or will have them within the next few. You can't help thinking the system is just going to grind to a halt at some stage. That's why there is so much talk by administrators these days about the need to do teaching more efficiently, and about the possibility that flexibility and the new technologies might help. That brings me to the third item.

UniServe Science recently hosted a colloquium, unfortunately available only to academics in the Sydney basin, on distance learning and on-line course delivery. The speaker was Professor Lynne Schrum from the University of Georgia, immediate past president of the International Society for Technology in Education, and she was in Australia to give the keynote address to a conference of Australasian Computers in Education Conference in Melbourne. She gave us a comprehensive overview of the issues and difficulties in attaining successful learning by means of on-line courses, and if she got across any message it was that the issues are many and the difficulties great. In fact I, and many of my colleagues, came away from that talk convinced that there was no way that flexibility and the new technologies are going to do our teaching for less money.

You see, the undeniable fact is that the traditional lecture, which is the prime feature of most universities' teaching, cannot be beaten for cost efficiency. One person spending one hour in front of a class of 100+ students will give more teaching per dollar than any viable alternative. Even if you allow an extra hour of teacher's time for preparation, that's still true. It doesn't matter that research shows that the traditional lecture is a very ineffective means of promoting understanding for all but a very few students. No one ever tries to measure the amount of learning gained per dollar spent. It's always the number of students taught per dollar that counts. That may be deplorable, but it's the way the world runs.

I think that is the real challenge facing those of us who are particularly interested in teaching and teaching innovations. We're comfortable with the idea that our students are struggling and need all the help we can give them. That's why we have spent so much time and effort aiming at flexibility, at giving students alternative ways of learning. The trouble is that offering two different ways of learning, by definition, costs more than offering one way. It is time we faced the idea that our departments are also struggling and need all the help we can give them. We've got to find a way of helping students learn that does not cost more than our traditional lectures, tutorials and labs. The new technologies should be able to help. We just have to keep trying.

[1] The University of Hard Knocks by Malcolm Knox, *The Sydney Morning Herald*, July 9, 2000.

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Thinking, Learning, Teaching and Geography

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If we ever have time to reflect we wonder if our teaching is 'getting across' to the students. How to improve the process is problematic.

We now have many aids for learning and teaching as well as many new tools for our work. But how these are to be built into programmes of learning is not clear. Thinking about the broad nature of our time, the basis for judgement, the problems geography faces and consideration of what learning and thought might be like should help develop the ways we use new developments. This line of thought was prompted by close examination of the *Virtual Field Course*.

The time: the problem

We live in a time of both stress and fascination. The reshaping of society as nations interact in an increasingly integrated world system is causing upheaval and uncertainty. Contradictions epitomise the time, as in the policies of deregulating economic activity yet increasing direction and regulation of higher education. The burgeoning progress of information systems and communications is partly to blame for change and the consequent stress, but also the systems can be a relief. The contradiction inherent in information systems is that although many tasks are simplified the scope of issues we can deal with has expanded beyond our expectations less than a decade ago. Learning and pedagogy is caught up in a maelstrom in which we struggle to progress.

It is essential to focus on and promote learning in higher education. Budgetary constraints and increasing demands on time limit learning. Students live more independently than they did 20 or so years ago; teachers find their time pressured by the number and range of essential tasks. Meanwhile subject content seems to increase exponentially as issues and ideas change and develop, and methodology becomes more complex.

The needs of geography

A fundamental proposition is that learning in all higher education should develop thinking. Of course learning should involve thinking. Whether learning can develop thought is more enigmatic. One wonders whether thinking can only be subliminal, and not directly addressed and managed. At a practical level is the question whether there is time in a course to address these deeper issues, given the constant expansion of subject content.

Learning in geography faces tasks of great complexity. I think we do not fully understand or appreciate this. Not only is there a need for abstract deductive thought, but also there is the need to learn observation and inductive thought. Other disciplines are more selective and less concerned with observation and induction. And as

geographic databases proliferate in spatial and thematic cover, the need to be able to manage systems to glean information is pressing. The thinking involves relating the observation of places to ideas and theories. This brief involves the reality and complexity of place and landscapes. In all walks of life this is extremely valuable learning and knowledge.

Our familiarity with our discipline might be the cause of our failure to appreciate what we have. An explanation might also be in the ordinariness of our subject to us (Meinig, 1979). In this sense the ordinary landscapes of our places on Earth are our subject and consequently to that degree more difficult to disentangle ourselves from in learning who we are and what our place is.

To be a good observer demands skill and experience. Any doubt about this is soon dispelled by a field visit with an expert. What are impressive are not just the issues and facts known but the ways of knowing. It is fascinating to visit a place with an expert; it is challenging and fun to take someone to a place we call our own. In both instances it is the interpretation of the place and the mode of thought that is challenged. To learn these skills and experience raises the question of pedagogy and the time and other resources involved in this form of learning. It also demands critical evaluation of the information systems that complement field work, like the *Virtual Field Course* (http://www.geog.le.ac.uk/vfc/). Observation is essential to understanding place.

The material from field observation ranges from mental imagery to data and notes. Representations, like maps, also support observation. Imagery generated by systems that analyse and represent data graphically is another input to thought, as well as the wide range of ideas and information in books, reports and on the Internet.

But information and knowledge heavily depend upon thought about mental imagery. As well, thought involves diverse sets of mental imagery. On its own the imagery is just that: imagery; complex, potentially informative but certainly not information. Understanding how information and knowledge are created and communicated is crucial to be able to organise learning. But thought seems to just 'happen'. Reflection on thought reveals the outcomes, not the process. These observations pose a great dilemma for learning and pedagogy: how to involve thought and to develop our processes of thinking. We are limited to thinking 'It seems to be like this' or 'If it is like this'. Perhaps our limited understanding of learning excuses the concentration on content. The problem with this view is that technology is pushing our ideas about learning and thought.

Ideas about learning

One advantage of the development of information systems is the stimulus given to the study of human intelligence and consequently thought and learning. At best we seem to be more aware of our knowledge and its limitations in this area; at least we have expanded how we think about the nature of learning. I believe there has been a renaissance of thought about human intelligence and here simply list the areas that are very interesting and stimulating.

At the core are ideas about the nature of intelligence, particularly related to learning. Gardner's work on multiple intelligences posits that intelligence is differently expressed, and identifies seven types (Gardner, 1983). For geography, is the form of spatial intelligence essential, and what about the other six forms?

The work on mental imagery is crucial for geography. The last decade or so has seen the reinstatement of imagery after decades where propositions and stepwise conceptualisations ruled. The fundamental question is whether thought is in the form of imagery, or is in some simpler symbolic form. Rollins (1989) makes the most interesting contribution in the field. And if imagery is a form in which thought happens, what about language? Lee's article on language and learning is very stimulating (Lee, 1997). The idea of patternment in language introduces a concept familiar to geographers.

Much of the work in graphics dictates presentation practice, with little regard to thought about and with the imagery. Classic statements are by Robinson (1953) and Raisz (1962), while the whole visualisation field of computer graphics is about how to represent (search the Internet to review this field). Another group considers the perception of graphics, e.g. Cleveland (1985). Bertin (1981) and Monmonier (1991) show how complex the

perception of graphical representation can be and some of the pitfalls in even the best devised representations. Tufte (1983; 1990; 1997) is concerned about representation but also identifies six principles of communication of information (1990). His leadership in the field is recognised at Yale through his consultancy role in computer science. Bertin (1981) is alone in writing specifically about graphics and the creation of information.

Technology and learning

Technology also challenges the presentation of courses or programmes for learning, opening up many new issues and perspectives as well as creating many opportunities. The challenge is to maximise the gains and minimise the losses. The nature of the challenge depends on the role of technology. If learning is about the technology the task is simple: course design should promote an understanding of the technology. If the goal is to work with technology in a subject the systems have to serve the subject matter of the course, and in particular its philosophy and methodology.

Finally, learning *through* information systems can develop a deep scholarship of the presentation of learning. Learning and skills like those of programme production for the media are involved in the preparation of these courses. The fundamental issues faced in the organisation and order of a course of learning without technology are the same; it is just that with technology the issues are more pervasive and pertinent. Matters of content, forms of presentation and timing are fundamental.

Criteria for judgement

It is essential, therefore, to review and evaluate presentations for learning. Judgement of the outcomes of learning in individual courses and programmes of teaching in higher education is problematic. The answers to three fundamental and interrelated questions are important:

- How *elective* is the learning? This is the fundamental criterion. It raises the issue of the experience gained, related to the effort put in. For example, a poorly organised and presented programme probably will limit learning; a deep, well-organised and well-presented programme could open an unlimited learning experience, carrying on beyond the course.
- How *equitable* is the learning? Whereas there is strong evidence of inequitable access to university this is not in question at a course or programme level. At issue is the limit pedagogy might create for learning in a course generally presented in a particular way. Feynman's physics course is a celebrated example of a revision of pedagogy. He thought it should improve access to learning but concluded that it did not change the results that students gained overall (Feynman et al., 1965).
- How *efficient* is the learning? The concern here is about the costs of preparation and learning related to the returns from learning.

Conclusions

If I am right about the time we live in, there is a great need for the dedication and commitment of scholarship and research into the nature of learning. Through this we will have a window on the nature of intelligence. The type of dedication and commitment is for time and resources to be made available to this end, not squeezed into an already full timetable of commitments. It demands that a wide range of positions be available to this critical process of learning. In turn this learning has to be ploughed back into pedagogy for more learning. This is the typical cycle of action research, a classic mode of work where the research is a fundamental part of the milieu.

As subjects we have courses (especially the exploratory and developmental ones) and tools of learning to use as vehicles. It seems necessary to share the learning of the scholarship with the learners, or those who are deeply involved in learning. There is a great need to structure and link reviews into the learning programme, especially where it is explicit or can be made so. This means the evaluation and judgement is not 'at an end' but deeply embedded in the whole process of scholarship: learning; teaching; and research.

One thing seems clear: the virtual of information systems can support the real but is not a surrogate for it. Used well it is another window into learning and pedagogy. The virtual is only an expanding of influence, not a

changing one in our search for and development of knowledge through learning.

