UniServe
SCIENCE

NEWS

Vol. 13, July 1999

In this issue . . .

From the Director

UniServe Science News is now in its 13th issue. We have been publishing articles, reviews, and reports of interest to tertiary teachers of science for over four years. In that time we have printed over 50 articles, contributed by teaching academics from all the sciences, representing all Australian states and many countries. And we still get others willing to write for us.

It seems to us that this shows admirable commitment to the ideal of sharing knowledge and experience among the community of their peers. Writing an article takes time, and time is what academics in modern universities do not have much of. Furthermore, we all know that there is precious little in the way of reward for writing an article, *unless it is peer-reviewed*. It seems wrong to us that many of the articles that we have published, which we believe have been of high quality and certainly of use to others, should not have been able to be added to their authors' CVs. We believe the time has come for UniServe Science News to begin publishing reviewed articles.

Now the idea of publishing another technical, archival journal is not something that should be taken lightly. The physicist, David Mermin has argued, quite vehemently, that the scientific world does not need any more journals. There are far too many already, and the number of published papers that scientists are expected to produce has got to the silly stage. He is fond of saying that, if the journals keep increasing in size and number as they are now, library bookshelves will soon need to be expanding at the speed of light. But that's all right. The information contained in them does not move at this speed, because no one reads them anyway.

Facetious though those remarks may be, they contain more than a grain of good sense. Why start another journal with peer-reviewing and all the extra work it entails, if the articles can quite happily be published in this form somewhere else? Surely there already exist journals to which the authors could submit the articles they want to write?

Well, there are journals devoted to physics education, and to chemistry education, and biology, and psychology, and so on. But if you publish in them no one will read your article, except physicists, or chemists, or biologists, or psychologists, or whatever. There are journals devoted to science education which tend to have a very broad spread of interests, from the most theoretical to the most narrowly detailed, but only a very small fraction of their articles have the relatively restricted focus covered by the publication you are now reading. We genuinely believe that there is no other peer-reviewed journal, certainly not in Australia, which concentrates on the pedagogical and developmental aspects of IT in teaching, while at the same time addressing issues of interest across the sciences.

And so we have decided, with the concurrence of virtually everyone we have talked with, to start publishing, next year, articles that have been through a formal peer-review process. There is work to be done. It will take time to set up the appropriate reviewing and editorial panels. We will certainly let you all know when we are ready.

Next year, we will have to start charging for this journal. Up till now, we have sent out copies to each science department in the country – one for our contact to archive, and one or two copies to be put on public access. We have also made copies available to anyone that asks. In future we will have to ask people to pay. Exactly when this will happen, or how we will proceed, is not decided yet. We will probably continue to send one copy to each science department – although we are not nationally funded, we still feel a responsibility to the original vision of UniServe Science being a nation-wide service. For the many of you who have asked to be on our regular mail-out, we will set up a subscription mechanism.

If you have any comments or suggestions about any matters I have raised here, please contact me at idj@physics.usyd.edu.au. In the end, the way we will go will be the way that suits as many of you as we can accommodate.

Published by: UniServe Science, Carslaw Building (F07), The University of Sydney, NSW, 2006
Editor: Anne Fernandez
ISSN: 1329-7724 (print version)
ISSN: 1329-1645 (on-line version)

Flexible Teaching and Learning: Perspectives and Practices

Roy Lundin, Queensland University of Technology

A more detailed paper on this topic was presented by the author at the UniServe Science Workshop, "Tools for Flexible Learning", April, 1999 and appears in the Workshop Proceedings at http://science.uniserve.edu.au/pubs/procs/wshop4/

Roy Lundin
School of Professional Studies
Queensland University of Technology

r.lundin@qut.edu.au

Pressures

The 20th Century is closing with a build-up of pressures on every organisation whether it be industry or service oriented. These pressures may be listed as: economic (income versus expenditure); equity and social justice; technological; deregulation; improved productivity and quality assurance; and global competitiveness.

All universities face challenges with regard to these pressures and addressing them is crucial for survival in the competitive climate of today. This is particularly the case in the Pacific Rim area, including Asia, as well as the European Community, where countries are taking advantage of each others' learnings at an accelerated pace.

All of these pressures, of course, require universities to address ways in which undergraduate as well as continuing professional education programs are designed and delivered. Therefore, these pressures are as relevant to education and training providers as they are to commercial enterprises of all sizes. For example, due to deregulation of education and training, the growth in numbers of non-government private training providers is increasing exponentially in many countries. The challenge for all providers, whether they be internal to the organisation or external providers tendering for contracts, can be summed up as follows:

- to establish new corporatised operations as public (i.e. government tax-based) funding is withdrawn;
- to provide 'just-in-time' training;
- to deliver into the workplace or the home;
- to design programs which meet new quality standards;
- to customise training for the particular client, both in terms of the organisation and the individual learner;
- to enter into partnerships to ensure accreditation and articulation towards higher qualifications;
- to achieve economies of scale;
- to employ flexible delivery modes using a range of technologies; and
- to compete in the global market place.

According to Moore (1993), higher education is entering its 'third generation'. The first, which lasted for centuries, was based on bricks and mortar technology, and one received the award from a university based in a specific place – e.g. 'The University of Queensland'. The second generation, has been only partially place-free and has involved various forms of open learning universities and agencies using a range of distance delivery modes and technologies. The third generation, Moore explains as follows:

> Such restrictions are no longer necessary. With the development of the communications technologies of the 1990s – the electronic highways to our homes and workplaces – we are rapidly approaching technical readiness for the Virtual University, the third generation of higher distance education. (Moore, 1993, 4)

Characteristics and principles of open learning and flexible delivery

Without becoming too pedantic about the terminology, some indication of the various labels and how they are used should be addressed briefly. Over the years the evolution of the terminology has probably been indicative of the convergence of related concepts, for example:

- Correspondence education;
- External studies;
- Distance education;
- Distance learning;
- Open learning;
- Flexible delivery;
- Flexible learning;
- Flexible teaching and learning; and
- Distributed learning.

The term ‘open’ in reference to education and training has become widely used and, usually, distance learning and the use of technologies for flexible delivery are considered to be important components of an open learning approach.

All forms of flexible delivery for education and training should remain valid in an open learning approach. That is, the so-called ‘traditional’ face-to-face option where teachers and learners are in the same location, must continue to be available, particularly when there is a need for some form of special high level of interaction or use of rare or expensive resources. However, various forms of ‘face-to-face’ human interaction can now be effectively replicated through emerging communications and information technologies. Further, there are increasing examples in the literature of new, creative techniques and strategies for teaching and learning becoming available through these technologies which are not possible through a face-to-face approach.

Open learning, however, also implies flexibility in policies and delivery ‘on-campus’ as well as ‘off-campus’, and therefore the term is seen as a broad approach to increasing access and choice in learning. There is still some debate as to the applicability of an open learning approach in schools, but for university, college and industry training as well as all types of professional development, this approach facilitates flexible delivery to suit the work patterns and professional needs of adult learners.

The main issue, however, is that ‘flexible delivery’ implies a one-way direction from provider to learner. The interactive technologies, on the other hand, empower professionals to send as well as receive, and thereby initiate professional development networking that goes beyond the unidimensional implication of ‘delivery’. It is, therefore, necessary to re-look at the terminology and perhaps place the emphasis on ‘flexible teaching and learning’.

There are four major dimensions to flexible teaching and learning. Firstly, there is the flexibility that can be provided through a range of teaching and learning strategies, including various resource-based options, such as: lectures with tutorials, independent study, discussion/seminar groups, debates, computer based education, and many more. Secondly, flexibility may also be provided in the curriculum by permitting alternative pathways through modularisation of the content, allowing learners to choose the sequence and negotiate assessment. Thirdly, there can be flexibility in organisational arrangements such as summer schools, block programs, emersion programs, part-time evening programs, distance learning (off-campus) and mixed mode. Finally, the most difficult of all, is the provision of flexibility through the institution’s administrative policies and procedures, such as open entry and exit.

However, these ignore the major power shift being experienced in post-compulsory education and training. That is, the shift in power from the institutions to the learner. Whereas previously universities used to be able to dictate entry requirements, entry times, sequencing of curriculum components, content of curriculum components, timing and mode of delivery and assessment requirements, this is no longer possible in the deregulated educational marketplace. Learners can now choose from a range of providers and negotiate these elements of their learning. Such new demands from the 'clients' means that there needs to be increased flexibility in administrative procedures as well as curriculum content and delivery.

The result is that we are truly confronting a major paradigm shift for teaching and learning, and that many of the components of the new mainstream paradigm come from the distance/open learning tradition. This new paradigm is based on a new 'philosophy' of higher education which is inexorably linked to the applications of communication and information technologies.

In summary, flexible teaching and learning is an idealised state where there is a mixture of educational philosophy, pedagogical strategies, delivery modalities and administrative structures which allows for maximum choice for differences in student learning needs, styles and circumstances. It is characterised by:

- a shift in the emphasis of responsibility for learning from the teacher to the learner;
- the use of a range of teaching and learning strategies;
- the ability of the learner to negotiate various aspects of the learning program;
- flexibility within the curriculum to provide learners with alternative pathways through the content to suit learner needs;
- a range of delivery systems, including the use of communication and information technologies;
- flexible administrative procedures; and
- increased learner support systems, including guidance services, pre-packaged learning resources, library and information services and access to computer facilities, in the recognition that there are several sources of information and knowledge, especially on-line electronic sources.

There is no single model of flexible teaching and learning which can be superimposed on a particular university setting. Rather, a university may adopt as a principle a commitment to increasing flexibility for its clientele, and exhibit and develop a variety of manifestations of flexibility in practice.

The extent to which these forms of flexibility will apply in a given situation will depend on the needs of the learners, the nature of the subject and its objectives, the approach of the teacher and the feasibility of the various options. These four elements are considered further as a decision-making model later in this article.

National and international contexts

There are at least three major developments in higher education which require flexible approaches to teaching and learning:

- increased flexibility for students in terms of access to and progression through courses to move closer to meeting their needs, including delivery of courses to where they work and live;
- use of a range of technologies, but increasingly the Internet on-line, for delivery; and
- globalisation of markets and delivery.

Often referred to as the constructivist paradigm, the move by institutions to more flexible teaching and learning is being recognised as part of the shift to ensure learners' needs are met more adequately than they have been previously. These needs are often linked to **equity of access**, but the same shift has with it the potential to extend markets nationally and internationally. Coupled with shrinking funding and increased competition, the movement, in Westernised countries particularly, is accelerating. There now exists the possibility for people in Australia to enrol in university courses from overseas, for credit, which are delivered by satellite television or through the Internet. It is possible, for example, to undertake a Masters in Business Administration from Duke University in the USA through the Internet in 20 months for $US19,500. There are as yet no regulatory controls in Australia to cope with this type of 'educational invasion'.

Universities in Australia, however, have not been slow in recognising this potential for their own purposes. Open Learning Australia, for example, is moving into the Asian market-place using the ABC and its learning packages, and several of them already have courses on-line on the Internet. USQ, for example, has a Graduate Certificate in Distance Learning available internationally on the Internet.

The **use of communication and information technologies** in higher education has been a major aspect of change in the past 10 to 20 years. Whereas universities were using various single function technologies (e.g. audioconferencing, satellite television, electronic mail) during the 1980s, they are now moving to multimedia formats, such as CD-ROM, videoconferencing and on-line Internet, which itself is becoming increasingly 'interactive multimedia'.

Globalisation of delivery and markets is evident in the examples above. It will become less feasible, and perhaps less socially and politically desirable, for increasing numbers of overseas students to come to Australia to study on-campus. Universities in the USA, for example, are advancing their delivery directly into overseas countries or they are exporting their expertise to assist overseas universities in developing countries to become self sufficient.

Decision-Making Model

The choice of open learning/flexible delivery options should be based on four decision-making considerations:

Assess the needs of the participants/clients and practitioners:

- Personal needs: age, gender, abilities, learning styles, nature of employment and work patterns, home responsibilities, nature of isolation, other special personal needs;
- Professional needs: program relevance, experience and qualifications, present knowledge level;
- Access needs: location, distribution (geographic), disability, number of participants/practitioners; and
- Choice: types of programs/courses/services available, place, pace, time, timing, duration, individual or cohort preference.

Clarify the objectives of the program, nature of the processes and the relevance of the content:

- Interaction and participation needs: level and type of interaction required among the participants such as live (i.e. synchronous, immediate/real time) versus delayed (asynchronous) interaction, level and type of supervision required, number of participants/practitioners;
- Teaching/learning strategies most appropriate for the content and objectives; and
- Content demands: need for audio, need for visual component (e.g. still graphics, colour and motion), type of knowledge, skills and attitudes needed to be acquired and/or demonstrated.

Consider the choice and skills of the practitioners:

- Confidence and skills in particular mode of delivery;
- Program strategies chosen as most appropriate; and
- Support available.

Determine the feasibility of the program:

- Access to equipment and systems for production and delivery, by participants/practitioners;
- Costs and availability of funds;
- Local support for participants (e.g. local site co-ordinator, training in the use of the technology, learning centres, information); and
- Institutional support (e.g. library services, production services, administration services).

Future issues, trends and unanswered questions

Future predictions usually fall short of reality both in terms of actual developments and the pace of change. The major areas that will impact on flexible delivery of professional development are associated with:

- changing role of the provider;
- globalisation;
- deregulated climate for advanced education and telecommunications;
- compulsory continuing professional development;
- increased technological options; and
- virtual learning.

The changing role of the provider involves the way in which educational and training institutions organise themselves. There are evolving consortia at national and international levels, there is a very rapid increase in private providers, and learners are demanding increased flexibility in terms of who they contract with for various programs.

With regard to globalisation, in addition to institutional consortia, it is increasingly possible for providers to transmit both synchronous and asynchronous education/training programs anywhere in the world. The globalisation of the virtual university or the international virtual higher education market place has some exciting potential, but there are also several issues to be considered in putting it all together. Questions that may be asked include:

- How will learners determine the quality and authenticity of such programs?
- How will credit be obtained for subjects taken from another country?
- Who will the teaching staff belong to if they are teaching through another institution?
- Who will the students belong to?
- What are the regulatory and cultural implications of the globalisation of education?

At best, this globalisation will provided new opportunities and access where little or none previously existed; at worst it will result in educational invasion.

Due to the move to 'open learning' options in advanced education, the rise in private providers who are being encouraged, the corporatisation of government services, deregulation of telecommunications, cuts in government funding for education leading to a user pays system, and a general devolution of authority in education systems, we are entering a deregulated climate in which future developments are very difficult to predict. This type of catch-as-catch-can competitive environment may cause concern if it leads to lower quality of programs and a fragmentation of the curriculum for professions. Attempts to overcome this are evident in terms of the setting of national and international standards for learning outcomes, as well as requiring providers to become registered in the country in which they are operating.

Increased technological options, especially through the convergence of modes of communication onto the Internet, indicate that all of the above areas of development will expand exponentially. This, plus the increased miniaturisation of computer technology, the increased flexibility of computer use, the personalisation of communication contacts and the personalisation of search engines, will make it possible for adults to tap learning just-in-time from sources anywhere in the world to meet life and work needs as they arise. This type of virtual or 'feral' learning will not necessarily have any overall sequence or plan and educational institutions will be challenged in terms of learners fronting up for recognition of prior learning. The learner, whether professional adult or young child will be able to say: 'I am my school' or 'I am my university'.

Reference

Moore, M.G. (1993) Teleconferencing in the Theory and Practice of Transactional Distance. In *Distance Education for the Twenty-First Century: Conference Abstracts***.** Nonthaburi, Thailand: International Council for Distance Education.

UniServe Science PERSONNEL

Directors: Dr Mary Peat and Associate Professor Ian Johnston

Deputy Directors: Professor Robert G. Hewitt and Professor David J. Patterson

Educational technologists:

Anne Fernandez
Tel: (02) 9351 5783
PhySciCH@mail.usyd.edu.au

Kaye Placing
Tel: (02) 9351 2960
BioSciCH@mail.usyd.edu.au

Correspondence to: UniServe Science
Carslaw Building (F07)
The University of Sydney NSW 2006
Fax: (02) 9351 2175

Web site: http://science.uniserve.edu.au/

Weaving the Web into Learning and Teaching Statistics

Edwin Redfern, University of Leeds, UK

This article was published in the February 1999 issue of the CTI newsletter Maths&Stats and is re-printed here with permission from the publisher and author.

Edwin Redfern
Department of Statistics
University of Leeds, UK

edwin@amsta.leeds.ac.uk

Introduction

The Internet has in a short period of time developed into a widely used and versatile hypertext system which has the potential to be a valued addition to the facilities we have available for teaching statistics and a source through which students learn about statistics.

The TLTP program enabled the development of a large source of computer based learning materials. The STEPS project (Bowman et al 1998) was one that contributed to this resource base through the development of 37 standalone modules. Each was designed to introduce or revise a small set of statistical concepts through a problem. One of the problems not fully addressed up to now is how to integrate this material into a teaching environment. Another of these has been how to find time in a traditional course for the use of such material. Knowing that such software is freely available is only the first step. To fully exploit its potential each module needs to be explored, evaluated and its use built into a balanced teaching program. The different modes of learning such modules demand from the students suggest that this is not a formality.

The MEANS project (http://www.maths.nott.ac.uk/rsscse/means/means.html) among its findings emphasised the importance of a practical emphasis in the teaching of the statistics as it provides the source from which theory develops. It was also argued that there should be a more radical approach to assessment and the use of a wider range of techniques, ones that will be more in keeping with the stated aims and objectives of statistical education. This is especially relevant to transferable skills, e.g. communication and listening skills of the type associated with statistical consultancy, working in a team, etc.

This article explores one strategy for addressing some of these issues by describing a first year Joint Honours Statistics course at Leeds University designed around the STEPS material in which the web was used as the linking medium between Lectures, the STEPS modules, *MINITAB* and other material.

Uses of the web

The web can be used in many ways to assist both the teaching and learning of Statistics (see Figure 1).

As a means of storing material
Handouts, exercise sheets and solutions can be placed on the web as a useful backup resource for students. The amount of paper based information that is given to students can be reduced, with the added advantage that the material is always available without continual reference to the teaching staff.

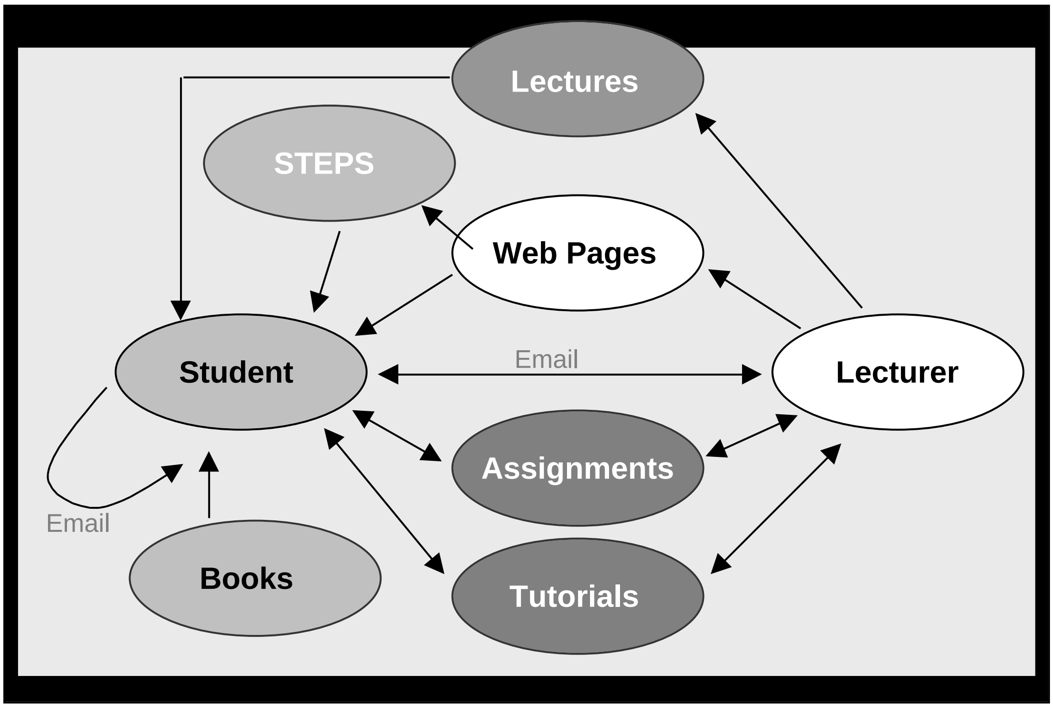

Figure 1. Ways in which the web can assist both the teaching and learning of Statistics

As a resource for material and information to support the lectures
Lectures are by nature limited in length and the students' needs vary depending on their natural abilities in understanding and developing a comprehension of ideas. The web can therefore be used as a source for further examples on the material covered and supplementary and alternative explanations of concepts. The STEPS glossary (http://www.stats.gla.ac.uk/steps/) is an example of a useful source of definitions.

As a source of explanatory material
Taking the above one stage further, fully exploiting the potential of hypertext and dynamic Java applets leads to the development of on-line texts. Good examples of this are Keith Dear's Surfstat (http://u2.newcastle.edu.au/surfstat/main/surfstat.html) and David Lane's Virtual Lab in Statistics (http://www.ruf.rice.edu/~lane/rvls.html).

As the hub around which a course revolves
If contact between teachers and students is reduced then the web can serve as the focal point of contact between members of the course. It can be easily updated to inform students of activities, deadlines and other issues related to the course as it progresses. It can provide links to interactive learning material, and can contain instructions for using a statistics package and supporting material. Lecture notes can also be made available as a useful backup resource for students allowing them to work through material again at their own pace.

Statistics through application

Statistics through application is a first year course at Leeds University. It is designed to explore and develop a more thorough understanding of some of the basic principles of statistics by using examples and case studies to place them in context. It does this by using some of the STEPS modules (Bowman et al 1998) to revise and extend ideas met in other courses. The use of the different modules is best described through a short summary of the assessment which was done through essays based on themes which can be explored by a range of different modules. These were:

Exploring data
Students are introduced at various stages of their introduction to statistics to some of the principles of exploring data. Frequency tables, histograms, mean and median are part of the National Curriculum. Box-plots are included in some A-levels. This range of tools is developed and extended in introductory

university courses to include stem and leaf plots, scatter plots and probability plots. To develop this theme, students are asked to work through at least three of the STEPS modules that explore this theme (Birds of a Feather I, Exploring a Pharmaceutical Company's Behaviour, Exploring a Pharmaceutical Company's Environment, Exploring Dyslexia, Rainfall [Numerical and Visual]). The choice is left to them and facilitates an extended range of subjects making the marking of the resulting essays a more enjoyable task. Having studied the material students are asked to reproduce the analyses in *MINITAB* and write a report describing the tools and techniques for exploring data, illustrated by examples from the modules.

Estimation, variability and decision making
The principles of hypothesis testing and estimation are covered in The Skinfold Thickness, Birds of a Feather II, Angina, Trials and Tribulations, Rats and IgE modules. These cover a range of issues such as confidence intervals, determination of sample size, estimation, transformations and hypothesis testing as appropriate to the specific problems being addressed. Access to the data for analysis in *MINITAB* together with macros for simulations associated with the specific problems and for plotting power against both sample size n for fixed standardised scientific error, and standardised scientific error for fixed sample size, was made available.

Earthquakes, plantain and traffic flow
Based around applications of the Poisson distribution this essay is based on the principles explored in the spatial patterns module and data available on the Internet about earthquakes.

An additional part of the course is group based learning. In this the students are formed into groups of 5 and work on an open-ended project. On completion they must submit a single report, a diary of meetings (summarising discussions, decisions and progress) and make a presentation to other class members. Assessment is based on all these aspects and also includes an element of peer assessment.

To free time for the open learning approach only 8 formal lectures were given. These included time for discussion of transferable skills such as report writing. This poses a problem due to the reduced amount of contact. This was overcome by setting up a web site (http://www.amsta.leeds.ac.uk/~edwin/m1830.htm) as the focus point for the course. This was used as a source of information and backup material, as a means of guiding the students on what they should be working on at any stage, and as a means of communicating messages to the students. The other key feature was that the STEPS modules could be launched from links on the web pages.

Construction of web material

This is now relatively easy to do and the problem can be addressed in several ways. Information prepared in *TEX*, *Word97*, *Excel97* and *PowerPoint97* can be easily converted into HTML code. In the case of *TEX* we use the *LATEX2HTML* converter developed by Drakos (visit http://www.cbl.leeds.ac.uk/nikos/personal.html) while all the programs in the *Microsoft Office* 97 suite include the option to save as HTML code. Like most automatic converters the code needs to be edited to enhance the display and tailor it to the users preferences, but a large part of the task is ready almost instantaneously. The code can be edited using the WYSIWYG editors available with *Netscape* and *Internet Explorer*, which make some of the tasks like setting up additional links very easy. Note that the final tweaking of the pages' appearance will need to be done by editing the HTML code.

Student reaction

The reaction of the students to this type of teaching was very positive. They particularly liked the freedom to organise their own learning. The access to the web site meant that information was there when required and could not be lost. The use of email meant that they felt freer to ask questions. They found that they had to work harder but most felt that they were learning more as they had to develop their own notes rather than simply record and work on information supplied in lectures. Surprisingly, perhaps, attendance did not drop off from the few lectures presented even towards the end of the course.