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LTSN update

As discussed in *UniServe Science News* Vol. 14, the Computers in Teaching Initiative (CTI) centres were closed at the end of 1999 and replaced by subject specific Learning and Teaching Support Network (LTSN) centres. Details for the newly established LTSNs responsible for the various areas of science are given below.

http://www.ltsn.ac.uk/

Geography, Earth and Environmental Sciences
Department of Geographical Sciences
University of Plymouth
email: info@gees.ac.uk
http://www.gees.ac.uk/

Mathematics, Statistics and Operational Research
School of Mathematics and Statistics
The University of Birmingham
email: p.bishop@bham.ac.uk
http://www.bham.ac.uk/msor/

Information and Computing Science
Faculty of Informatics
University of Ulster
email: ltsn-ics@ulst.ac.uk
http://www.ics.ltsn.ac.uk/

Physical Sciences
Department of Chemistry
University of Hull
email: ltsn-psc@hull.ac.uk
http://dbweb.liv.ac.uk/ltsnpsc/

Bioscience
Faculty of Biological Sciences
University of Leeds
email: bioltsn@liverpool.ac.uk or ltsnbioscience@bmb.leeds.ac.uk
http://bio.ltsn.ac.uk/

Psychology
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How Commercial Publishers are Responding to the New Teaching Technologies

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New technological capabilities are democratising education delivery. Increasingly, students demand information packaged and delivered through technology, whether on-campus or to their doors. Not only academics, but also the publishing companies, who provide commercially available materials to support the learning community, are now required to provide education through delivery systems to fit the situation of each individual learner.

The increasing demands of the educational market means publishers must have considerable resources to compete against each other. A trend of acquisitions and mergers and name changes make it difficult to keep track of which company carries which imprints. The large educational publishers include Pearson Education (Prentice Hall, Allyn & Bacon, Addison-Wesley, Longman), McGraw Hill (WC Brown and Irwin), Macmillan (Freeman, Routledge, Worth), Nelson ITP group (Brooks/Cole, Chapman and Hall, Jones and Bartlett, West), Wiley (Heath, Norton) and Harcourt (Dryden, Mosby, Saunders).[1] These companies focus on producing resources for large undergraduate courses, leaving graduate areas to smaller publishers such as the university presses.

The majority of science textbooks are imported from the USA, where educational publishers are in a spiral where successive editions of big textbooks must have more and 'better' supplements than the titles they compete against, in answer to student and lecturer demand. The Australian market reflects these US trends, with lecturer expectation that a first year science text will be accompanied by instructor and student support material. On-line and technology supplements are largely where this pattern of demand is played out.

Early CD-ROMs and book web sites followed global technology trends in struggling to find balance between content and design features. Early supplements were often text based, perhaps with some pictures or limited interactivity, dumped into electronic format. As these tools grew in meaningful content, they also grew in educational pedagogy.

Current web sites and CD-ROMs aim towards user friendly features and pedagogy that improves student learning outcomes, incorporating meaningful content that complements the parent textbook:

- **book-specific 'companion' web sites** complement individual textbooks and offer rich on-line learning environments for instructors and students. These web sites offer content to complement and extend the text material: web links; resources and references; case studies; 'ask the lecturer'; and chat rooms.
- **book-specific student CD-ROMs** are commonly designed as electronic study guides, with self-testing questions, case studies, and interactive visualisations.
- Some texts are core textbooks with study aids added on; other titles are **truly integrated multimedia packages**, hybrids that

combine all technology solutions with a textbook, i.e. a book might be packaged with a CD-ROM containing the full text of the book as well as contextually placed multimedia icons, taking students beyond the pages of the traditional textbook and providing them with a rich multimedia learning experience.

Independent media tools not related to parent textbooks can offer deeper learning, structured pedagogically to maximise the benefits of the technology:

- **CD-ROMs** that have the capability to handle graphics rich programs are particularly appropriate for teaching in areas that require visualisation and interactivity of concepts. The life sciences in particular benefit from graphically rich products that offer interactivity, such as laboratory CD-ROMs that allow students to gain extensive dry lab experience economically. In areas where theoretical and quantitative information is valuable, research links or data disks can be of more value.
- **Discipline specific web sites** provide instructors and students with resources to enhance an entire discipline area, from introductory to upper level courses.

Instructor aids utilise new technologies too. Test banks were surely made to be electronic. CD-ROM and web format is particularly appropriate for digital art and interactive simulations from books and resource libraries, enabling instructors to build visually stunning lecture presentations.

Commercially available **course management systems** combine publishers' on-line content with class management tools. *WebCT* was the first of these systems, followed by *TopClass*, *Blackboard*, *eCollege*, etc. Publishers make on-line course content available for use within course management systems, offering web-based content and resources such as on-line study guides, assessment databanks, lecture resource material, quizzes, guided Internet links, and lecture notes, keyed to specific texts, which allow creation of robust web-based courses that are easy to implement and manage. Most of the major publishers have alliances with these systems to provide this content, e.g. Pearson Education has alliances with *WebCT*, *Blackboard* and *eCollege*. Publishers have no investment in specific systems beyond their capability to provide support for lecturers' courses. Content can be provided in theory for any systems (including locally created systems); but use of the common systems simplifies the distribution channel. Most large first year texts and many upper level texts have content cartridges available for these course management systems.

Publishers are now building **course specific home pages** for individual subjects. Pearson Education, McGraw Hill and other companies have the capability to personalise book sites to the lecturer's home page. A custom syllabus is created, with content from the textbook's web site integrated with custom content, assignments and quizzes.

Special alliances are being developed to enhance the services available. For example, Pearson Education has an alliance with America Online (AOL) as supplier of educational content and on-line learning tools on AOL and its other brands. Pearson Education is collaborating with Versaware Inc. to convert and distribute textbooks to electronic format for CD-ROM, DVD and the Web. Pearson Education is collaborating with *Blackboard* to customize a version of *Blackboard*'s leading software platform. These alliances create and facilitate the delivery of the content to wider audiences and provide infrastructure for e-commerce and retail sales.

These new technologies are of enormous benefit to the education industry, facilitating distance learning, automating management of large classes and having significant teaching advantages for visualisation of complex scientific processes. Publishers have extended their services from traditional print based products to providing content in a variety of flexible formats. Some of the developments listed above have happened in the last few months. As universities and academics continue to develop educational needs and frameworks for implementing these technologies, publishers will continue to respond.

[1] Information current to the best knowledge of the author at the time of article submission.

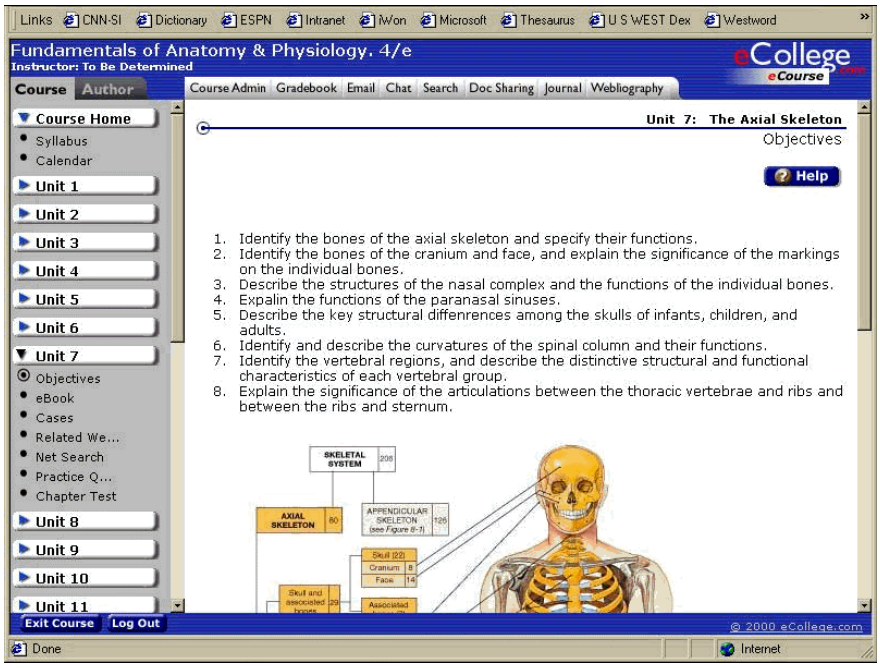

Figure 1. Sample of *eCollege* study guide

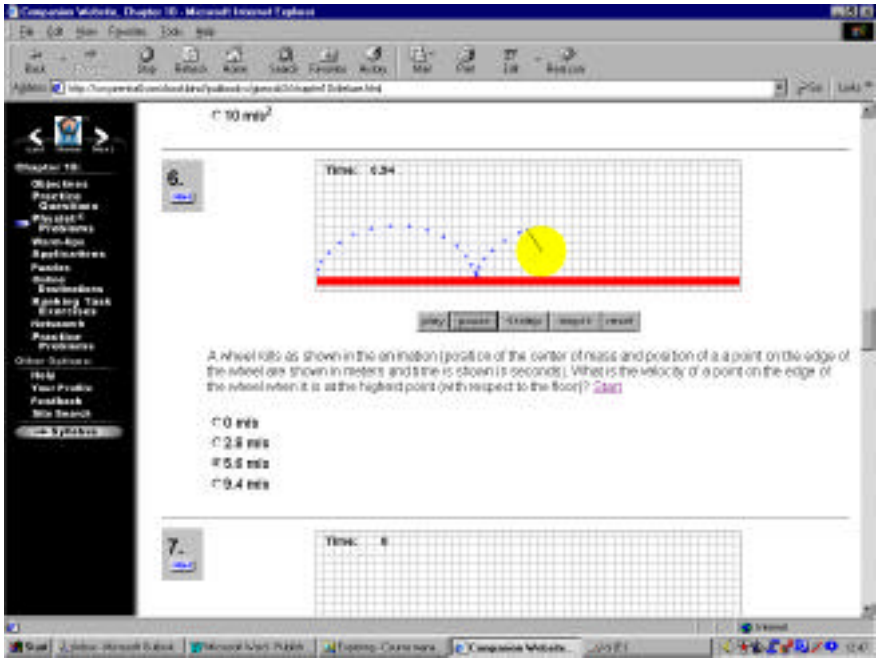

Figure 2. Physlet problem

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- **CAL-laborate** is a collaborative publication from UniServe Science, the UK LTSNs, the Swedish Council for Renewal of Higher Education and BioQUEST Curriculum Consortium, USA and is available on-line and in pdf

An Exercise in Course Evaluation

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Introduction

In April/May, 2000, one of the authors (CS) was a visiting fellow at UniServe Science and the School of Physics, The University of Sydney, under the Thailand Australia Science and Engineering Assistance Project (TASEAP). As part of that fellowship he undertook to evaluate the effectiveness of a course in computational physics which the School had just introduced. This module, an update of a long-standing component of the experimental physics curriculum for advanced students, introduced them to the topic of 'Oscillations and Chaos' by means of a newly written set of computer exercises based on the mathematical package *MatLab*[1]. The purpose of the evaluation was not only to allow the School to monitor the effectiveness of this particular item in its teaching program, but also to establish protocols for future evaluations of other parts of the curriculum.

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Description of the course

The computational physics module, 'Oscillations and Chaos', is one of six in Experimental Physics: Physics 1901 (Advanced). It consists of three-hour sessions in the laboratory, which students are required to attend once a week for three weeks. They work in groups of two or three, through a set of exercises provided in the laboratory notes[2]. Each group has access to a computer for the entire session. Students can obtain help during the session from tutors.