The STEPS modules were considered to be an interesting way of learning about statistical concepts, particularly the scope for seeing similar topics in different real situations. Asking the students to duplicate the results in *MINITAB* for inclusion in the essays reinforced the learning and the application of the ideas. The pages within the site giving guidance on doing this were considered to be useful and successfully avoided the need to spend time in lectures or practical sessions teaching how to use the package. It was consistently used in lectures to demonstrate the principles of data analysis and interpretation.

Structure of the site

The site was divided into three sections. There was the main course outline, statistical support material and a section on operational matters. The latter was intended to support the use of STEPS and *MINITAB* and provide information about and reminders of what was expected in each of the essays. It also contained details of groups, tutorial times and links to supporting material for the group project.

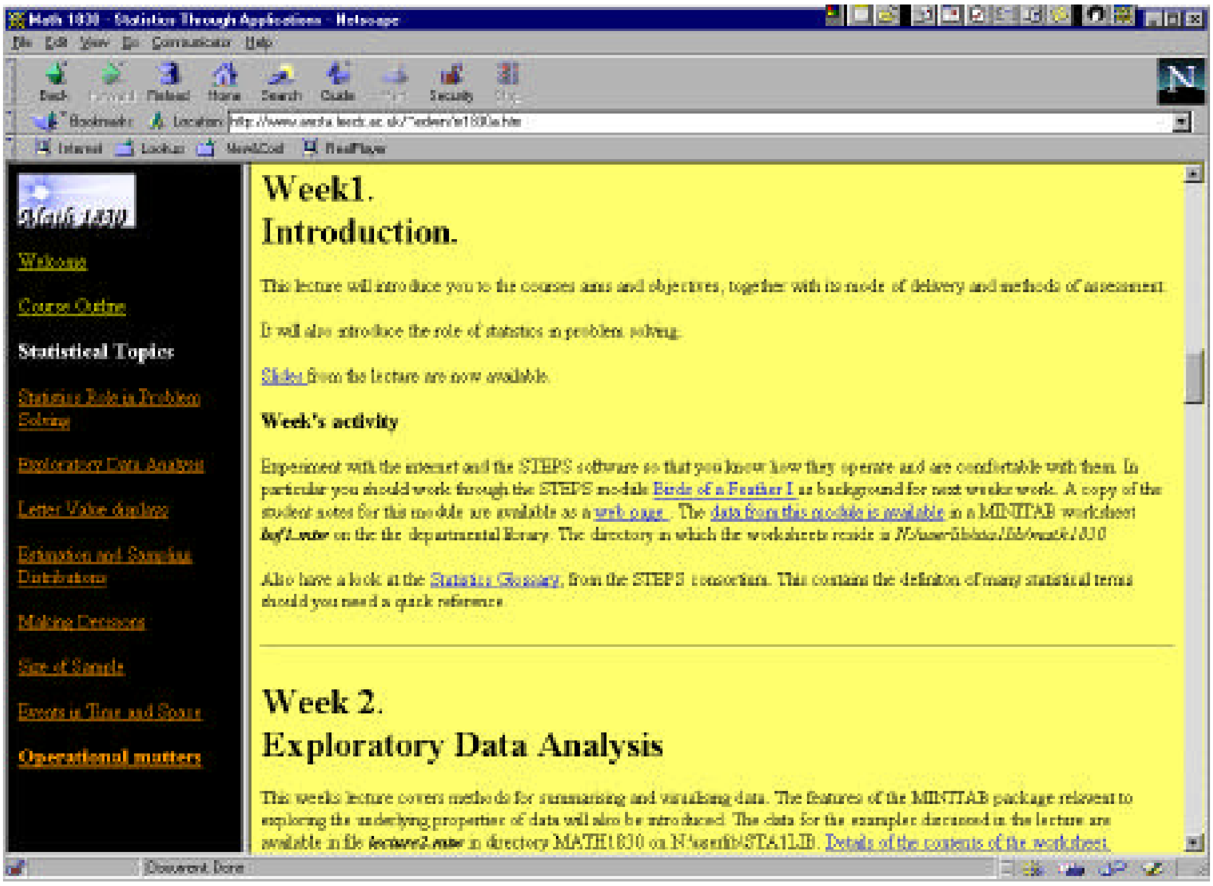

Figure 2. An example of the weekly student guide

The main feature of the site was the week by week guide to the students of what is expected of them. The example shown in Figure 2 is for the first week of the course. It includes the slides from the lecture, and links to the STEPS module Birds of a Feather I.

Students logged onto the network at Leeds can launch the module simply by clicking on the link on the page. The data from the module is also available to the students on the Leeds network and the description of the *MINITAB* worksheet is on one of the web pages. The Student notes for the STEPS module have been converted into a web page to which the students can also link.

There are several pages which give support for the use of *MINITAB*. Figure 3 shows the contents. These cover the relevant *MINITAB* menus, how to access the package and its operation and how to take information into *Word* for preparation of the report.

The layout was designed on the basis of frames so that the menu to the main options was always available on the left hand side. This had the further advantage that only the front page could be bookmarked ensuring that the students always passed the message page.

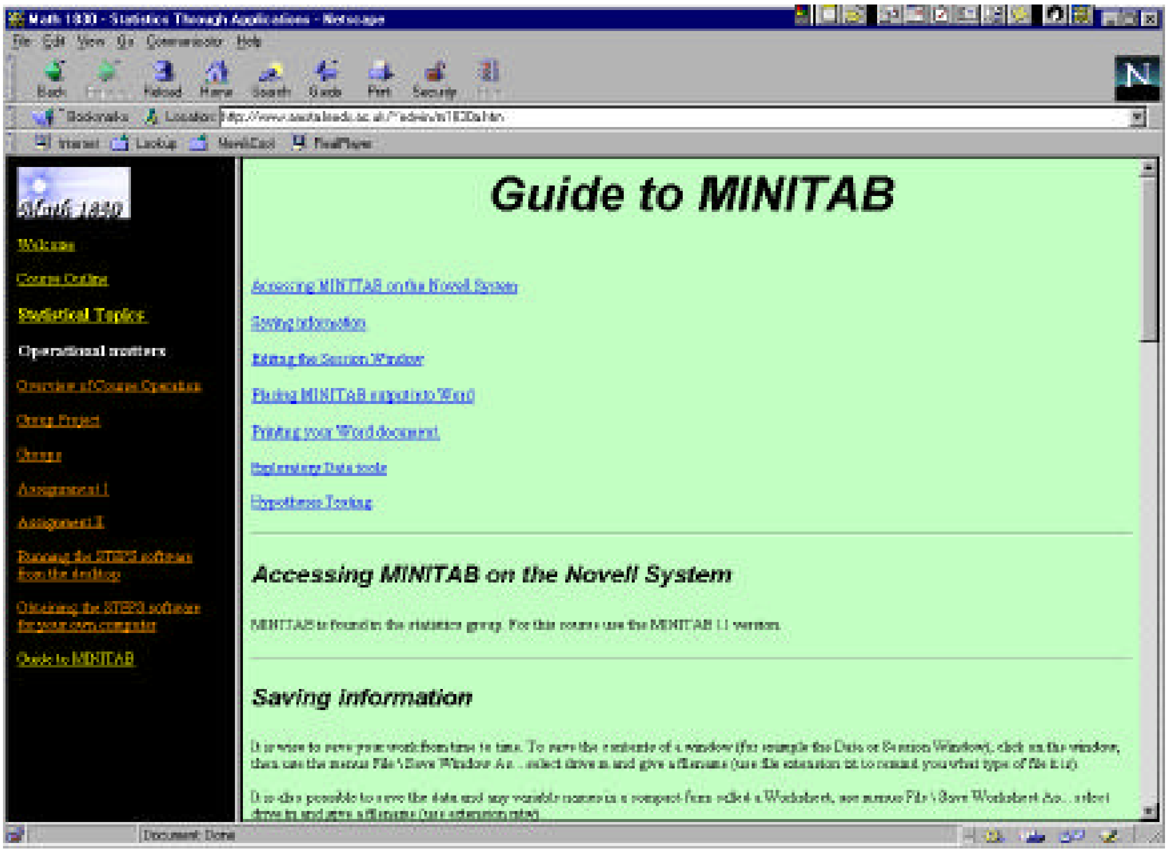

Figure 3. Facilities available in *MINITAB*

Students' learning benefits

The crucial issue is the benefits of using such a mode of teaching. There was clear evidence in the essays submitted that the students were learning not only about the statistical concepts but about how they were used in problem situations. It allowed students the freedom to express themselves and explore extended ideas related to the theme. Unlike an examination situation feedback was given on all work submitted which the students found extremely useful. In particular it allowed the possibility of correcting misunderstandings in fundamental concepts which is not usually possible following an examination.

Unexpected interesting features were the range of ideas discussed in essays resulting from many students feeling they could extend beyond the limitation of the material covered in the project. Several students also used the Internet to search for more material. An interesting example of this was the group that produced a novel analysis of sentence lengths using quality control methods based on a paper they had stumbled across on the Internet. The methods, which they had briefly been introduced to in an earlier course, were correctly applied and interpreted and the presentation included both an assessment of the paper they had found and a comparison with the more usual two sample tests the other groups covered. This willingness to explore had taken them beyond the scope of what was intended, but had been a valuable learning process to them.

Conclusions

Using the web as a pivotal medium for integrating computer based learning into an organised course has proved to be an interesting and beneficial exercise. It was largely well received although some students found the self-discipline required difficult. They also said that it required more effort on their part but it was usually rewarding and they felt that the learning process was good. This was supported by the evidence in their work. From the viewpoint of the lecturer it had the advantage of bringing one closer to the individual students, through regular email and personal contact. The amount of formal lecturing was reduced to less than 40% but was replaced by a different kind of support for the learning processes. It is clear that this form of teaching has many benefits for the students, however it does not produce large savings in teaching effort. It is however an interesting alternative adding to the variety in the learning experience. It is clearly not suitable for all courses to be delivered in this manner. Indeed there is a strong case for different modules within a course to be delivered in a range of styles appropriate to the content. There is, however, scope for some of the less comprehensive types of web use described above being of benefit to all courses as a support.

Reference

Bowman A., Gilmour W. H., Constable G., Davies N., Gilmour S. G. and Redfern E. J. (1998) Computer-based learning in statistics: a problem solving approach. *The Statistician* **47**, 349–364.

Web*Byte* No 6

Using Question Mark Perception for On-line Assessment

submitted by **Kevin Meehan**, Qmark Systems
Info@qmark.com.au

Question Mark Perception was used to create a three tier assessment program for The West Yorks Consortium for Industry Development (WYCID) program for on-line adult learning.

WYCID is one of the largest collaborative networks in the UK now working to create on-line materials for distance learning projects. Many of its courses are aimed at adult returners and supervisors wishing to improve promotion opportunities.

Learning materials were created using a combination of the latest Internet-based distance learning techniques and static data. Course participants are provided with CD-ROMs containing video and photographic materials which are referenced in the on-line course. This allowed for up-to-date course materials, on-line assessment, and rapid access to video material.

Question Mark Perception was used to administer course assessment in three ways. Firstly, it was used to create initial assessment, examining existing capabilities to determine at what level a student should enter the programme. Further assessment was and is used to check learning progress in order to tailor courses. Finally, *Perception* was used to conduct summative assessments through final examinations.

This project is aimed at widening education participation by changing the teaching medium. *Perception* and similar web tools are enabling this expansion into the community.

Congratulations

Congratulations to one of our departmental contacts, Dr Ove Hoegh-Guldberg, of the School of Biological Sciences, The University of Sydney. On May 4 at the Australian Museum, he was awarded The University of New South Wales Eureka Prize for scientific research. This prize, for “outstanding but under-appreciated, curiosity driven research done in Australia by an Australian scientist under 40”, was awarded for the first time this year, and Ove won it for his innovative work into the physiological basis of coral bleaching.

Article

Promoting Active Learning Using the Results of Physics Education Research

Priscilla Laws, Dickinson College, USA, David Sokoloff, University of Oregon, USA and Ronald Thornton, Tufts University, USA

Priscilla Laws
Department of Physics and Astronomy
Dickinson College
Carlisle PA 17013 USA

lawsp@dickinson.edu

David Sokoloff
Department of Physics
University of Oregon
Eugene OR 97403 USA

sokoloff@oregon.uoregon.edu

Ronald Thornton
Center for Science and Mathematics Teaching
Tufts University
Medford MA 02155 USA

csmt@tufts.edu

Introduction

On January 20–22, 1999 at The University of Sydney, and on January 27–29, 1999 at Swinburne University of Technology, we presented “Chautauqua” short courses on “Promoting Active Learning in Introductory Physics Courses”. This article outlines the rationale for these courses, and presents brief examples of activities from active learning physics curricula developed by the *Activity-Based Physics* group, of which the authors are members.

Are most students in physics courses acquiring a sound conceptual grasp of basic physics principles? Extensive studies of students’ basic conceptual knowledge before and after introductory college physics courses have convinced some in the larger community of physics teachers that they are not. The results of these studies show that students in selective universities, whether they be science majors or not, fail to use the same physical models as physicists when they answer the simplest conceptual questions. These same students are able to solve many traditional problems involving the solution of algebraic equations or even those requiring the methods of the calculus. Even so, they enter and leave the courses with basic misunderstandings about the physical world essentially intact. The ineffectiveness of these learning experiences seems to be independent of the apparent skill of the teacher, or whether students have taken physics courses in secondary school.

Consider traditional instruction in dynamics – force and motion – as an example of student conceptual learning in physics. Although a Newtonian framework is essential to understanding non-relativistic motion, it is common for more than 80% of students to answer most questions from a non-Newtonian point of view after an introductory physics course. Such students may believe, for example, that a net force is required to keep an object in motion at a constant velocity, that there is a residual force (impetus) on an object that has been pushed and released that keeps it moving, and that acceleration must increase as velocity increases. In contrast, those using a conceptual framework based on Newton’s laws of motion understand that a body moving at constant velocity requires no net force to keep it moving and so no residual forces are required. They also understand that a constant linear acceleration produces a uniformly increasing velocity. Research has shown that traditional instruction commonly changes the conceptual point of view of only 5% to 15% of the students.

Figure 1 shows the results of composite research data for thousands of students at US universities who took the *Force and Motion Conceptual Evaluation*[1]. Such results do not only apply to the US. For example, our research at The University of Sydney in Australia shows that entering students are better prepared than many students in the US, and more believe the Newtonian model before university instruction. However, good traditional university instruction again results in only an additional 10% of students adopting the Newtonian model for force and motion.

What is needed to change the state of physics education is agreement on a set of underlying principles about the teaching and learning of physics that will support the integration of the work of many different groups into a coherent educational response based on careful research.

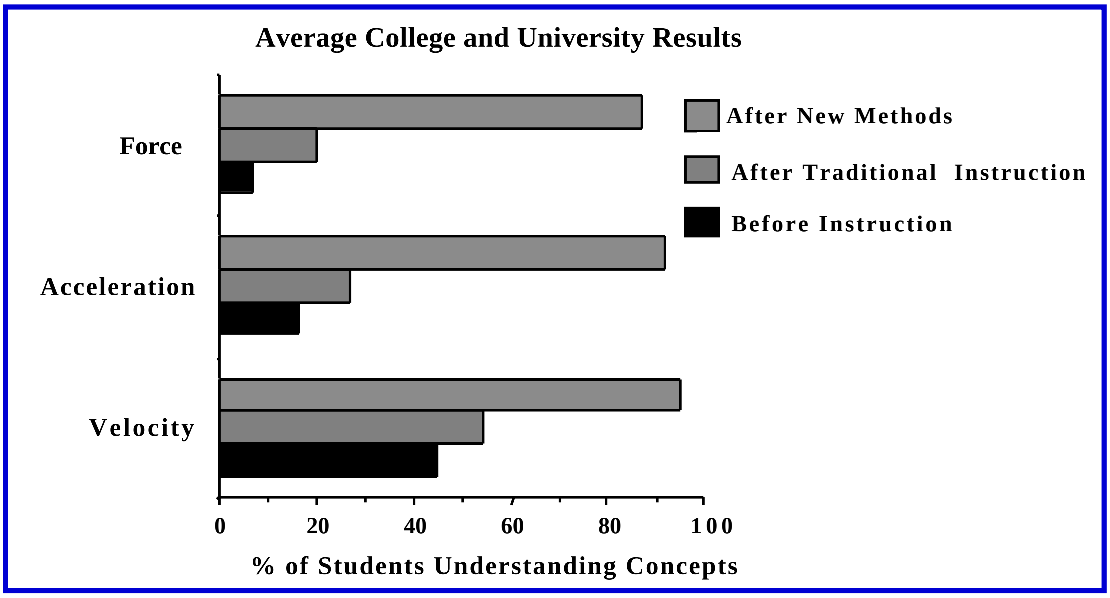

Figure 1. Composite assessment of US student understanding of kinematics (labeled **Velocity** and **Acceleration** concepts) and dynamics, as described by Newton's Laws (labeled **Force** concepts), using the *Force and Motion Conceptual Evaluation*. Dark bars show student understanding coming into beginning university courses, striped bars are after all traditional instruction. While the percentage of students who know concepts coming in can vary with the selectivity of the university, the effect of traditional instruction is to change the minds of only 5% to 15% of students. New methods described later in this paper result in up to 90% of students understanding concepts (lighter solid bars).

Principles for a new science pedagogy

Eleven physics education researchers from the US were assembled at Tufts University in 1992 to examine student learning in physics[2]. The researchers came to agreement on the following generalizations about student learning in physics and the inadequacies of traditional instruction:

- Facility in solving standard quantitative problems is not an adequate criterion for functional understanding.
- A coherent conceptual framework is not typically an outcome of traditional instruction. Rote use of formulas is common.
- Certain conceptual difficulties are not overcome by traditional instruction.
- Growth in reasoning ability does not usually result from traditional instruction.
- Connections among concepts, formal representations (algebraic, diagrammatic, graphical), and the real world are often lacking after traditional instruction.
- Teaching by telling is an ineffective mode of instruction for most students.

Each generalization is supported by research from different sources using different techniques. These include, for example, the results from student interviews by the Physics Education Group at the University of Washington[3], eliciting detailed accounts of understanding; the analysis carried out at the Center for Science and Mathematics Teaching at Tufts University on responses from thousands of students at many different institutions to research-based multiple choice and short answer questions that are part of the *Force and Motion Conceptual Evaluation*[1]; and the results on benchmark conceptual examinations designed by David Hestenes and his colleagues at Arizona State University[4]. It is difficult for physicists who look at the accumulating evidence to find justifications for continuing to teach in a traditional manner.

Most physics education researchers believe that students must be intellectually engaged and actively involved in their learning, and that traditional instruction is failing to provide this engagement. However, which methods of teaching and what learning contexts will help students learn most effectively? Can educational technology improve physics learning? Under what conditions does collaborative learning work well? What role should experimentation play in student learning?

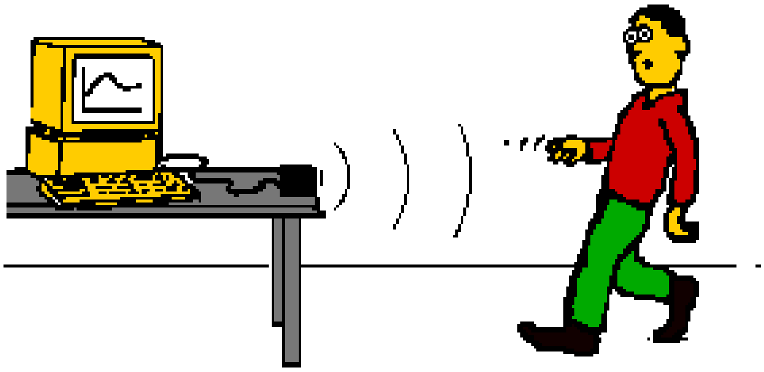

Figure 2. Student walking in front of an ultrasonic motion detector while his position is being graphed as he moves. The context and importance of this simple activity is described in the text.

Example of laboratory activities using the new pedagogy

Consider a simple activity that is included in three of the activity-based, computer-assisted, guided-inquiry curricula developed by members of the *Activity-Based Physics* group[5] – *Workshop Physics* [6,7], *RealTime Physics Mechanics*[8], and *Tools for Scientific Thinking Motion and Force*[9]. At the beginning of their study of motion, students first explore position, velocity and acceleration concepts using real-time graphs of body motions produced by walking in front of a “motion detector”. They generally work in groups of three, are required to make predictions of experimental outcomes, and are encouraged to discuss with other group members the graphs resulting from their movements. Students answer simple conceptual questions as they work that have them describe motion verbally, in standard written language, graphically, quantitatively, and in vector representations.

What effective practices for teaching physics does this example embody? In terms of general course structures we have found student learning is improved when we:

- use peer instruction and collaborative work;
- keep students actively involved by using activity-based guided-inquiry curricular materials;
- use a learning cycle beginning with predictions;
- emphasize conceptual understanding;
- let the physical world be the authority;
- evaluate student understanding;
- make appropriate use of technology – in this case graphs (an abstraction) are linked to actual physical motion, and also linked to the kinesthetic; and
- begin with the specific and move to the general.

Active learning activities in lectures

Small interactive groups working with computer-assisted data gathering are certainly not possible in all learning contexts. We have developed a method to change a classroom or a lecture hall with a single computer into a more active learning environment. The (computer-supported) *Interactive Lecture Demonstrations*[1,10,11,12] consist of a sequence of simple experiments (6 to 8 per session) based on research of the conceptual foundation needed to learn a particular topic area in physics. The computer is equipped with data logging software, an interface and appropriate MBL (microcomputer-based laboratory) probes. For force and motion, we might use a force probe and a motion detector with low-friction carts to explore the result of various forces on the carts' motion. To examine the interaction forces in a collision between two objects, we would use two force probes. Figure 3 shows such an arrangement. An experiment in which one cart is much heavier than another is part of the Newton's Third Law *Interactive Lecture Demonstration* sequence. The actual results from such a collision are shown in Figure 4.

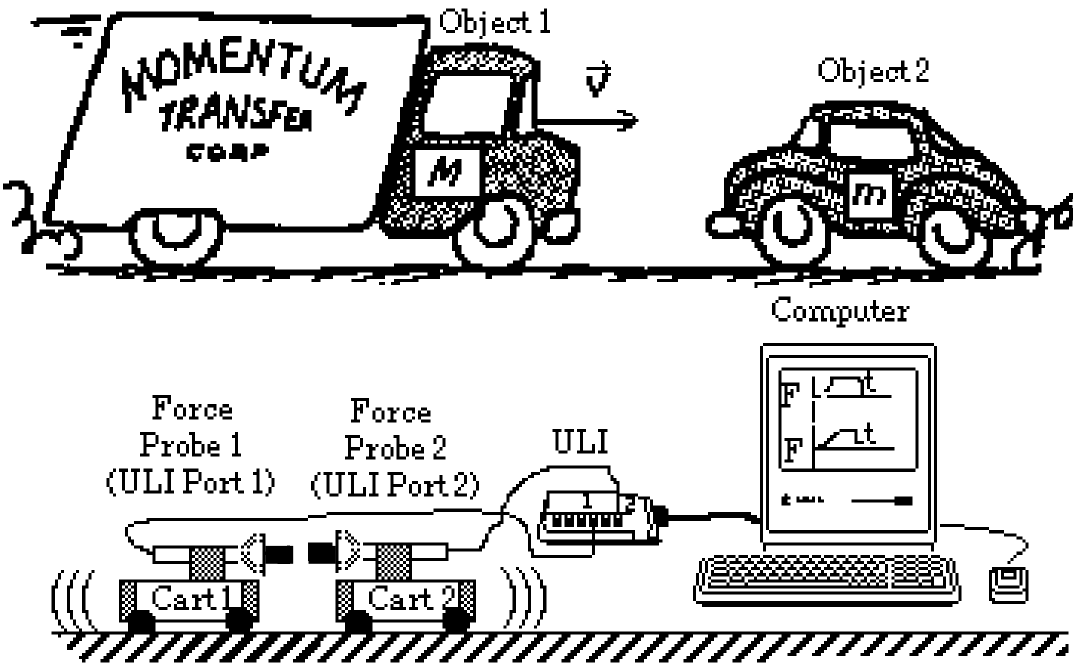

Figure 3. Arrangement for one of the experiments in Newton's Third Law *Interactive Lecture Demonstration* sequence. The force probes measure the interaction forces between the carts. An actual result of such an experiment is shown in Figure 4.