As with many university courses, the primary aims of this course had never been explicitly formulated before it was put together. However consultation with the teachers and tutors reached agreement that the course's main aims were:

- to provide an introduction to the role of computation in physics;
- to appreciate the role of modelling in physical understanding;
- to become comfortable with using computers in general; and
- to gain some understanding of oscillatory and chaotic behaviours.

An evaluation was then planned to test to what degree those aims had been met.

Methodology

The project sought to gather information about the students in three areas: attitudes; knowledge; and skills (see Table 1). Three different ways of collecting information were used: before and after interviews with participating tutors and lecturers; questionnaires for evaluation of the students' performance at the beginning and end of the course; and observation of how students approached their work during class. The objectives of each method are summarized in Table 2.

Attitudes	whether they found the material valuable and interesting, and whether they were encouraged to explore further.
Knowledge	how they saw the role of the computer in physics, and whether they appreciated the wide applicability of the methods used.
Skills	how comfortable they became at using the computer and *MatLab*, and how well they were able to use mathematical and physical reasoning.

Table 1. The three facets of information gathered

Tools	Objectives
Interviews	to define the objectives of the course in terms of teacher expectations, and to ascertain whether, and how well, those expectations were met.
Questionnaires	to determine the students' attitude toward their own skills/knowledge, and to determine the effectiveness of the course.
Observation	to describe the students' performance and activities during the class.

Table 2. The three methods and their objectives

Design of the Pre-Questionnaire

It was decided that it was important to determine the students' backgrounds with which they came to this course in two categories.

- *Attitudes and Skills*. They were asked to give their own rating on their computer skills, their mathematical ability and their understanding of the relevant physical concepts. Responses were asked for on a 1–5 (low – high) scale.
- *Knowledge*. They were tested on their understanding of the basic facts about simple harmonic motion, and their familiarity with the solution of ordinary differential equations. Testing was done mainly by short open-ended questions.

The actual questions can be viewed on-line[3]. This pre-questionnaire was given to each student at the start of the first session. Most students completed it within 20 minutes.

Design of the Post-Questionnaire

The post questionnaire was designed to check the development of the students in the same two areas.

- *Attitudes and Skills*. They were asked to give their own rating, on a 1–5 scale, of the usefulness of this kind of computation and *MatLab* in particular, whether their mathematical skills and their physics knowledge had improved, and their attitude towards the material.
- *Knowledge*. They were tested, by short open-ended questions, on their understanding of properties of oscillations and chaos, and computational and mathematical methods. Some of these questions were the same as on the pre-questionnaire.

The post-questionnaire questions can also be viewed on-line[4]. It was given to each student as he or she finished the last exercise. Most completed it within 20 minutes.

Results and discussion

The raw data from all of these information-collecting exercises can be viewed on-line[5]. Only the most significant findings are reported here.

Students' attitudes toward their own computer skills

More than 80% of the students felt very comfortable with their basic computer skills such as using *Windows*, managing files, backing up data and using the mouse and keyboard. This implies that students came to this course with adequate basic computer skills. On the other hand, they lacked experience in writing programs and using mathematical packages, implying they had little idea about using the computer as a tool for solving mathematical problems.

After the students had finished this course, more than 90% agreed that computational methods are helpful in understanding physics phenomena and in solving physics problems. In addition, most agreed that *MatLab* is useful for tackling many mathematical problems. These results show that, at least in their own

estimation, this course did give students a feeling for the role of computational methods in physics – which was one main aim of the course.

Students' attitudes toward their own mathematical and physics skills

At the start of the course most of the students were highly confident of their mathematics ability. At the end, very few felt that this course had helped in improving their mathematical skills. These findings are at least mutually consistent.

On the other hand a much smaller fraction felt they knew much of the physics at the start, particularly chaos; and at the end, more than 90% found the course to have been helpful in improving their physics knowledge. Again these results indicate success in exposing them to ideas about chaos – which was another aim of this course.

Students' attitudes toward the course as a whole

While more than 60% of the students felt that this course was interesting, enjoyable and useful in learning physics, only a very small fraction felt that they were encouraged to do further study. While not exactly contradicting any of the course aims, this feature warrants consideration in future.

Students' performance in test questions

Comparison of the results from the pre-tests and post-tests show that students did indeed improve their knowledge about oscillations; damping, driving, resonance and chaos. In addition, the number of students claiming not to know about solving differential equations decreased after they had finished the course. This has to be a success in terms of the aims.

However, a *qualitative* analysis of the open-ended questions indicated a marked increase in the tendency to answer those questions from a mathematical, rather than a physical, point of view. An example is the question 'What is the difference in behaviour between a pendulum swinging through a small angle and one swinging through a large angle?', which appeared on both pre- and post- tests. At the start of the course, most students answered in terms of actual behaviour – the period gets longer, or similar. At the end, the number of students answering this question in terms of linearity or the approximation involved had increased dramatically. This point also needs to be investigated more closely, in view of the fact that an aim of the course was deemed to be to appreciate the role of modelling in physical understanding.

Conclusions

In the modern university system, in most countries in the world, increased emphasis is being placed on improving the quality of teaching. It follows that we need to develop ways of evaluating the effectiveness of our courses which are transparent, comprehensive and not too time-consuming. The authors believe that the protocols described above are just that. They could easily be transferred to other courses. There may be doubt in the reader's mind that undue stress has been placed on students' own estimation of the outcomes of the course, rather than on more 'objective' measures. This is, however, in line with current trends in educational circles to carry out evaluations which focus on the student's, rather than the teacher's, perspective, for the reason that all learning is, in the end, mediated by students' perceptions of what they are being asked to do[6].

One last point should be made however. Before any reasonable evaluation of a course can be done it must be clear what the aims of the course are. As mentioned above, many university courses do not set these down before the course is put together. Too often the aims are defined in terms of the syllabus – 'They need to know *x*, *y* and *z*'. If that is the case, then the first job of the evaluator will be to determine what the aims are, which is indeed what happened here.

References

[1] *MatLab*, copyright The Maths Works Inc., 1984–96

[2] The complete course notes can be viewed at http://www.physics.usyd.edu.au/teach_res/CP1Chaos_site/cp1chaos.htm

[3] The pre-questionnaire is available in pdf format at http://science.uniserve.edu.au/newsletter/vol16/prequest.pdf

[4] The post-questionnaire is available in pdf format at http://science.uniserve.edu.au/newsletter/vol16/pstquest.pdf

[5] Complete results are available in pdf format at http://science.uniserve.edu.au/newsletter/vol16/results.pdf

[6] See for example, Prosser, M. (2000) Evaluating the New Technologies: A student learning focused perspective, *Proceedings of the Fifth UniServe Science workshop: Evaluating the New Teaching Technologies*, Sydney: UniServe Science.

UniServe Science Workshop: Evaluating the New Teaching Technologies

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The fifth national workshop was held at The University of Sydney on Friday, 28th April. The theme of the workshop was evaluation, not just of IT materials but of teaching techniques in general.

There were two keynote speakers: Professor Mike Prosser from La Trobe University (at that time), talked about the educational aspects of evaluation, and Professor Ann Sefton, the leader of the Graduate Medical Program at The University of Sydney discussed one of the largest Internet-based teaching programmes in the country, which has had evaluation built in from the start. As well, there were 82 academics attending from most states of this country, including one visitor from New Zealand and seven from Thailand. The seven contributed papers included issues relating to the evaluation of projects in physics, chemistry and biology, experiences at distributed campuses and the commercial potential of IT solutions. The proceedings of the workshop are available on-line at http://science.uniserve.edu.au/pubs/procs/wshop5/.

As is now the tradition at UniServe Science annual workshops, the last session of the day was devoted to an open-floor discussion of issues raised during the day. Three questions occupied most of the discussion. As usual, opinions differed, and some interesting points were made.

How can we who value innovation in teaching convert our colleagues?

There were those who felt that it had to happen by example. Innovations that are successful will impress others and a ripple effect will ensure that these new ideas will be accepted by the more conservative teachers. Others were less optimistic and felt that successful innovations had to come from the top down. If they are not promoted by heads of departments or deans, they are unlikely to be widely adopted. Perhaps the main need was for more professional development to bring the information to those who do not perceive there is a problem in the first place.

How can we assess whether learning is 'deep'?

Among the ideas brought out by the keynote speakers was the thought that students needed to have more ownership of their studies. In discussion it was felt that we should make students aware of the approaches to learning and get them to think about how they study, and perhaps then they might adopt a more responsible approach to assessment.
It was believed that IT had the capacity to allow a variety of kinds of examining, and this could lead to assessment for deeper learning. However it is important not to trivialize assessment. Lastly, while there is a need to make students enthusiastic about the subject matter, it must be remembered that depth of learning is a desire to understand. It is not the same as enthusiasm for the subject.

Are universities under threat from commercialization of tertiary education?

There is a foreseeable threat that private companies could seek to take over the teaching of the more popular first year courses. If that happened, it would mean that universities would have to specialize much more in what we offer students. Certainly there is a decline in postgraduate student numbers, and we need to investigate more aggressively web delivery of graduate courses. Maybe, in the end, there will be a need for some kind of liaison between the smaller universities and large consortiums or franchises.

UniServe Science Discussion Forum: The First Year Experience

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The First Year Discussion Forum was a new venture for UniServe Science. It was held on April 27, 2000, the day prior to the Annual Workshop, to allow interstate and overseas participants to attend both events. The 48 delegates represented 18 Australian, one New Zealand and three Thai universities and were mainly academics from science departments and faculties together with staff from student support networks.

The programme commenced with eight 'cameo' presentations. These provided outlines of programmes that are being implemented at various Australian universities, either as university-wide initiatives, or at a college or faculty level. Summaries of these presentations are available at http://science.uniserve.edu.au/workshop/fye/.

The group identified a number of areas of concern. These included the need to:

- link student welfare to learning;
- recognise the importance of first year teaching;
- recognise the increasing heterogeneity of students and identify the variables;
- plan any transition activities as extended programmes, not just a 'one-off' event;
- train staff in transition issues;
- establish outreach activities and bridging courses; and
- support institutions' student services.

The group recognised that the problems experienced by first year students in the schools and faculties of science (and engineering) are different from those experienced in other faculties. It is proposed that a similar meeting will be held next year in association with the annual workshop.

Web*Byte* 12
Are there any 'furrowed brows' out there?

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In traditional lectures and seminars, the furrowed brow is a certain indicator that students are experiencing some difficulties or uncertainties. Obviously, with on-line teaching and learning, these are more difficult to detect.

Three strategies that we have employed at our institution to determine whether the students are uncertain about topics, concepts or expectations are:

- posing an individual question to each member of the class to explain their understanding of a concept or idea;
- every week asking each member of class for three topics or concepts that they do not understand or find difficult or confusing; or
- requiring one from each group to summarise some study material and post their summary of the topic or issue.