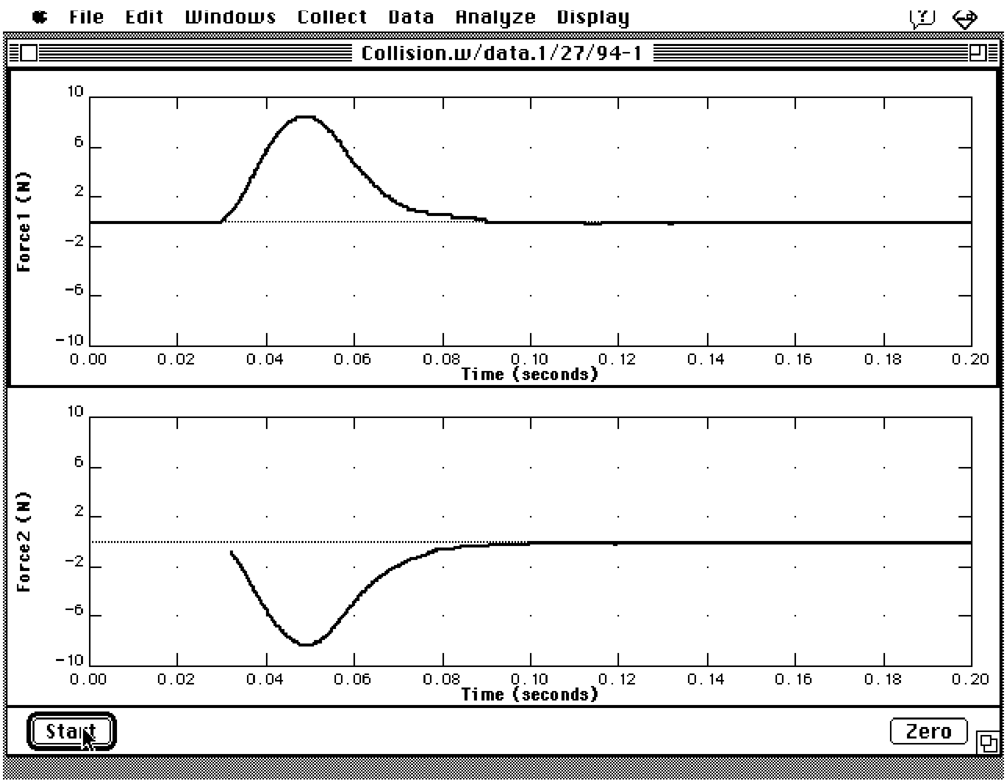

Figure 4. Actual result for one of the experiments in Newton's Third Law *Interactive Lecture Demonstration* sequence shown in Figure 3. In this case, cart 1 is three times heavier than cart 2 but just as Newton would predict, the interaction forces are equal and opposite.

In an *Interactive Lecture Demonstration* session students are given a “prediction sheet” with space to write their individual predictions. The sheet is collected to encourage participation. They are also given an essentially identical “results sheet” which they may fill out with the actual experimental results and keep. For each simple experiment or demonstration in the sequence, we use the following protocol.

1. Describe the demonstration and do it for the class without MBL measurements.
2. Ask students to record individual predictions.
3. Have the class engage in small group discussions with nearest neighbors.
4. Ask each student to record final prediction on handout sheet (which will be collected).
5. Elicit predictions and reasoning from students.
6. Carry out the demonstration with MBL measurements displayed.
7. Ask a few students to describe the result. Then discuss results in the context of the demonstration. Ask students to fill out “results sheet” which they keep.
8. Discuss analogous physical situations with different “surface” features. (That is, a different physical situation that is based on the same concept.)

These methods embody many of the same successful teaching and learning practices described above.

Learning gains

The successes of the research-based strategies and curricula described above have been demonstrated by large conceptual learning gains in introductory courses. After traditional instruction, only 30% of a sample of over 1200 students in calculus-based physics courses at five different universities, understood fundamental acceleration concepts. When, for the first time, two *Tools for Scientific Thinking* active-learning kinematics laboratories were offered at these universities, more than 75% of the students understood these concepts. At universities where the complete set of *RealTime Physics Mechanics* laboratories have been implemented, such as the University of Oregon and Tufts University, 93% of students understand these concepts, even in non-calculus introductory courses. At such universities, less than 15% of students held a Newtonian point of view after traditional instruction in dynamics, while 90% did so after *RealTime Physics* laboratories. There is good evidence that this conceptual understanding is retained.

The *Interactive Lecture Demonstrations*[1,10,11] have had similar success in changing the large lecture environment into an active environment that enables students to learn force and motion concepts. Such limited implementation of new methods is not enough, but begins to address the problem of changing instruction in traditional environments. Similar positive results are achieved in the more comprehensive *Workshop Physics*[6,7] program at Dickinson College that has replaced lectures with a combination of student-oriented activities using similar active learning techniques and the educational technology described above.

Conclusion

In summary, there is considerable evidence collected by researchers in physics teaching and learning that traditional instructional methods – largely lecture and problem solving – are not effective in promoting conceptual learning in physics. There is also widespread evidence that active learning methods, some of which were described here, work well in many different environments. There is enough agreement among careful researchers that the physics teaching community would do well to use curricula and methods based on practices that have actually been demonstrated to enhance student learning. It is prudent to examine in a scientific way the learning results of these new methods in specific learning contexts. Initial results show that activity-based, computer-supported, interactive learning environments well serve the diversity of students studying physics.

References

1 Thornton, R. K. and Sokoloff, D. R. (1998) Assessing Student Learning of Newton’s Laws: The *Force and Motion Conceptual Evaluation* and the Evaluation of Active Learning Laboratory and Lecture Curricula, *American Journal of Physics* **66**, 338–352.

2 The New Mechanics Conference held August 6–7, 1992 at Tufts University, was attended by Pat Cooney, Dewey Dykstra, David Hammer, Priscilla Laws,

Suzanne Lea, Lillian McDermott, Robert Morse, Hans Pfister, Edward Redish, David Sokoloff and Ronald Thornton.

[3] McDermott, L. C. (1991) What We Teach and What is Learned – Closing the Gap, *American Journal of Physics* **59**, 301–315.

[4] Hestenes, D., Wells, M. and Swackhamer, G. (1992) Force Concept Inventory, *The Physics Teacher* **30**, 141–158.

[5] The authors are the original members of the *Activity-Based Physics* group who were involved in developing these materials. The present group also includes Patrick Cooney, Edward Redish, Karen Cummings and Maxine Willis.

[6] Laws, P. W. (1991) Calculus-Based Physics without Lectures, *Physics Today* **44**, 24–31.

[7] Laws, P. W. (1997) *Workshop Physics Activity Guide*, New York, Wiley.

[8] Sokoloff, D. R., Thornton, R. K. and Laws, P. W. (1998) *RealTime Physics: Mechanics*, New York, Wiley.

[9] Sokoloff, D. R. and Thornton, R. K. (1992) *Tools for Scientific Thinking – Motion and Force Curriculum and Teachers' Guide, Second edition*, Portland, Vernier Software.

[10] Thornton, R. K. (1997) Learning Physics Concepts in the Introductory Course: Microcomputer-Based Labs and Interactive Lecture Demonstrations, *Conference on the Introductory Physics Course*, J. Wilson, ed. Wiley, New York, 69–85.

[11] Sokoloff, D. R. and Thornton, R. K. (1997) Using Interactive Lecture Demonstrations to Create an Active Learning Environment, *The Physics Teacher* **35**, 340–346.

[12] Thornton, R. K. and Sokoloff, D. K. (1997) *Microcompter-based Interactive Lecture Demonstrations in Force and Motion with Teachers' Guide*, Portland, Vernier Software.

WebByte No 7

Fatal Bacteria and Their Toxins Studied in Virtual Safety at Leeds University

submitted by **Kevin Meehan**, Qmark Systems
Info@qmark.com.au

The Microbiology Department at the University of Leeds has turned to computer based sessions to enable its students to study fatal bacterial diseases such as typhoid and botulism, where laboratory exercises are deemed to be too dangerous to run.

These 'virtual' laboratory sessions are enabling students to look at case study material that includes comprehensive bacteriological data. In one, an imaginary eight year old girl is unwell having arrived back in the UK after visiting Australia. Sometime later, she is booked into hospital and diagnosed as suffering from typhoid. The students are then asked to play the role of virtual detective by studying appropriate data to discover where the virus was first contracted. Likewise, students also discover how to prepare a novel canned food in order to prevent the risk of botulism.

The new study methods have been made possible through the testing and assessment software program, *Question Mark*. The program enables complex multimedia tests to be constructed without recourse to individual programming skills. The software is also able to assess the results of completed tests, saving valuable teaching resource time.

The Microbiology Department has also created a series of web pages giving access to a full set of notes designed to support the lecture material associated with the Laboratory and Scientific Medicine Course. Case-based tutorials can be found in the local Microbiology Departmental Software Library available on the University Computing Service desktop. It is hoped that these tutorials will be transferred to the web, again using *Question Mark* software. This will give the students the opportunity for true distance learning.

The software can also be used to analyse responses and determine what parts of the curriculum have been most readily absorbed by the students and which have been misunderstood. The teaching can then be tailored based on these results.

EDUCAUSE 99 in Australasia: Doing IT Right – "People and Technology"

Mary Peat, Director
UniServe Science maryp@bio.usyd.edu.au

EDUCAUSE is the association for managing and using information resources in higher education and it accomplishes its mission of enabling higher education's transformational changes by providing members with diverse opportunities for education and peer interaction. In particular, EDUCAUSE seeks to develop higher education's present and future leadership by supporting a curriculum that balances the need for technical, managerial and leadership skills and one that enhances the knowledge of trends in higher education. This year's conference was held in Sydney at the Hilton Hotel. The conference was supported by CAUDIT (Council of Australian University Directors of Information Technology), CAUL (Council of Australian University Librarians) and EDUCAUSE.

The theme for the 1999 EDUCAUSE in Australasia (18–21 April, 1999) was Doing IT Right – "People and Technology". The conference provided an opportunity for IT professionals, librarians, academics, educators and administrators to interact and discuss the effective management and planning of IT and its role in the delivery and management of higher education and research as we move into the 21st Century.

There were four streams – IT infrastructure for strategic support; Education without boundaries; Collaborative solutions; and Bringing IT Together. Within the Education without boundaries stream there were some interesting uses of the web in the delivery of teaching. In particular OTEN has developed a virtual classroom suitable for most of its courses. It is easy to use and the display classroom can be viewed at http://vc.tafensw.edu.au/ (go to sample classroom). The classroom idea could be used in many tertiary settings. On the library front, there were some stimulating papers on how libraries are filling the need to help both students and academics use the Internet more usefully. A recurring theme from the conference was the still pressing need to train/teach/support students and staff in the use of IT within teaching and research and it would seem we still have a long way to go.

The program, including abstracts of many of the papers, can be found at http://www.usyd.edu.au/cause99/

UniServe Science Workshop: Tools for Flexible Learning

Anne Fernandez, Educational Technologist
UniServe Science PhySciCH@mail.usyd.edu.au

UniServe Science held its fourth annual national workshop on April 9, 1999, in Sydney. The theme was Tools for Flexible Learning. The workshop was attended by 78 tertiary educators from around the country.

Over the past year we have seen the academic interest in science teaching resources move from individual software packages to tools for improving course delivery, student involvement and communication with students. It is therefore appropriate that the focus of this workshop was on the tools and techniques which best support the learning strategies employed in science teaching rather than a 'show and tell' of the technology employed.

The keynote speaker, Roy Lundin, QUT, gave a very entertaining and informative presentation which addressed the issues relating to the rapid growth in flexible delivery of open learning and teaching through the use of interactive communication technologies. Overseas and Australian examples given indicated that two major developments in this area are the forming of consortia of providers and the use of the Internet to deliver programs. Roy also outlined what appear to be major trends associated with flexible delivery.

The aim of the second session was to familiarise workshop participants with some of the web-based environments available for flexible teaching and learning. This began with presentations from Simon Housego, UTS, Stephen Sheely, UWS Hawkesbury and Lindsay Hewson and Chris Hughes, UNSW, featuring three of the more commonly used tools. *TopClass*, *WebCT* and *WebTeach* were used to illustrate: on-line quizzes; communication of administrative information to students; on-line discussion forums; bulletin boards; on-line brainstorming; on-line delivery of course materials; and more. It is interesting to note that a great deal of the discussion revolved around the pedagogical issues rather than the technology. This was followed by a question and answer session with a panel of experienced academics.

The remainder of the program was contributed papers and posters. There were nine contributed papers, not all devoted to technological tools, thus reminding us that flexible learning means much more than just the use of the web. These papers covered: group learning; laboratory kits; role playing; videoconferencing; collaboration; and much more. There were eight posters focusing on a variety of web-based learning environments. Unfortunately, the way we had structured the program left very little time for participants to view the posters.

As has become tradition with our workshops the day finished with a sumptuous banquet which was an invaluable opportunity for participants to meet and get to know their colleagues in an informal atmosphere.

The proceedings of the workshop are available from the UniServe Science web page http://science.uniserve.edu.au/pubs/procs/

The Fifth Australian World Wide Web Conference, AusWeb99 and Best of AusWeb99 Roadshow

Kaye Placing, Educational Technologist
UniServe Science BioSciCH@mail.usyd.edu.au

The Fifth Australian World Wide Web Conference, AusWeb99 was held from the 17th – 20th April in Ballina, NSW. Keynote speakers for the conference included Robert Cailliau (CERN, Switzerland), Bebo White (Stanford Linear Accelerator Center and Stanford University), Lee Gilbert (Nanyang Business School, Singapore), Steve Chazin (Apple Consortium Manager for North America) and Carmel McNaught (Learning Technologies Unit, RMIT University). Proceedings of the conference are available on-line from http://ausweb.scu.edu.au/aw99/papers/

As the main conference was fully subscribed at least two months prior to the event, the AusWeb99 Roadshow was launched. Local organisers provided interested people in the capital cities with an opportunity to attend a one day workshop featuring the best of AusWeb99 taking advantage of the presence of overseas speakers. The Roadshow visited Brisbane, Melbourne and Sydney in the week following the main conference.

The Sydney Roadshow was held at The University of Sydney and organised by UniServe Science in association with Allan Ellis (Southern Cross University) and AusWeb99. Presenters included Bebo White (who delivered an entertaining and thought provoking keynote address entitled “The Evolving Role of the Webmaster”) and local presenters: Igor Hawryszkiewycz (UTS); David Lowe (UTS); and John Eklund (Access Australia CMC). Afternoon workshops were conducted by Bebo White, Rik Hall (University of New Brunswick) and Jeni Li (Arizona State University).

It is hoped that the Roadshow becomes a regular feature of the AusWeb Annual Conference.

The AusWeb team are seeking ideas for the staging of AusWeb2K (check the web site at http://ausweb.scu.edu.au/aw2k/aw2k.html).

Psyk.trek

Stephen Provost, Department of Psychology
The University of Newcastle Provost@psychology.newcastle.edu.au

Psyk.trek is a multimedia product designed to complement Wayne Weiten's excellent First-year text *Psychology: Themes and variations* (1998, Brooks-Cole). It comes as a CD-ROM, which will run under both *Windows* and Macintosh OS, as long as *QuickTime* is installed. In general the interface seems to have been designed to look slick, but is inconsistent and confusing (not to say annoying) in a number of places.

The Interactive Learning Modules are professionally presented material corresponding roughly to the chapters of the textbook. They consist largely of good-looking drawings, animations and pictures derived from the text, and a few video clips, with soothing male and female voice-overs providing the content. The content follows the text. At the end of each section there is a review and you can do a multiple choice quiz.

The Interactive Study Guide contains a large number of review questions and allows you to randomly generate multiple choice tests. This certainly could be useful if properly used by the student, although it might depend upon how closely lecturing staff follow the text.

There are seven simulations: The Stroop Test; Hemispheric Specialisation; Poggendorff Illusion; Shaping; Memory Processes; Problem Solving; and Measuring your Creativity. Each is followed by a discussion of what your individual results might mean, which in some cases is at a level appropriate for use in laboratories. The main deficiency in these simulations is the absence of any mechanism to vary any of the experimental parameters, in order to build a serious laboratory experience around it. They are demonstrations, really, not simulations.

The Multimedia Glossary consists of a word-list and search engine, which provides a simple definition of a number of terms (but few examples), and the opportunity to hear what the word sounds like.

With a stronger emphasis on developing simulations, and some work on interface design, *Psyk.trek* could be a useful tool for the academic psychologist. At present, it provides a nice-looking overview of introductory psychology for the senior high-school or commencing student.

(See page 26 for product information)

PsychSim: Interactive Graphic Simulations for Psychology

Sue Burney, Psychology Department
Monash University Sue.Burney@sci.monash.edu.au

This useful and popular software package contains 19 interactive graphic simulations that have been developed for use in Year 12 and first year psychology classes. The aim of the software is to provide classic psychology demonstrations and simulations to enhance student learning. Each module takes approximately 15-20 minutes to complete and is accompanied by worksheets. The topic areas covered by the modules include: sensation and perception (2); biological bases of behaviour (4); cognition (4); learning (3); social cognition (2); abnormal psychology (2); and descriptive statistics (2).

PsychSim is accompanied by a very basic manual (40 pages) which clearly outlines the system requirements and installation instructions. It also includes a statement of purpose for each module, gives a brief description of each, and also contains some very simple worksheets.

The modules outline in a "student-friendly" format some of the classic experiments in psychology and also some of the basic psychological processes. It also contains two very useful demonstrations of descriptive statistics that provide a painless introduction to these topics.

The content of the software is accurate and the instructions make it very easy to use. The student can exit the program at any stage and obtain feedback about their performance at multiple points. While it does not have a HELP function this is not a problem as the instructions and the design of the template make this unnecessary.

PsychSim can be networked which makes it a very useful teaching tool in undergraduate psychology courses. It is a worthwhile purchase as it demonstrates a range of concepts that could not be achieved using traditional teaching methods. However, its usefulness depends to a certain extent on having an understanding of the theoretical underpinnings of pertinent psychological concepts, as it provides very little depth in this area.

(See page 26 for product information)

Introducing Web Site Reviews

Software reviews have always been a regular feature of UniServe Science News. These reviews have been commissioned by UniServe Science and carried out by Australian academics. We feel this is a valuable service and we will continue with it. We also welcome software for evaluation.

However, with the rapid changes in technology and varying approaches to teaching and learning, the focus of information technology in science teaching is turning to the web. With this in mind we believe it is appropriate that we extend the review process to include educational web sites. We have compiled review guidelines and a checklist to assist in the review process. Details of the review guidelines are published below and the checklist is available on request. The reviews of web sites commissioned by us will be available on-line at http://science.uniserve.edu.au/disc/reviews/ This newsletter also contains the first such web site review (see page 25). Our plan is to make these a regular feature alongside the software reviews.

We would like to hear from any of our readers who are interested in reviewing a particular web site or who use or maintain an appropriate web site that they wish to be reviewed and included in the newsletter.

Web Site Review Guidelines

1. Reviewer's name, affiliation, email and correspondence postal address:
2. Site URL:
3. Site title:
4. Date visited:
5. Date site was created:
6. Date site was last modified:

Rating: (Excellent, Good, Average, Poor, Not useful)

The rest of the review should be in narrative form, covering at least the following points (preferably separating them using appropriate headings and sub-headings):

General:

Does the site state its objectives, and are those objectives appropriate in your opinion?
What audience is it intended to serve? Does the site make it clear?
Which science discipline is it applicable to? Does the site make it clear?

Content related aspects:

What topics/content are covered?
Please comment on usefulness and richness of each topic.
How complete is the content?
How accurate is the content?
Is any of the content original?
How appropriate are external links? What is the quality of these external links?
How would you rate the educational value of the site?
Which subject areas might this site be used in? What level might it be used at? Possible usage – extension, introduction, laboratory session, formative assessment, summative assessment, other (please explain)?
How useful would this site be for teachers of these subjects?
How useful would it be for students for study and/or reference purposes?

Connectivity:

Is the site easy to access, or does it take forever to load? Do the items appear only when the site is fully loaded?
Does it require special software or plug-ins (e.g. *Shockwave*, *QuickTime*, *RealAudio*) to use many of its elements? Is the plug-in available at the site?
Does it state a preferred browser?
Are there any special browser requirements?
Can you select frame or non-frame version?
Can you select text-only version?
Is access free or is there a subscription charge?
Are there any other access restrictions, i.e. password protection?

Interface related aspects:

How do you find the layout of the web site? Is the site structure and content clear as soon as accessed?
Is the background colour and graphics non-intrusive, fonts readable, and images viewable?
Do the pages contain the right amount of information or is there too little/too much? Are the graphics appropriate?
Do the pages adjust for changes in viewing windows?
How easy is it to find information on this web site? If there are icons, is their identity and what they are supposed to do immediately clear?
How equipped is the site with navigational aids? Are there well-placed navigating tools?
Are there any search facilities available? If yes, do they come up with correct information?
Does the information flow logically from one page to another? Are you tempted to go further into the web site after browsing introductory material?
Does the site use audio, video or other special effects? How appropriate are these effects?
Are animations used effectively?

Overall issues:

Who is supporting the web site: an association, a commercial firm, an individual, ... ?
Does the site state contact details of site owner(s) (such as email, postal address, etc.)?
Does the site include advertising? If yes, is it clearly differentiated from the main site content?
Is the site kept up-to-date? Are there any signs of regular updates? Does the content look obsolete or current? Do the external links annoy by failing to connect?

Finally:

Are you using the site in your teaching?
Would you recommend your colleagues use the site in their teaching?
The things you liked the best
Things which could be improved
Any special remarks!

First Year Biology Virtual Resources Room

Sue Jones, School of Zoology
University of Tasmania S.M.Jones@utas.edu.au

General

This site has been developed to support first year biology teaching at The University of Sydney. As might be expected from the innovative teaching team involved in that course, the site contains a variety of on-line material, ranging from course information to custom designed computer-aided learning packages (CAL). The site is obviously aimed at their own first year biology classes, but any teacher of entry level biology would benefit from browsing the site to see how the learning materials are presented, how dialogue is maintained between students and staff, and to appreciate the underlying philosophies of learning exemplified by the way this site is put together. It is well worth a visit just to experience the award-winning CAL modules “Photosynthesis” and “The Ear”.

Content

The site provides an extensive virtual learning environment. The home page, the Virtual Resources Room, represents a stylised room with graphics of “computers” with access to various learning packages, a stack of “handouts”, a graphics board, and an entrance to a lecture hall; doors lead to related sites at The University of Sydney. A group of figures invites you to join a lively discussion group to which both students and staff can contribute, while students can email specific questions to the teaching team through “CyberTutor”. Learning resources include self-assessment modules, Visual Reminders, and CAL packages, all thoughtfully produced to a high standard with exceptionally good graphics. I strongly recommend checking out the mid-semester mock examination developed by Dr Mary Peat, using *Authorware*. After sitting the examination in real-time, students mark their own paper on-line, and can then use related revision workshops to improve their understanding of key concepts, an excellent example of how to use on-line resources to stimulate independent learning.

Obviously the material is very much geared to the content of the units being taught at The University of Sydney. In the self-tests, therefore, I found that some of the questions required answers derived from a very specific knowledge base. However, higher level questions required paragraph answers, so there was more scope for students to explore concepts. There were occasional very minor irritations such as americanisations.

Connectivity

The site is easy to access and loaded reasonably quickly on a Mac Performa and a 686 P200+, using *Netscape 3*. Generally, images are a vital component of the content, and text-only versions would not be appropriate. The home page recommends 16 bit colour for viewing, but some modules do suggest a black and white option for optimising browser performance when accessing the site through the Internet. *Shockwave* is required as a plug-in for viewing most of the learning material because it includes animations; however, downloading *Shockwave* is very easy using the buttons located both on the home page and on the first page of relevant packages. A language plug-in is necessary for utilising the site search option. Specific trouble-shooting advice is available on downloading *Shockwave*, and there is also a link to the University's IT help desk.

Access is free, but entrance to the "lecture hall" is by password for enrolled students only. Interestingly, there is no password required to join the Discussion Group. Reading some of the interchanges showed that an initial requirement for password access had been removed early in the semester because of difficulties caused by the requirements for different passwords for lectures, assessed quizzes and discussion groups.

Interface related aspects

The layout of the home page is immediately understandable, although I thought the labels on the graphics could have been in a more definitive colour or typeface. I also turned off the audio after encountering the 'page-turning noise' in the visual reminder modules! It is difficult to comment concisely on the interface because the materials available here are so diverse, and serve very different purposes. For example, the lecture notes provided very much reflect the style of individual lecturers. It appears that they are still indeed lecture notes; not substitutes for lectures; I assume that most students would attend lectures in real-time and that these would be available as back-up. The site is easy to navigate around, with links back to the Virtual Resources Room, the School of Biological Sciences, and to the university home page at the start of all modules. Overall, it is a thoughtfully designed site, which would be readily accessible to novice users.

Overall issues

This is a site prepared and maintained by the first year team of the School of Biological Sciences at The University of Sydney. As a university-based site, it contains no advertising, and links only to other university sites, although I did find some URLs recommended by specific lecturers in their lecture notes.

Conclusions

This site is an impressive product of a dedicated teaching group who have whole-heartedly embraced the versatility of on-line teaching, as well as the benefits regarding catering to very large classes. I would strongly recommend to people still at the planning stage of a move into virtual teaching that they visit this site to see what can be achieved. The overall impression is that the pedagogy has been carefully considered in the design of the various components, and the range of materials presented. The comments of the students on the discussion group were hugely enthusiastic, and include some insightful comments into their experiences of the learning process, providing an appropriate demonstration of the value of well-designed electronic learning materials.

Rating: excellent

Product Information

Psyk.trek is available from
Brooks/Cole Publishing Company
511 Forest Lodge Road
Pacific Grove, CA 93950-5098, USA
Tel: (408) 373 0728

PsychSim is available from
Worth Publishers Inc
41 Madison Ave
New York, NY 10010, USA
Tel: 800 446 8923

The *Virtual Resources Room* is located at http://fybio.bio.usyd.edu.au/SOBSFYB/FYB_StuRes.html
and is maintained by First Year Biology at The University of Sydney
contact maryp@bio.usyd.edu.au

An Internet Environment for Learning Software Testing Processes

Sita Ramakrishnan, School of Computer Science and Software Engineering
Monash University sitar@csse.monash.edu.au

Introduction

The Internet has been recognised not only as a tool for communication in the 21st century but also as an environment for enabling changes in the paradigm of teaching and learning. This report describes our development effort (sponsored by the CUTSD98 Grant) in designing educational material on object-oriented (O-O) testing in an Internet environment. O-O software testing has the advantage of being easily visualizable in terms of state changes and data-flows. By making use of this advantage, we have attempted to show the inner workings of the complex processes involved in O-O testing.