Call for papers

Contributors are invited to submit articles to be published in the refereed section of *UniServe Science News* commencing in Volume 17 (November 2000). Details are available on page 15 of this newsletter or on the Web at http://science.uniserve.edu.au/newsletter/referee.html.

Guidelines for refereed papers

Objectives of the Newsletter

The main objectives of the Newsletter are to:

- promulgate results of research into the use of new technologies or related techniques in the teaching, learning and assessment of science at a tertiary level;
- inform teachers of novel teaching/learning techniques which can be used across the sciences;
- promote collaborations with respect to teaching and learning between the science disciplines; and
- update teachers on the advances in teaching and learning in the sciences.

Criteria for refereed papers

For papers to be considered for refereed publication they must meet the general objectives of the Newsletter, and describe original work or educational research which has not been published elsewhere. Papers which describe innovative teaching materials or techniques are acceptable, provided they do so within an educational research framework. Preference will be given to papers with an interdisciplinary flavour, or whose results can be applied to other disciplines.

Editorial organisation and reviewing process

The Executive Editor is appointed by UniServe Science and has final responsibility for all editorial decisions associated with the refereed section of the Newsletter. Associate Editors together with the Executive Editor process all manuscripts which are received, and this group has the support of an Editorial Advisory Board.

When a manuscript is received the Editors will first judge whether it meets the above criteria. Manuscripts that are purely descriptive or simply confirm previous work may be published in the non-refereed section of the Newsletter. Authors will be given the opportunity to rewrite their paper if they are judged not to meet the criteria.

After preliminary review, manuscripts will be sent to two referees. Reviewers are selected based on their specialisations within science and education. If reviewers disagree, the paper will be sent to the Editorial Advisory Board for arbitration. Editorial decisions that result from this process are final.

If the manuscript is returned for revision the author should reply to the specific recommendations in a covering letter stating how each point has been addressed. If any recommendations have been disregarded the reasons should be given.

Submission of manuscripts

Three paper copies should be sent for refereeing to: The Executive Editor, UniServe Science, Carslaw Building, F07, The University of Sydney, NSW 2006.
The final paper should be sent to: PhySciCH@mail.usyd.edu.au in *Microsoft Word*, as an attachment.

Presentation of manuscript

All contributions must be in English. A4 paper, double spaced, Times or Times New Roman font, 12 point, margins 3cm wide and pages numbered consecutively. References should follow the APA Manual 4th edition.

The usual length of papers is between 3,500 and 5,000 words. However longer or shorter papers will be considered.

Layout – first page acts as a cover sheet and should include the title, the names of the authors, and the institutions, address and email. The second page should have the title followed by an abstract of up to 200 words. There should be no indication of the names of the author(s) to ensure anonymous refereeing.

These guidelines are available on-line at http://science.uniserve.edu.au/newsletter/referee.html.

The Pearson Education UniServe Science Teaching Award

The Pearson Education UniServe Science Teaching Award recognises teaching that improves student learning outcomes via the innovative and integrated use of information technology.

The Award consists of:

- guest keynote address at the 2001 UniServe Science workshop, including travel and accommodation expenses; and
- prize of $1000 to be presented at the UniServe Science workshop 2001.

Dates

Entries must be I n writing and submitted by 31 October 2000 to UniServe Science. The winning entry will be announced in February 2001.

Information technology innovations may include (but are not limited to):

- implementation of a course management system (that fits the criteria);
- development of flexible delivery within on-campus courses;
- use of IT to replace expensive experiments/experiences which are difficult to deliver for large numbers;
- use of IT/CD-ROM/CAL to enable students to undertake self-assessment; or
- development of teaching materials which are IT-based and which have made a significant impact on student learning.

Submissions can demonstrate single innovations or a series of linked innovations that have had a significant impact on the learning experience or learning outcomes of students.

Nominations

To nominate for the Science Teaching Award, simply download the Nomination Form (pdf file), print it, complete the requested information, attach to it your detailed submission (no longer than five pages), including abstract, aims, rationale, description of the innovation, outcomes and evaluation, and send it to UniServe Science. If the innovation involved the development of a piece of software do not include the software with the submission. Entries must be nominated by at least one peer.

Further details of criteria and conditions are available at http://science.uniserve.edu.au/about/award/.

Subscription Rates

UniServe Science is now offering academics an opportunity to receive personal copies of *UniServe Science News* and other UniServe Science publications by taking out a subscription.

Rates are as follows:

Australia	
1 year (3 issues)	$33.00 including GST
Overseas	
1 year (3 issues)	$45.00 including GST

Partial subscription fees will be pro rata.

Other publications are available at
$11.00 (Australia); or
$15.00 (overseas) per copy.

These include (subject to availability):

- Back issues of *UniServe Science News*;
- Issues of *CAL-laborate* (the international newsletter); and
- Proceedings of the national workshops.

Visit our web site for details on contents − http://science.uniserve.edu.au/pubs/ availability and subscription details − http://science.uniserve.edu.au/about/subscrip.html.

The Biology of Frogs

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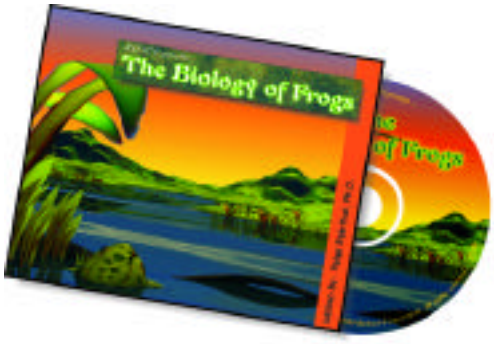
I was looking forward to reviewing this CD-ROM. I teach aspects of frog biology in several subjects, and am always eager to have a look at anything that may be useful as an instructional aid or as a supplement to my lectures and practicals.



Now that I've spent several hours working with it, my feelings are a bit mixed. I think it could be a useful supplement for high school or undergraduate tertiary teaching, but I'm not as enthusiastic as I had hoped that I might be.

First, a general description: the CD-ROM uses a combination of animations, text and audio clips to present information on frog biology. It covers the evolution of frogs (briefly), presents a moderate amount of detail on their anatomy and ecology, and spends some time on their conservation status. The information that is presented is mostly accurate and in an intelligible format. The level of the information seems to me to be variable. Some sections read as though they are aimed at school students, while others appear more oriented to first year or even more advanced tertiary students. The word 'read' in the previous sentence is important; although the reading is enlivened to a variable extent by animations and some interactive illustrations, students will not really learn a lot from this CD-ROM unless they read the detailed text that accompanies most sections. I think that one of the purposes of instructional multimedia should be to cause students to learn as much as possible without doing the equivalent of reading from a textbook; in this sense this CD-ROM was only moderately successful.

Some specifics about the program and its operation: it requires at least a Pentium 133, 32 Mb of memory, and an 800 x 600 x 256 colour display to run, and will certainly take advantage of faster processors and more available memory, but will not do anything with a larger screen. It can be installed on a hard drive, requiring 190 Mb of free space, or (a major plus) will run directly from the CD-ROM. All information is presented through a constant, if somewhat cluttered, interface. Text appears in a scrollable region at the left of the display; graphics, animations and some additional text appear in a large region at the centre. A series of navigation buttons are at the bottom, and are labeled with their functions when active. Navigation instructions appear at the top right, and a tree diagram that can be used for navigation appears at the top. A 'G' button, also at the top, will activate the glossary when it is boldfaced. There is a large area at the lower right that, according to the introduction, is supposed to store and display detailed information related to the topic at hand, but rarely contains anything.

The opening sequence of the program sets the scene. There is a nice animation of a day at a pond as background, with scrolling text explaining that frogs are presently of particular concern as they are thought to be in decline. The text can be a bit hard to read, but is repeated in the scroll box at the left of the screen. When the animation finishes you are left looking at a blank screen and need to work out what to do next to continue. The option to bypass this sequence is presented when you open the program.

The next step is to click on 'Main menu' in the navigation area. The main menu appears bottom centre, with an animated croaking frog above it, and some (quite important) instructions about the screen layout and navigation in the text box. Unfortunately,

while looking at the main menu, the constant 'croaking' of the animated frog can become quite annoying, causing the user to skip carefully reading the navigation information, which will make some aspects of the layout more confusing than they need to be.

If the navigation information *is* read carefully, navigation is reasonably straightforward, and the program allows the user to work his or her way through a series of modules on the evolution, ecology, anatomy, and conservation of frogs, plus a self-evaluation model that quizzes on the knowledge gained in the other sections.

The evolution section is brief but provides most of the necessary background for a simple understanding of the origins of anurans. The ecology section was somewhat disappointing. It is in this section that many of the most fascinating aspects of frog biology were covered, and some of the coverage seemed rather thin. For instance, students are usually keenly interested in the wide variety of modes and methods of reproduction used by frogs. In this CD-ROM, the discussion of reproductive modes is very short, presenting only a fraction of the diversity that occurs. It has few illustrations, and lacks details for some of the examples that are given, e.g. the final example used just says 'One of the more fascinating egg deposition sites is where the females swallow the fertilized eggs ...' without naming the frogs (the gastric brooding frogs *Rheobatrachus* spp.) or providing any additional details (for example the fact that they live in fast-flowing mountain streams, which is likely to be one reason this mode evolved). The audiovisual material used was also disappointing. There are some animations, which are well done and illustrate basic points nicely, but no video footage of real frogs and very little audio of real frog calls (five North American *Rana* and one hylid), and relatively few photographs. Plenty of good audio and video of all aspects of frog reproduction and many aspects of ecology exists, and would have been a real addition to this section.

The anatomy section uses the capabilities of a multimedia presentation to better advantage. It presents a series of interactive animations illustrating the external anatomy and dissections of the musculature, skeleton, brain, and body cavity, with a reasonable level of information on the functions of the parts being illustrated. There were some places in which I would have liked more anuran-specific information, for example, the Anatomy; Head; Ear section misses out altogether the fact that frogs have an unusual system, the operculum-papilla amphibiorum complex, that receives and processes low frequency sounds picked up from the substrate, and the section on the eye mentions that there are four different types of photoreceptors, but fails to say what they do, thus leaving unanswered a common question, e.g. 'do frogs have colour vision?'

The section on conservation of frogs is well balanced, presenting the generally accepted picture that amphibian populations in many places are in decline, probably for a variety of reasons, combining local and global problems. As with other parts of the CD-ROM, the presentation could have been made more stimulating by the inclusion of more audiovisual material and a more dense linkage, for example adding some form of hypertextual links to relevant aspects of the ecology and anatomy sections when discussing threats that frogs are vulnerable to and why.