As part of this project, we have developed a system, known as "Light Views", which contains O-O testing case studies described by visual images, animation, and interactive lessons, to assist active participation by learners to result in better understanding and knowledge retention.

The distributed teaching and learning approach discussed in this report employs appropriate UML diagrams, makes the diagrams test ready by including details of constraints as part of state/event transitions, and provides interactive lessons for learning O-O software testing. More details are available on the project web page – http://www.sd.monash.edu.au/~sitar/se_educ_proj/

Project objectives

The aim of this work on an Internet environment for learning O-O testing processes is to enhance the state of the art in learning O-O testing by visualizing O-O testing and interactive courseware in virtual communities.

Our project objective is to develop a system to learn O-O-testing, where testing itself is only one component. The O-O testing case studies contain visual images, animation, and interactive lessons, with a belief that active participation by the learner results in better understanding and knowledge retention. The other important aspects are visualization and interactivity with the system under test, instructional material on preparing test plans, and provisions for evaluation and feedback.

Background

Traditionally, students of undergraduate courses in software engineering have been taught techniques to design and develop relatively small programs, with only minor emphasis on software testing and maintenance. However, testing is an important activity both at the development and maintenance phases of software development. Industry data show that around 60% of software costs go into the maintenance phase of the software life cycle. It is important that software engineering students learn systematic testing of software systems.

O-O technology encourages modular and incremental development of large systems. At Monash University, we teach O-O software development for building complex systems, in which testing is an integral part. However, a lack of adequate teaching environments and tools support has made it difficult for students to master the complexity of software testing.

Expected benefits of our approach

Learning outcomes

Students are expected to undertake this task of software testing systematically by visualizing execution paths and state changes in the tested program. Students are expected to produce better test data (for their assessable components) that tests the possible states of the objects and their interaction during system execution by simulated and animated examples using Unified

Modeling Language (UML) state diagrams augmented with constraints.

Student-centred learning

The project shifts the learning process from the traditional teacher-centred approach to a student-centred approach. The change from a traditional teaching paradigm to distributed learning and teaching in virtual communities is aimed to engage the student in active participation as part of the learning process. Since software testing is a complex process, the learning pace of students may not be uniform and therefore this shift to resource-based learning in the students' laboratories in the University should help the students. A significant number of students have home computers with connections to the Internet. By providing the system on the Internet, students have the flexibility of learning at their own place. Thus we provide both time and space flexibility in the learning process.

Visualizing aspects of O-O testing on the Internet

Visual images and animation are used in the education process. Computer based animation and visualization are powerful and motivationally attractive education techniques, which can simplify the presentation of the conceptual frameworks and schematic overviews, thereby enhancing learning. O-O software testing has the advantage of being easily 'visualizable' in terms of state changes and data-flows. By making use of this advantage, a complex process can be taught in a better way. It is vital for students to internalize the notion of testing so that they can produce systems, which are reliable, and of good quality.

Teaching and learning of O-O testing on the Internet

Our current work entitled, "Light Views", for learning the process of O-O testing is an interactive hypermedia courseware geared towards a distributed learning community model for visualizing the O-O software testing process through web-based software. The Internet technology has been used as an enabler for creating pedagogically sound material, such as active participatory learning in collaborative environments.

The courseware has adopted the good principles of instructional design and human computer interaction. A short textual description of the problem is provided interspersed with passive learning material containing UML diagrams. These diagrams can be stepped through moving from one state to the next in a system directed fashion. UML diagrams with the learner controlling the interactivity and also the paths taken as a consequence are part of the active learning material provided. Links to O-O theory, and glossary terms of relevance to O-O testing in general and to those case studies in particular are also part of the courseware. Each case study contains an evaluation component with a questionnaire and quizzes. Questionnaires are aimed at receiving feedback from the users about the effectiveness of the web content. We have used their feedback in providing improvements. Students are also required to answer quizzes which range from simple True/False, multiple choice questions to interactions with state diagrams (running Java applets, Java script and Perl scripts). Quizzes are used as an on-line testing mechanism to check their understanding. When the student chooses the wrong answer, we show the correct answer for the quiz in question as part of their learning and feedback.

We have found that UML state diagrams annotated with these easy to understand visual cues are beneficial in students' understanding of test selection, test coverage, and the inner workings of simple UML dynamic models.

Java applets and interactive visualization of O-O testing processes

The use of Java applets for passive and active illustration of dynamic O-O models suits our requirement to make the courseware accessible on a platform independent basis. We have implemented some animations using Java. However, we have also used the tool, *Flash*, to draw and animate a number of these diagrams, and Macromedia's scripting language, *Lingo*, for producing interactive illustrations of the test paths. Since our learning environment is an interactive, web-based environment, we convert these diagrams to *Shockwave* movies or Java applets. Initially, we created the content pages by writing standard html.

However, we have reworked them using *DreamWeaver*, a visual authoring tool for creating and managing web pages.

For web-based distance learning to work, the designer must take care of the content, web instructional design, interactivity, and take the students' feedback and assessment of the effectiveness of the material into account. This evaluation may necessitate redesign and reimplementation. Since we wanted to experiment with a number of test strategies, and take the students' feedback to evolve the solution, we have chosen to use these authoring tools to develop an Internet solution.

We have included four case studies in the courseware, geared to learn about the various test strategies employed in testing O-O software systems. We focus on various aspects of O-O testing: black-box testing of a simple account object; systems testing and white-box testing in a VCR system; event based testing and applets; and distributed component testing.

Dissemination of information

We have endeavoured to disseminate the project information amongst academics in our faculty and benchmark our effort against other work in O-O testing in other universities and research organisations by:

- including status reports and URL entries of our project in our School's monthly newsletter, and asking for feedback from academic staff;
- participating as an invited member in the NSF funded workshop on O-O testing at Clemson University, South Carolina, USA in June 1998, benchmarking our work against O-O testing work at the universities of the other attendees;
- contacting and forwarding our project's URLs to research staff interested in O-O testing at CSIRO, and to staff interested in interactivity aspects of learning and teaching at the University of California, Berkeley;
- presenting at the Eiffel Teaching Conference held in September 1998 to showcase our work to other local (Australian) universities;
- demonstrating as an internal exhibitor at the Flexible Learning and Teaching Conference held in September 1998 at Monash University;
- submitting posters and progress reports of the project to the School of Computer Science and Software Engineering Symposium held in February 1999;
- involving students at Clemson University in the use and evaluation of the case studies; and
- presenting a paper titled "Visualizing O-O Testing in Virtual Communities – Distributed Teaching and Learning" to the International Conference on Technologies of Object-Oriented Languages and Systems to be held at Santa Barbara, CA, USA in August 1999.

Summary

We have endeavoured to create an effective Internet based courseware by having content experts in O-O testing, programmers, human computer interaction and web-based course designers, educational professionals with experience in interactive web-based application, and distance teaching and learning, and graphic designers.

We have designed an Internet environment to visualize the inner workings of the complex processes involved in O-O testing. Our objective is for students to learn the basic goal of achieving high productivity in testing by being able to create a minimum number of test cases to uncover the maximum number of errors for a given amount of effort.

To achieve this objective, we have used four case studies to explore the various test selection techniques. We have included the specification based black-box testing – at the unit level in case study 1 for an Account object, and at the system level in case study 3 for a JavaBean application. Case study 2 has been used to illustrate event based testing by visually representing the dynamics of Java applets at work, and using interactivity to learn how to test Java applets, threads, and applet communication. For unit level black-box testing, we have shown how to use the UML state diagram augmented with design by contract notions as part of the transition, to verify the behaviour of an object with few test cases. For system testing, we have shown how to derive meaningful test cases by using testing techniques that focus on related events that occur in the system level model of the VCR system in case study 3.

In 1998, the author's final year undergraduate students studying a subject entitled "Object-Oriented Programming Systems" learned about O-O testing using the case study on Accounts as the web-based interactive teaching resource, in addition to standard classroom lectures. They took part in formative evaluations of the material and completed on-line quizzes to check their understanding. These students received this material very positively. This approach presents a new road to self-paced learning by enabling learners in distributed locations to follow the new ROAD – Read the on-line material; Observe the static and animated O-O diagrams (Passive learning); Absorb; and Do (Active learning). The interactivity features allow the learner to direct the test paths taken by the system.

Students studying O-O testing in the Department of Computer Science, Clemson University during January – April 1999 participated by studying the case studies and undertaking the student questionnaires and quizzes. The evaluations look positive at first glance and we are working on a detailed evaluation of the same. The details of the evaluation will be included in the final report to the national funding body, CUTSD and also to the wider community through our project web pages. We are also considering using this design experience in interactivity to develop a framework in Java for learning O-O testing strategies and processes.

WebAssign: Assessing Student Performance Any Time Any Where

John Risley, Department of Physics
North Carolina State University webassign@ncsu.edu

Introduction

Motivating students to learn and keep up with instructional material and assessing their performance is a constant concern for teachers. Doing this task asynchronously at a distance is an even more daunting task.

At North Carolina State University we are developing *WebAssign* – a web-based delivery, collection, grading, and recording system that has shown the potential of solving this problem for homework and quizzes[1]. *WebAssign* delivers content that can be graded automatically. *WebAssign* is an important, versatile instructional tool that can be deployed for any kind of learning, distance or local, any time any where.

- *WebAssign* can be used on any computer connected to the Internet at any location and at any time. As such it is a powerful tool that can broaden access to education that is not limited by time or place.
- *WebAssign* has agreements with major publishers in the US to include questions from their textbooks in our database.
- *WebAssign* is used by 10,000 students throughout the United States (count taken during the spring semester, 1999).
- *WebAssign* can be used to develop and assess distance learning programs by providing the teacher (and/or researcher) with instant access to student involvement and progress in the course material.
- *WebAssign* fully supports HTML tools so that full multimedia presentations can be incorporated into the distance learning programs.
- *WebAssign*'s built-in assessment methodologies allow teachers to quickly identify and measure the skill competencies of their students.
- *WebAssign* is aggressively pursuing opportunities to develop and implement courses in all disciplines.

What is *WebAssign*?

WebAssign is a versatile, web-based homework service for educators who want to offer expanded learning opportunities to their students. *WebAssign* delivers, collects, grades, and records customized homework assignments over the Internet. Assignments can contain content as well as questions. The questions can contain different numerical values, so each student can be provided with a unique question to solve. This feature encourages independent thinking with the benefit of allowing collaboration on solution methods. *WebAssign*'s unique homework delivery system will save teachers time spent grading and recording homework assignments, plus allow them to assign more homework, more often, and with more content.

Teachers can write their own questions, and use questions that their colleagues have found successful. If teachers are using one of the textbooks supported by *WebAssign*, they can offer pertinent exercises and problems directly from the book.

Access to *WebAssign* is secure. With the use of passwords, only the teacher and the student have access to the student's records. See Figure 1.

Where are the *WebAssign* servers?

The *WebAssign* servers are located on the North Carolina State University campus. These servers with high-speed connections are available 24 hours a day 7 days a week (except for short maintenance periods). NCSU provides the technical support.

If a university decides that it is more economical to host their own server, the *WebAssign* code can be transferred. A high level of computer experience and training in *WindowsNT* or Unix and databases is required for maintaining a *WebAssign* server.

Figure 1. The secure entry into *WebAssign*. For trial of *WebAssign*, use **demo** for username, institution and password.

Who is Using *WebAssign*?

A growing number of educators are currently using *WebAssign*. The latest tally showed that nearly 10,000 students at more than 100 educational institutions are using *WebAssign*, in physics, biology, physical sciences, mathematics, computer science and computer proficiency (count taken in 1999). The list of some of the universities using *WebAssign* includes:

- Auburn University;
- Catholic University of America;
- Davidson College;
- Duke University;
- Eastern Nazarene College;
- Gainesville College;
- Georgia Institute of Technology;
- Jacksonville University;
- North Carolina A&T State University;
- North Carolina State University;
- North Georgia College & State University;
- Old Dominion University;
- Penn State;
- Rensselaer Polytechnic Institute;
- Rhodes College;
- Rutgers University;
- South Carolina State University;
- Spring Arbor College University of Michigan-Dearborn; and
- University of Tennessee.

Using *WebAssign*

The main advantage of *WebAssign* is that teachers can offer homework or quizzes frequently with immediate feedback to students and no grading/recording chore for the teacher. This feature gives students more practice while eliminating the work of grading and recording homework. Student performance can be assessed regularly to keep abreast of individual progress for “Just-In-Time” teaching[2]. With *WebAssign*, teachers can add more weight to homework, and decrease dependence on tests. *WebAssign* reduces grading errors and automatically provides an answer key after the assignment due date.

Teachers can make assignments using questions and problems from the class-adopted textbook. Homework is graded instantly and automatically. Password control protects access to student records. Questions can be modified, created anew, or used directly from the database. Grades can be downloaded into a spreadsheet so that they can be combined with other class grades.