The self-evaluation section at the end is reasonably well-presented. It presents an extensive set of questions in a variety of formats, including multiple choice and fill-in-the-blanks, and provides immediate feedback and correct answers. Sometimes the feedback is provided as soon as the answer is complete, while at other times the user must click a button to receive it, but this section is certainly useful.

There is an extensive glossary that is available from any point in the CD-ROM, except the self-evaluation section. This system is helpful, but does suffer from a number of flaws and apparent bugs. Flaws included some extremely brief and possibly uninformative definitions. For example, in the section on

ecology, the text says 'The tadpole undergoes a dramatic **metamorphosis** into a very different adult form'. The word metamorphosis is highlighted, indicating that there is a glossary entry. Clicking on it in the hopes of finding out more about the topic will be a disappointment, though, as the glossary entry says 'metamorphosis – the transformation of a larva into an adult'. This does not add a great deal of information. It is also generally incorrect for anurans, in which the usual end product of metamorphosis is a juvenile, which is often behaviourally, ecologically, and to a greater or lesser extent morphologically distinct from the adult. Some other glossary definitions are self-referential, e.g. 'sacrum – a single sacral vertebrae (sic) with a thicker transverse process than those found in other trunk vertebrae ...'.

Another problem that a heavy glossary user would find frustrating is that once the glossary is called up, it remains in view until one of the navigation buttons is pressed – there's no way to recover the main illustration for the current topic. An apparent bug is that clicking on more than one glossary item on the last screen of a section causes the labels on the 'next' and 'last' navigation buttons to appear, but pressing either of these returns you to the start of the section.

In summary, although various aspects of this CD-ROM can be criticised, it does a competent job of presenting a summary of the basics of frog biology and conservation. A student who conscientiously follows through the package will learn a lot about these subjects, and although the presentation could have included many more media clips and internal links, it is certainly more exciting than reading the same material in a text. As a supplement for interested students, it may be a worthwhile investment.

The Biology of Frogs, Version 1.0, is written by P. Reinthal and published by RANACO.

(See page 23 for product information)

Discovering Science: Topics in Biology and Ecology and **Discovering Science: Topics in Biology and Geology**

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These two CD-ROMs provide students with an excellent collection of resources for obtaining a solid introduction into some of the key concepts in biology. Students are able to work independently, without supervision, and at their own pace. The degree to which students can interact with the material varies between the modules, however, it is generally excellent. The activities range from structured tutorials which introduce some important and difficult topics in biology, to analytical exercises, to directed practical activities involving field work, data collection, analysis and interpretation. Students can access 'Help' menus and glossaries at any time and are provided with ample opportunity to explore a wide range of additional resources. The CD-ROMs are easy to use and the instructions for each module are excellent, with a few minor exceptions.

Discovering Science: Topics in Biology and Ecology contains two modules:

- Ecological chains: finding the links (suggested study time 300 minutes) introduces students to some of the fundamental ideas of ecosystem ecology. The ecology of a temperate woodland dominated by oak trees is used as a model for students to explore the concepts of food chains, food webs and energy flow through ecosystems; and
- Galapagos: adaptation and evolution on islands (suggested study time 120 minutes) provides students with the opportunity to

explore the diversity of plants and animals found on the Galapagos Islands with the view to introducing the concepts of adaptation, evolution and speciation.

The Ecological chains module is excellent and the level of interactivity ensures the student's attention is maintained. Students explore various aspects of the woodland natural history before embarking upon an analysis of a typical food chain and energy which requires the use of a range of analytical skills. Many students find the numerical components of biology and ecology particularly difficult and I believe this module is likely to provide a valuable learning opportunity for many of these students.

In the Galapagos module students are introduced to the basic principles of evolution, adaptation and speciation by undertaking an exploration of the Galapagos Islands. This module is also very good, however, the level of interactivity is more basic than that required by the Ecological chains module, and thus the quality of the learning is unlikely to be as high. The interactivity sometimes just involves students completing a series of multiple choice exercises. Other activities involve students matching items correctly, for example, matching finch beak types with various food items and feeding mechanisms. This module has several annoying features which detract from the overall quality of the module. It is not possible to skip the introductory sections of the activity. This is particularly annoying when you are returning to the module to complete more advanced sections. In addition, there are times when insufficient information is provided to make informed decisions which leads to simply guessing answers.

Discovering Science: Topics in Biology and Geology includes four biology activities and three geology topics. Only the biology topics are included in this review. They are:

- The Holly leaf miner module (suggested study time 150 minutes) involves students undertaking a field investigation of the sources of mortality to the holly by its leaf miner.
- The Cells and energy module (suggested study time 90 minutes) enables students to review the structure and function of cellular organelles and investigate the processes of respiration and photosynthesis.
- In the Mitosis, meiosis and recombination module (suggested study time 105 minutes) students are introduced to these processes.
- The Galapagos: adaptation and evolution on islands module (suggested study time 120 minutes) provides students with the opportunity to explore the diversity of plants and animals found on the Galapagos Islands with the view to introducing the concepts of adaptation, evolution and speciation. This is the same module as reviewed above for *Discovering Science: Topics in Biology and Ecology*.

The Holly leaf miner module is excellent. However, its use to an Australian audience may be limited because of the taxonomic specificity of this activity. Students, after being introduced to this system, are guided through a field study involving data collection analysis and presentation of the mortality factors of holly resulting from herbivory by its leaf miner. The structure of the numerical activities is excellent and likely to be of great benefit to students who perceive numerical activities as difficult. The interactive resources provided are interesting and extensive but specific to this system.

Cells and energy is an advanced module, probably beyond the level of most introductory biology subjects. This module begins with a quick review of the structure and function of cell organelles. Students then undertake a series of activities to familiarise themselves with the pathway of glucose oxidation and the reactions of photosynthesis. The cellular and subcellular animations are fabulous and the level of interactivity is excellent.

Mitosis, meiosis and recombination is one of the best multimedia resources that I have encountered for enhancing students' learning of the key phases and events of mitosis, meiosis and recombination. After viewing videos and animations students are provided with the opportunity to direct a cell through these processes. Useful feedback is provided throughout the activity.

Overall, I believe these two packages are excellent teaching and learning resources that would complement any introductory biology programme.

(See page 23 for product information)

Discovering Science: Topics in Earth Sciences – Two

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This package is a CD-ROM from the Open University Discovering Science Course, covering their *Topics in Earth Sciences – Two*. It mainly deals with marine geological themes, in particular: plate tectonic motion, sea floor spreading, mid-ocean ridges and earthquake wave motion. It is an interactive CD-ROM suitable for use on PCs running *Windows* 3.1/95 and higher (as tested). It requires installation to your hard drive and 5.5 Mb of space. I reviewed it on a Dell Precision Workstation running *Windows NT* with 128 Mb of RAM, a 650 MHz processor and a 48X CD-ROM RW drive.

The program as tested on my computer installed easily, and ran well throughout. The only problem I encountered was occasional sound bites which did not finish or missed short segments. The content consists of eight modules which are suitable for teaching introductory marine geology themes to first year students in an earth science course. The material could be used as laboratory exercises, or as stand alone exercises for students to explore themselves. This review was conducted only on a single CD-ROM which is part of at least a seven CD-ROM course in Science with two CD-ROMs in Earth Science. As a complete course in introductory earth science, these CD-ROMs would not cover it however they would be most useful in supplementing individual sections of a course.

The CD-ROM consists of five main, separate modules. These are:

- Journey to the centre of the Earth (an interactive exercise using four types of wave motion to infer the properties of the crust, mantle and core);
- Exploring the mid-Atlantic Ridge (an interactive exercise based around piloting a submersible to two ridge sites and exploring a range of features found there);
- Rates of sea-floor spreading (calculating ridge spreading rates from magnetic anomalies);
- Plate tectonics on a sphere (spherical geometry as applied to plates on the earth); and
- Plate motion in the past and the future (simulations of past and present plate distributions and real time motion of plates from –400 Ma to +100 Ma).

The material contained on the CD-ROM was accurate and up-to-date. The best features were clearly the interactive graphics, simulations and video clips. For example, there were excellent videos of black smokers in action, submersibles at the mid ocean ridge, motions of plates at scales of hundreds of millions of years and the specific motion of P, S, Love and Raleigh waves. Most instructive!

There are also extensive questions and answers and many exercises to create graphs of sea-floor spreading, wave motion, etc. In short, I would highly recommend this CD-ROM chiefly for its contribution in graphically illustrating some marine geological features in a very clear and innovative way. The content is standard introductory earth science as covered in most texts, but the quality of illustration and student interaction is first rate.

(See page 23 for product information)

Engineering added to the discipline list

Due to the increasing overlap between engineering and some of the science disciplines, engineering has been added to the list of disciplines supported by UniServe Science. The first review of a piece of engineering software appears in this newsletter (see page 22). The engineering discipline pages can be accessed at http://science.uniserve.edu.au/disc/eng/. Please make your engineering colleagues aware of this service and encourage them to contribute to the resource.

Introduction to Statistics

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[*UniServe Science News* Vol. 15 contained a review of *Introduction to Statistics* by Julie Hansen, Queensland University of Technology. This second review highlights different aspects of this well received package.]

The CD-ROM software, and the three accompanying texts, are suitable for the statistics and design components of a first year psychology program. The three texts (Units 1, 2 and 3) would stand alone, and Units 1 and 3 appear to have done so as British Psychological Society Open Learning Units since 1994 when they were published. The CD-ROM is a very worthwhile addition which complements these texts.

In general the CD-ROM makes good use of sound (including speech) and graphics (still and animated) to bring the subject to life. There is an obvious attempt to use data collected in situations that might interest young people (e.g. dancing and car racing).

Installation was not entirely straightforward. Installation instructions should probably be at the beginning of the user notes rather than on page 14. Complicated procedures for networks and multiple users could occupy later pages of the user notes.

Navigation was generally very good. The 'see again' option in the demonstration was extremely valuable, as was the ease with which the user could exit at any time. The word 'next' was confusing at times because it appeared on the left (back) and right (forward) arrows, in a manner not easily predictable. However, the page number between these arrows (and the option to type in a page number to go to that page) was very useful.

I didn't read all of the texts but the CD-ROM content was clear and accurate. I was surprised to see a related (or matched samples) *t* test also called a one-sample *t* test. Though a set of difference scores can be considered a single sample whose mean is compared with an expected zero, the data can still come from two samples and all other authors I know of classify the test accordingly as a two-sample test.

Section 8 (Necessary Skills) was excellent but might have been better placed at the beginning than the end since it covers a lot of basics. Students could be given the option to skip it, or better still, to take a short test to assess whether they need to refresh some skills.

In summary, except for some minor opportunities for improvement, I found this CD-ROM to be a pleasure to review and I would expect most students to find it a most welcome addition to the texts it accompanies.

(See page 23 for product information)

Engineering Dynamics

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Monash University terry.berreen@eng.monash.edu.au

This interactive CD-ROM has 43 problem frames in Engineering Dynamics covering particle motion, rigid body motion and vibrations. The problem frames are spread over ten sub-topics with up to seven problems in each. It is easy to navigate via a convenient grid on the right and bottom of the screen to any sub-topic and to any problem.

Each problem contains an introduction, theory, solution and simulation. The introduction describes what is known and then poses the question to be solved. Help is given to the user by suggesting an approach or

approaches to solving the problem. The theory section describes definitions and concepts. If more than one theory frame is required this is clearly indicated. The solution details the equations and method of solving the problem. In any of these sections audio is included and this was non-intrusive and in fact quite informative and authoritative. In some sections the diagrams change in conjunction with the audio.

The simulations make use of *Working Model*, a modelling tool that is widely used in engineering schools in the United States and can be used to create models of mechanical systems. These simulations show a working model and the plotting of the solutions. Parameters can be varied and the simulations run to determine the effects of parameter variation. Each problem would take some running and re-running, as initially it is difficult to watch the model behaviour and the plotting at the same time. However with experience at using the simulations this can be achieved. Anyway there is a button to stop and then restart the simulation at any time.

The simulations are excellent and these virtual experiments should certainly improve understanding of the underlying concepts. The problems are real life situations and should certainly appeal to students and teachers.

There are four appendices that can be pulled down at any time to aid in the problem solution. These are Basic Equations in Dynamics, Section Properties (that has the best moment of inertia and moment of area interactive tabulation, containing 20 shapes, that I have experienced), Conversion Factors, and Fundamental Topics in Mathematics.

There is also a book button, which allows the reader to select from eight textbooks on dynamics with cross-references to the problems in the interactive program. Commonly used textbooks in engineering dynamics such as Meriam-Kraige, Beer and Johnston, and Hibler are included.

This is a most useful interactive series of problems. The simulations and overall structure are excellent. The only criticism and a familiar one with technical material from the United States is the use of British units in about half of the problems. This could be partly overcome with the use of the Conversion Factors Appendix but the use of slugs for mass and force in pounds would be most confusing to Australian students so versed in SI units. This difficulty spoils for the Australian market an otherwise excellent interactive CD-ROM in Engineering Dynamics. Because of this its use may be restricted to teachers for use as lecture demonstration material.

(See below for product information)

Product Information

The Biology of Frogs is available from
Lynn Huggins
RANACO
Tucson, AZ
USA
Email: lhuggins@deltabio.com

Discovering Science: Topics in Earth Sciences – Two, Discovering Science: Topics in Biology and Ecology and *Discovering Science: Topics in Biology and Geology* are available from
Educational Media Australia
214 Park St
South Melbourne Vic 3205
Tel: (613) 9699 7144

Engineering Dynamics is available from
Pearson Education Australia
Unit 4 Level 2
14 Aquatic Drive
Frenchs Forest NSW 2086
Tel: (612) 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

Web*Byte* No 13

A Virtual Learning Environment for first year biology students

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Whilst teaching budgets are falling and student numbers are rising those of us responsible for the provision of appropriate quality learning experiences for large numbers of students have been looking at alternative strategies to fulfil the expectations of both the students and the administration. In First Year Biology we have been working on the development of a Virtual Learning Environment (VLE) which offers both access to various learning materials and communication with other students and staff. In an attempt to offer them a greater flexibility in the learning environment our Virtual Resources Room (VRR) originally launched in 1997 (Web*Byte* No 1) has been remodelled and enlarged to offer the students more materials and functionality, with a new focus on individual units of study. The rationale for changing the VRR was based both on student interviews, group discussions and a perception that the VRR had become overcrowded and had outlived its usefulness. In particular we needed to consider the various requirements of our large heterogeneous group with varying incoming academic backgrounds and interests. It was perceived that we needed to offer students specific information about each unit of study to give a better sense of continuity and direction but without losing the functionality of the original VRR. The design of the VLE uses a building metaphor, the building representing the School of Biological Sciences. Students enter the building and take the lift to any of three levels, representing the three years of undergraduate study (this section is currently under development). Our first year students proceed to the Level 1 Lobby and are presented with access to general materials and help functions. Within the lobby there is a notice board with the names and email addresses of staff, a coffee table with general information, and access to CyberAdmin and CyberTech, for answers to general questions of an administrative or technical nature. From the lobby the building metaphor is continued, enabling students to enter various rooms, each room representing either a unit of study in first year biology, the Resource Centre or other areas within the University, such as the University Library (Fisher Library catalogues). In this way the students are directed to focus their attention on the materials, communication functions, and discussion forums that are necessary for the specific unit of study without being presented with all the materials available in the Resource Centre. There are doors out to lecture theatres (lecture notes) and a seminar room (web-based discussions). On the wall a notice board provides the current notices. CyberTutor appears here and is available to discuss biological content, with CyberAdmin and CyberTech also available for consultations. Learning materials are available from computers (tutorials, revision modules, remedial materials and self-assessment modules) and there is a desk at which students can access tests (answers to weekly self-test questions from the laboratory notes) and examinations (a mid course practice examination and sample examination questions).

In summary, we have created a more usable resource for our students and with the flexibility for expansion in the future. Levels 2 and 3 have yet to be developed along with the entry into the building, with links to the rest of the University including specific links to all of the student services, the Union, and health services. When complete we will suggest a way in which the Faculty of Science could develop a teaching site for all its undergraduate units of study, using the biology development as the model.

The Virtual Learning Environment web site can be visited at http://fybio.bio.usyd.edu.au/vle/L1/.

The Effect of Signal Multipath on the Global Positioning System

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Introduction

The Global Positioning System (GPS) is widely used for navigation and timing applications throughout the world. The satellite-based system was developed by the United States Department of Defense for military applications, however non-military use now dominates. The surveying and mapping profession has been quick to adopt GPS technology. GPS techniques are often faster and more cost effective than conventional techniques and in many cases more accurate. GPS theory and techniques are currently delivered within the Department of Land Information, RMIT, for undergraduate and postgraduate programs. Traditional lectures covering theory and practical exercises are run throughout the year and at an intensive field camp to reinforce GPS concepts and techniques.

Students and professionals using GPS techniques need to have an understanding of the capabilities and limitations of the system. There are a variety of factors that influence the accuracy attainable with GPS. One of the most significant and difficult error sources to model is termed 'signal multipath'. Multipath is caused by satellite signal reflection and diffraction from nearby and overhead objects. Another important consideration is satellite geometry, that is, the relative location of satellites overhead. Multipath and satellite geometry varies with both time and location and therefore it is difficult to provide students with strict rules on how both factors will affect estimated position. A practical exercise, where the students acquire actual satellite data and analyse a limited data set has been introduced to aid this understanding. However, due to expensive equipment, software costs, large student groups, limited time and staff resources, it is not feasible to conduct an experiment that reveals the necessary information.

A virtual package

To address these issues, a web-based package, which incorporates a *predict-observe-explain* paradigm, was developed to enable students to discover the effects of multipath and satellite geometry on GPS in Australian environments (see Figure 1). The package focuses on a GPS project, where the user of the package is asked to provide guidance on the positioning aspects of a freeway construction.

GPS is used at four of the sites on the project:

- bush;
- built-up;
- clear; and
- water.

Each site presents different satellite tracking scenarios and multipath environments. The entry point into each site provides some background material and a panoramic view of the surroundings (Figure 2). Experienced GPS users will normally take a look around a site before they start observing to assess the likely quality of the signals. The panoramas replace the need for physically visiting each site. All panoramas were constructed from a collage of digital photographs using *MacroMedia Director* software.

The flow through the package was carefully considered during the design phase. Access points for more detailed analysis tools appear in sequence, rather than all at once. This provides uninitiated users with a progression in their understanding of the concepts and minimises the need for external and internal help text. The challenge was to orchestrate flow and progression without making the package cumbersome for experienced users.

Figure 1. Entry point for the web-based package

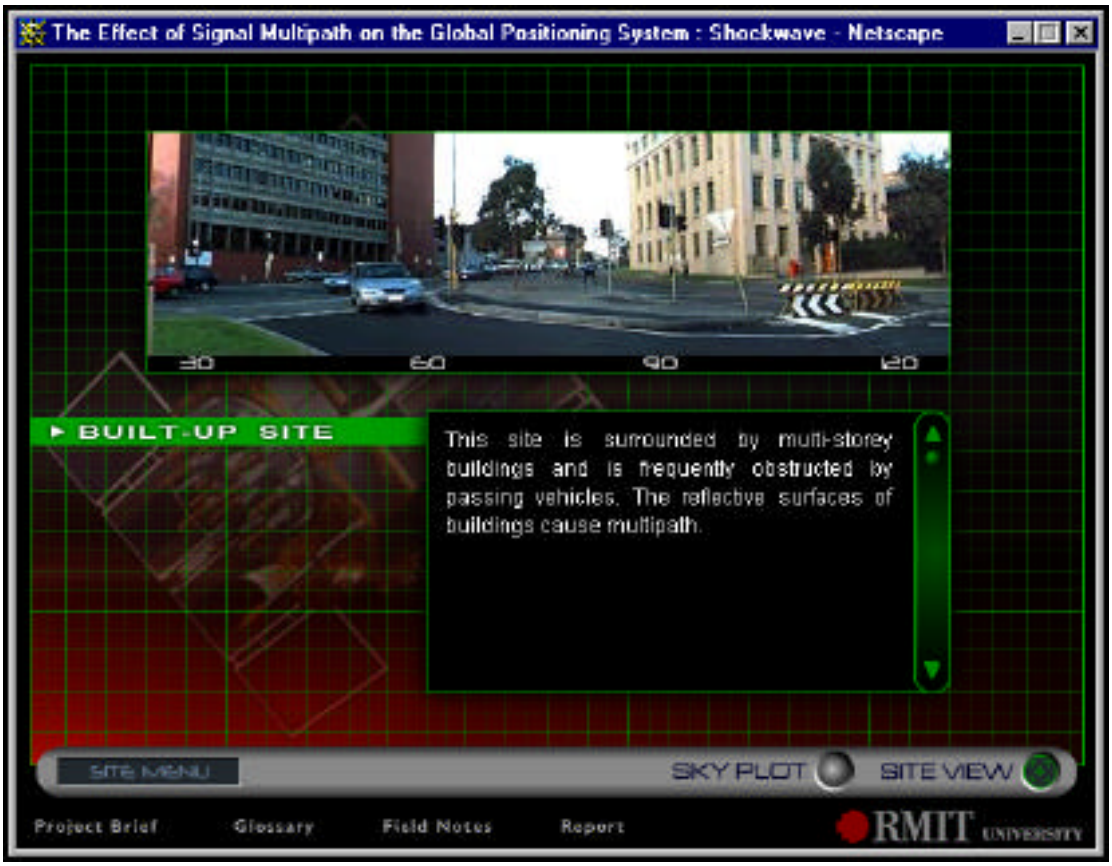

Figure 2. A moving panorama for the built-up site

The analysis

The quality of a GPS exercise is normally measured in terms of the accuracy of the results and the efficiency with which the data was obtained. Positioning accuracy is a temporal quantity with GPS. The 24 GPS satellites (currently 27 including three spares) orbit the earth every 12 hours and therefore the prevailing satellite geometry can change from being very good to very poor. The Position Dilution Of Precision (PDOP) is commonly used to assess satellite geometry. Generally the more satellites that are tracked at once, the stronger the geometry and the lower the PDOP. High PDOP (>7) indicates weak geometry and normally occurs when six or less satellites are in view.

In open areas, such as the *Clear Site* in the package, satellite geometry is the dominant factor in positioning accuracy. In *Built-Up* and *Bush* sites, signal multipath and attenuation degrade results.

Skyplots graph satellite location overhead and can also be used to show obstructions (see Figure 3). Graphs of east, north and height errors over time were generated from field data collected at each site. The combination of the skyplots and position errors are the focus of the analysis component of the package.

Users are asked specific questions about the relative quality of each site and the optimal time to observe at each site. The analysis view can be scrolled in time to help make the necessary judgements.

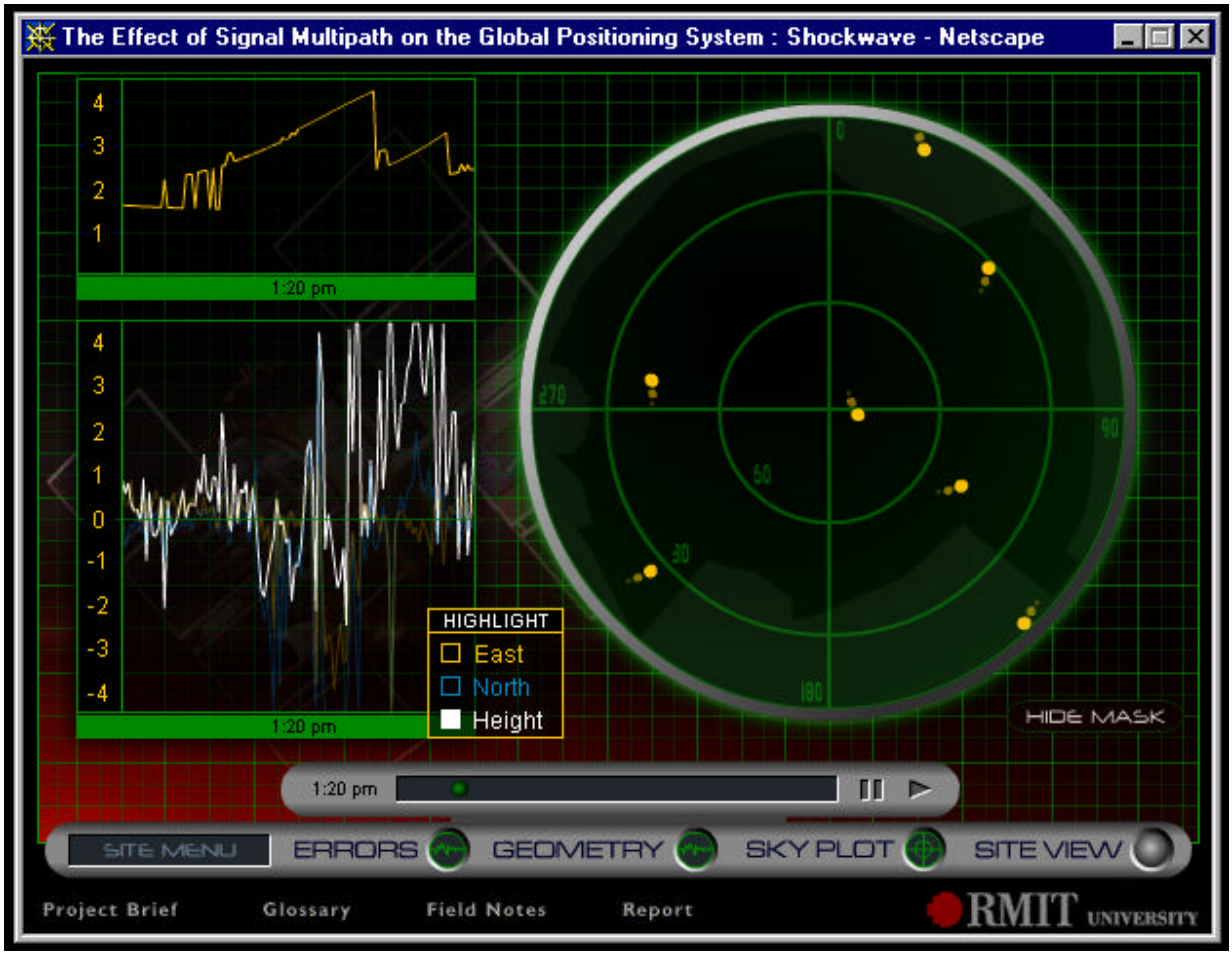

Figure 3. Analysis view of the built-up site

The report

The on-line report at the end of the package endeavours to stimulate the user to question the reasons for variation in accuracy at each site over time. This is designed to consolidate students' understanding of multipath effects with an emphasis on typical Australian environments. Answers and explanations are provided once the report is completed. The package has been aimed at both self-paced learning as well as laboratory-based practicals.

Student evaluation

A preliminary student evaluation of the package was conducted and the results are encouraging. After using the package for one hour, all students reported a deeper understanding of multipath, importance of site selection prior to GPS survey and the impact of satellite geometry on GPS positioning. A more detailed evaluation will be run over the second semester and will be reported late in 2000.

Conclusion

The Global Positioning System is an important tool for surveying, mapping and engineering professionals. Effective use of GPS for positioning applications only comes from a comprehensive understanding of the underlying error sources. Of particular importance is the effect of signal multipath and satellite geometry. The web-based package developed, takes users through a virtual tour of a variety of tracking environments. Site view, skyplot, position error and geometry graphs can be played and viewed over time to analyse the causes of errors. The interactive nature of the package is aimed at stimulating users to predict-observe and then explain the relationship between site environments, multipath and position accuracy. The package forms an important component of enhancing the professional judgement of surveying graduates on the use of GPS.

Development of a Web-based Learning System at the Institut Teknologi Bandung

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Realizing that most of our students experience difficulties in understanding basic sciences which are full of abstract concepts, Institut Teknologi Bandung has begun to look at the use of the Web in the process of learning. From the beginning we have tried to develop a prototype of a web-based learning package which was then uploaded to the Common First Year Program web site. We call it a prototype because this is our first experience in web-based learning.

One of the packages, which comes from the Department of Physics, discusses the properties of mechanical waves. The main purpose of the package is to show the students visualization of the properties of waves to support the lecture. These are not covered in the classroom, because there is not enough equipment, such as computers, projectors, film, etc.

The discussion begins with an explanation that there are two kinds of waves, these are electromagnetic waves and mechanical waves. Furthermore, mechanical waves consist of transverse and longitudinal waves, depending on the direction of oscillation of particles of the medium relative to the direction of propagation of the waves. Visualization of these waves clearly shows the direction of oscillation of particles of the medium, so that students can easily understand the difference between those waves.

Next, the package discusses the wave equation. Serious students may follow the derivation of the formula for propagation along a string, propagation in a rod, and propagation of sound in air. This discussion is followed by a representation of wave function as a solution of the wave equation. The package does not include the derivation of the wave function because it is discussed at length in the classroom.

Following the discussion on the wave equation and the wave function, the package represents one and two dimensional waves. Examples of those waves are a wave that propagates along an infinite string, a line wave that propagates on an unbounded membrane, a circular wave that propagates also on an unbounded membrane, and a surface wave on a very large pond. Students who want to know the form of the path followed by the particles of water can also find the derivation of the formula in the package.

While the above discussions and visualizations are limited to single waves that propagate along an unbounded medium, the subsequent discussion covers the superposition of two waves. This section is divided into two sub-sections. The first sub-section discusses superposition of two waves with a common plane of vibration. There are three visualizations in this discussion each followed by an explanation of the mechanism of wave superposition; superposition in general, standing waves and beats. The second sub-section discusses polarization, where the planes of vibration of the waves are perpendicular to each other. This sub-section also includes analysis of properties of the resulting wave. The visualization of polarization also includes projection on a plane perpendicular to the direction of propagation, so that students can easily understand what is meant by left or right polarized wave.

In the last discussion the package shows what happens when a wave propagates along a limited medium. For example, what happens if a wave propagates along a string and then comes to a junction with another string with different properties? or ultimately, what happens if a wave propagates along a string and then comes to the end of the string? There are two possibilities for the end of the string. It may be free, or it may be fixed. In the package each situation is analyzed mathematically and also shown in a visualization.

Each visualization in the package has been made as interactive as possible, and an easy to read explanation enables students to change the parameters of the wave or the medium and watch what happens to the wave. In this way we hope that students will enjoy physics more than before. The text in the package was written in *MS Word* and saved as HTML files, illustrations were made with *Corel Draw*, and visualizations were prepared with *Delphi* (Thank you Professor Ian Johnston for your suggestion to use *Delphi*).

GEOSKILLS: An Introduction to Spatial Data

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GEOSKILLS: An Introduction to Spatial Skills is suitable for use by those who need to be aware of: how maps are produced; the assumptions and errors that arise in creating models of the real world; how digital spatial data relate to the conventional printed map and how they differ; how Geographic Information Systems (GIS) and remote sensing may be used in inventorying and monitoring environmental data; and any application that involves knowing where things are. In other words, anyone who uses spatial data in analogue or digital format will benefit from using *GEOSKILLS*.

As *GEOSKILLS* provides a framework of the theory that underlies GIS and remote sensing, it is an invaluable tool for students. Although topics such as map projections have fallen out of favour, an understanding of them is essential in the era of digital maps. The change in the model being used to represent the Earth and the consequent changes in coordinate systems that are being implemented in Australia will result in differences in coordinates of over 200 metres. *GEOSKILLS* explains why the change is being implemented and illustrates in simple language, through diagrams and animations, the theory behind the change. Data Collection provides a brief overview of surveying, photogrammetry and global positioning systems.

In Cartography – Planimetry and The Third Dimension methods of creating maps are discussed in a way that will encourage students to look critically at maps before using them. Problems introduced through scale and its impact on the validity of techniques such as stream ordering, the construction on river profiles and cross sections for assessing intervisibility are covered.

Digital Maps explains the differences between the raster and vector models and the relationship between the spatial and attribute data. Some examples of how spatial data may be used in a GIS are illustrated.

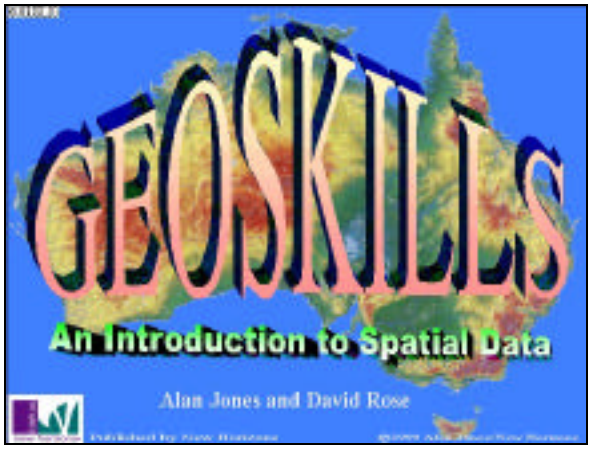

Figure 1. *GEOSKILLS* opening screen

Figure 2. *GEOSKILLS* main menu

Remote Sensing includes a basic introduction to the topic with sections on aerial photography and satellite remote sensing. The final section is a brief introduction to digital image processing.

Each section concludes with a screen summarising the key points that should have been learned. In addition to the usual forward and back arrows, a series of buttons indicate the progress through each section and these may be used to navigate to any topic within that section. Answers are provided for each exercise with students having a maximum of three attempts to provide the correct answer before being provided with the answer. Key terms are hot linked to a dictionary explaining their meaning.

The CD-ROM includes animations, interactive exercises and a workbook in *Adobe Acrobat* format.

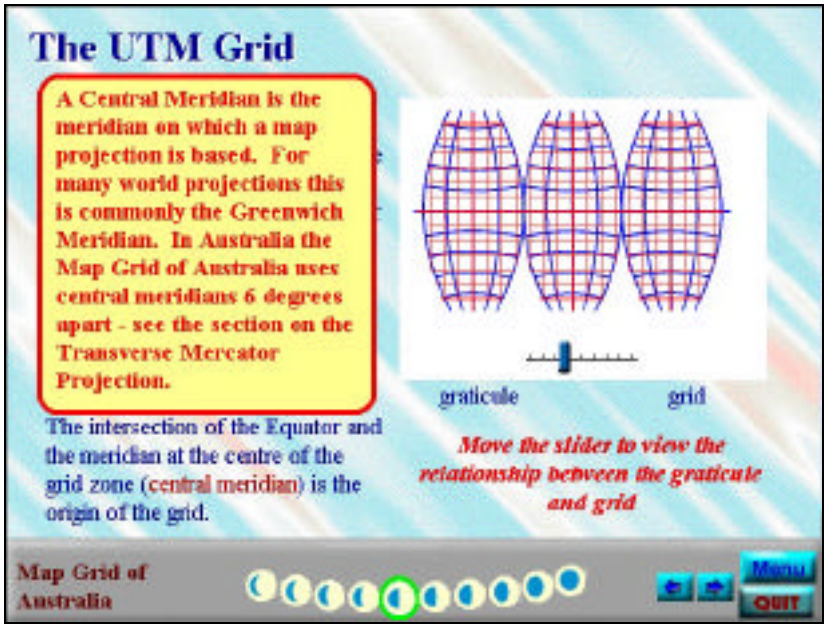

Figure 3. Sample screen

GEOSKILLS: An Introduction to Spatial Data is suitable for use on *Windows* or Macintosh platforms and requires a minimum screen configuration of 640 x 480 pixels with 16 bit colour. Systems with 256 colours may suffer some loss of quality and occasional colour distortion. At least 16 Mb of useable memory must be available – a minimum of 32 Mb of memory is advised. *GEOSKILLS* may be run directly from a CD-ROM reader and does not need to be loaded onto the hard disk.

Copies of *GEOSKILLS* may be obtained from: New Horizons, PO Box 658, Armidale, NSW 2350 (http://www.nh.com.au/). A sample of some of the *GEOSKILLS* modules may be found at http://www.une.edu.au/ajones/ajones.htm.

Publishing Houses

There are currently six major publishing houses which supply textbooks and reference materials for the Australian universities market. These publishing houses are increasingly supporting their popular titles with electronic resources and support materials. This a summary of the support available at present.

Harcourt Australia

- representing Saunders College Publishing, W.B. Saunders, Academic Press, Harcourt Brace, Holt, Rinehart and Winston and others
- supporting *WebCT* and *Blackboard*

Depending on title, the resources are distributed on CD-ROM/DVD, on-line, pdf files, chat rooms and discussion forums.

Science subjects supported are: biology; biochemistry; computer science; chemistry; geography; geology; physics; psychology; mathematics; and statistics.

A selection of titles that are supported by extensive multimedia/ technology components: *Interactive Biochemistry* (Garrett and Grisham) and *Chemistry and Chemical Reactivity* (Kotz).

http://www.harcourt.com.au/
service@harcourt.com.au

Pearson Education Australia

- representing Allyn & Bacon, Addison-Wesley, Benjamin/ Cummings, Longman and Prentice Hall
- supporting *WebCT*, *Blackboard* and *eCollege*

Depending on title, the resources are distributed on CD-ROM/DVD, on-line, pdf files, chat rooms and discussion forums.

Science subjects supported are: biology; biochemistry; computer science; chemistry; geography; geology; physics; psychology; mathematics; and statistics.

Some titles that are supported by extensive multimedia/technology components: *Biology* (Campbell); *Ecology: the experimental analysis of distribution and abundance* (Krebs); *Concepts of Genetics* (Klug); *Organic Chemistry* (Wade); *Earth Science* (Tarbuck and Lutgens); *Physics for Scientists and Engineers* (Giancoli); *Calculus* (Bradley and Smith); and *Microbiology* (Tortora).

http://www.pearsoned.com.au/
marketing@pearsoned.com.au

Nelson Thomson Learning

- representing Autodesk Press, Brooks/Cole, Course Technology, Wadsworth and more
- currently supporting *WebCT*, *Blackboard*, *MyCourse* and *CyberClass*

In general, the resources are distributed on CD-ROM/DVD or via a web page.

Science subjects supported are: biology; computer science; chemistry; geography; geology; physics; psychology; mathematics; and statistics.

A selection of outstanding and popular titles includes: the Brooks/Cole Resource Centers (http://www.brookscole.com/); *Online Journey Through Astronomy* (http://www.onlineastronomy.com/); and *Seeing Statistics* (McClelland) (http://www.seeingstatistics.com/).

http://www.thomsonlearning.com/
customerservice@nelson.com.au

Macmillan Publishers Australia Pty Ltd

- representing Macmillan Academic and Reference, Falmer Press, Psychology Press, Garland Publishing, Macmillan Press, Macmillan Reference, W.H. Freeman and Company, Worth Publishers, Inc. and others

Sciences covered include: chemistry; mathematics; physics; environmental and biological sciences; information technology; and psychology and include reference books, textbooks and other support material.

http://www.macmillan.com.au/
academic@macmillan.com.au

McGraw Hill Australia

- representing McGraw Hill
- supporting *WebCT* and *WebMCQ*

Titles that are supported with extensive multimedia/technology components are *Biology* (Knox), *Psychological Science: An Introduction* (Bond and McKonkey) and *Chemistry: The Molecular Nature of Matter and Change* (Silberberg).

http://www.mcgraw-hill.com.au/

John Wiley & Sons, Inc

- representing John Wiley and Sons
- supporting*WebCT* and *Wiley eGrade*

WebCT courses are available for: *Introduction to Electric Circuits* (Dorf); *Psychology: Mind, Brain, & Culture* (Westen); *Psychology In Action* (Huffman); *Physics* (Cutnell and Johnson); with other titles being available shortly.

An excellent example of web-based resources is the *GeoSystems Today: An Interactive Casebook* (http://www.wiley.com/college/ geocases/) which supports *The Blue Planet: An Introduction to Earth System Science* (Skinner).

http://www.jacwiley.com.au/college/
bcabot@wiley.com

Calendar of Coming Events

ALT-C 2000
Policy, Practice and Partnership
September 11 – 13, 2000, Manchester, UK
http://www.umist.ac.uk/alt-c2000/
Janet.Adnams@umist.ac.uk
Clive.Young@umist.ac.uk

35th APS Annual Conference
The Brain Games – The Meeting of Minds!
October 3 – 7, 2000, Canberra
http://www.psychsociety.com.au/news/fr_news.htm

EDUCAUSE 2000
Together We'll Think IT Through
October 10 – 13, 2000, Nashville, USA
http://www.educause.edu/conference/e2000/

Student Success in Online Learning
International Online Conference on Teaching Online in Higher Education
November 13 – 14, 2000
http://www.ipfw.edu/as/2000tohe/

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

Mapping Sciences Institute Australia National Conference
Spatial Business Beyond 2000 – Daring to Change
December 3 – 6, 2000, Sydney
http://www.promaco.com.au/conference/2000/msia/

IWALT 2000
International Workshop on Advanced Learning Technologies
December 4 – 6, 2000, Palmerston North, NZ
http://lttf.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/

AIP2000 Congress/OzCUPE5
Driving Technology Through Discovery, Understanding and Innovation
December 10 – 15, 2000, Adelaide
http://science.uniserve.edu.au/disc/phys/aippeg/

ComBio 2000
Australian Society for Biochemistry and Molecular Biology
December 11 – 14, 2000, Wellington, NZ
http://www.sct.gu.edu.au/ASBMB/ComBio2000.html

NZ Geographical Society and Institute of Australian Geographers: Joint Conference
2001 Geography, a Spatial Odyssey
January 29 – February 2, 2001, Dunedin, NZ
http://www.geography.otago.ac.nz/Geography/nzgs/nzgsotago.html
pam.quin@stonebow.otago.ac.nz

M/SET 2001
International Conference on Mathematics/Science Education and Technology
March 3 – 6, 2001, Orlando, Florida, USA
http://www.aace.org/conf/mset/
info@aace.org

CAL2001
Learning Across the Ages
April 2 – 4, 2001, Coventry, UK
http://www.elsevier.nl/homepage/sag/cal/
e.reed@elseveir.co.uk

CUMREC 2001
Heat Up the 21st Century
May 13 – 16, 2001, Phoenix, Arizona, USA
http://www.cumrec.com/cumrec2001/

Ed-Media 2001
World Conference on Educational Multimedia, Hypermedia and Telecommunications
June 25 – 30, 2001, Tampere, Finland
http://www.aace.org/conf/

NECC 2001
National Educational Computing Association
June 25 – 27, 2001, Chicago, USA
http://www.neccsite.org/

WCCE 2001
7th World Conference on Computers in Education
Networking the Learner
July 29 – August 3, 2001, Copenhagen, Denmark
http://www.wcce2001.dk/
wcce2001@sek.ddf.dk

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