Students can access their grades immediately after completing an assignment (Figure 2). Students can work an assignment multiple times until they get the correct answer if the teacher sets up the assignment with this option. Students can have secure access to any or all of their test, homework, laboratory, or project grades.

Teachers and students using *WebAssign* have access to a comprehensive User’s Manual and Student Guide (both printed and on-line), email and telephone technical support.

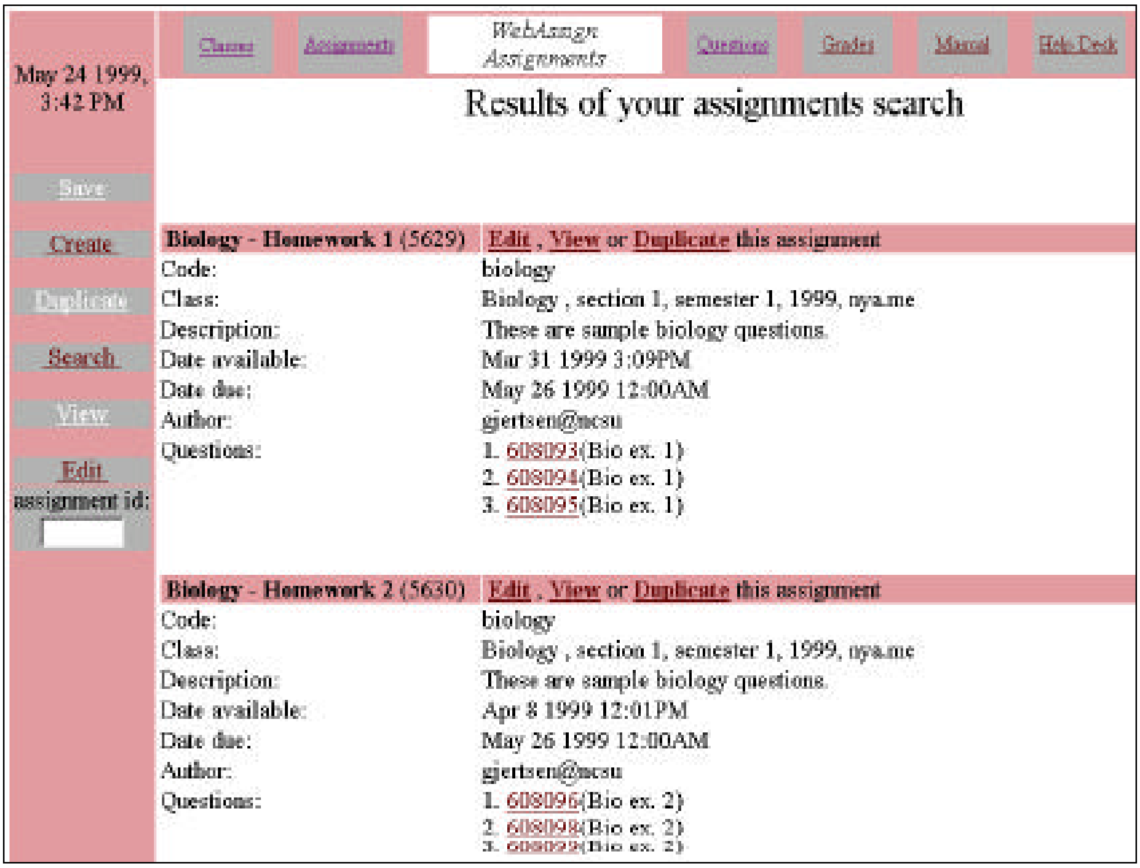

Figure 2. Students can access homework results immediately

Partnerships with publishers

While NCSU is directing the development of the *WebAssign* tool, publishers have the content. Publishers allow *WebAssign* to deliver their questions (Figure 3) if teachers have adopted the publisher's textbook. The following publishers have given us permission to use questions from their textbooks: Addison Wesley Longman ("Physics for Scientists and Engineers" by Wolfson and Pasachoff and "University Physics" by Young and Freedman); Brooks/Cole ("Physics: Algebra/Trig" by Hecht and "University Physics" by Reese); Duxbury ("Modern Engineering Statistics" by Lapin); Glencoe/McGraw-Hill ("Glencoe Physics: Principles & Problems" by Zitzewitz); John Wiley & Sons, Inc. ("Physics" by Cutnell and Johnson and "Fundamentals of Physics" by Halliday, Resnick, and Walker); Prentice-Hall ("Physics" by Giancoli and "Physics for Scientists and Engineers" by Fishbane, Gasiorowicz, and Thornton); Saunders College Publishing ("Physics for Scientists and Engineers" by Serway and Beichner, "College Physics" by Serway and Faughn, "Principles of Physics" by Serway, "Chemistry & Chemical Reactivity" by Kotz and Treichel); and W. H. Freeman ("Physics for Scientists and Engineers" by Tipler).

More information on *WebAssign*

Reports on some of the features of *WebAssign* have been published in *Computers in Physics*[3] and in *The Physics Teacher*[4]. Two popular reports have been published about *WebAssign*, one in the *Chronicle of Higher Education* "Textbooks and Tests that Talk Back", by Lisa Guernsey on February 12, 1999 and the other on NBC Nightly News on February 19, 1999.

Contacts

WebAssign
Box 8202
North Carolina State University
Raleigh, NC 27695-8202 USA
Tel. (800) 955-8275 or (919) 515-7447
Fax: (919) 515-2682
webassign@ncsu.edu

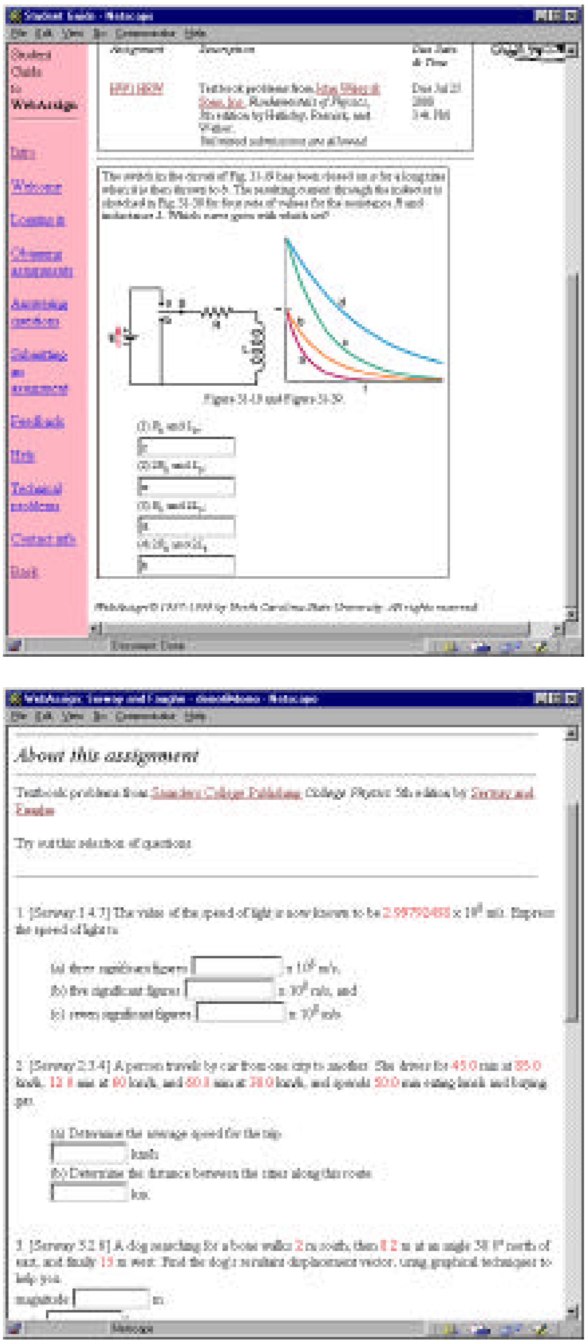

Figure 3. Sample questions from standard textbooks in *WebAssign*

Web site

To try out *WebAssign* and see what it is like to take an assignment, access the web site at

http://webassign.net/info/

Use **demo** for the username, **demo** for the institution, and **demo** for the password.

Faculty options are located at

http://webassign.net/faculty/

Use **demo** for all three entries.

References

[1] WebAssign.net User's Manual, North Carolina State University, 1998–99.

[2] Noval, G. M., Patterson, E. T., Gavrin, A. D. and Christian, W. (1999) *Just-In-Time Teaching*, Upper Saddle River, NJ, Prentice Hall.

[3] Titus, A. P., Martin, L. W. and Beichner R. J. (1998) Web-Based Testing in Physics Education: Methods and Opportunities, *Computers in Physics* **12**, Mar/Apr, 117–123.

[4] Bonham, S. W., Risley, J. S. and Christian, W. (1999) Using Physlets to Teach Electrostatics, *The Physics Teacher* **37**, May, 276–280.

Virtual Science

In the current environment of declining resources, increasing student numbers and increasing demands on the time of both students and academics, the Internet offers an exciting alternative to traditional science teaching and learning.

The following list contains examples of the types of interactive science teaching resources available on the web. Although the list is by no means complete, an attempt has been made to include a variety of activities, representing as many disciplines as possible and to include Australian examples where they were available. If you are using any of these resources or have found more appropriate resources, we welcome your comments. If you are interested in evaluating any of these web sites, please contact UniServe Science.

Virtual Field Trips

Virtual Field Trips: Creating Student Perspective for Online Earth Science Education
http://trex.tamu.edu/faculty/herbert/98Golden/

An Interglacial estuarine deposit at Largs, New South Wales, Australia
http://www.newcastle.edu.au/department/gl/shaun/molluscs.htm

Glacial Geology at University of Cincinnati
http://tvl1.geo.uc.edu/ice/glacier.html

Plant collecting in Western New South Wales
http://www.anbg.gov.au/cpbr/australian-plants/australian-plants.html

Fossil Forest near Lulworth Cove, southern England
http://www.soton.ac.uk/~imw/forest.htm

Intertidal Zone Field Trip
http://redbaron.bishops.ntc.nf.ca/wells/fieldtrp/field.htm

Physical Geology Virtual Field Trips (Big Bend National Park and Texas Hill Country)
http://geoweb.tamu.edu/courses/geol101/herbert/fieldtrips/fieldtrips.html

Virtual Laboratories

Virtual Flylab
http://vflylab.angis.org.au/

Virtual Dating
http://vearthquake.calstatela.edu/VirtualDating/

The Internet Psychology Laboratory
http://kahuna.psych.uiuc.edu/ipl/

Physics 2000 Applets
http://www.colorado.edu/physics/2000/applets/

The Virtual Laboratory (mainly physics)
http://physicsweb.org/TIPTOP/VLAB/

Rice Virtual Lab in Statistics
http://www.ruf.rice.edu/~lane/rvls.html

Electrophoresis Simulation Site
http://www.rit.edu/~pac8612/electro/E_Sim.html

Interactive Biochemistry
http://cti.itc.Virginia.EDU/~cmg/

SkyView – Virtual Telescope
http://skview.gsfc.nasa.gov/skyview.html

Real World Data

Modern and Fossil Pollen Data at the NOAA Paleoclimatology Program
http://www.ngdc.noaa.gov/paleo/pollen.html

El Niño Theme Page
http://www.pmel.noaa.gov/toga-tao/el-nino/nino-home.html

Bureau of Meteorology – temperatures, rainfall, satellite maps
http://www.bom.gov.au/

Update on Current Volcanic Activity
http://volcano.und.nodak.edu/vwdocs/current_volcs/current.html

Weather Climate and Drought – Vegetation greenness change maps – based on satellite imagery – show the relative change in the density of vegetation
http://www.agric.nsw.gov.au/climate/

Data Sets from Statistics at UCLA
http://www.stat.ucla.edu/data/

International Data Base at the US Census Bureau
http://www.census.gov/ipc/www/idbnew.html

Case Studies

Case Studies in Science
http://ublib.buffalo.edu/libraries/projects/cases/case.html

Case Studies from Statistics at UCLA
http://www.stat.ucla.edu/cases/

Your Genes, Your Choice
http://ehrweb.aaas.org/ehr/books/contents.html

Energy and the Environment
http://energy.fullerton.edu/case-ideas.html

Science in the News

Chance and Data in the News
http://www.ni.com.au/mercury/mathguys/mercindx.htm

Nova – Science in the News
http://www.science.org.au/nova/

In the news
http://www.geologylink.com/news/

Science News (Excite)
http://news.excite.com/more/science/

NASA Science News
http://www.earthsciencenews.com/

Real World Problems and Experiences

Virtual Workshop – Transport of East Asian Dust Pall Across the Pacific
http://capita.wustl.edu/ASIA-FAREAST/

Science in the Courtroom
http://www.geology.ohio-state.edu/~lahm/

Toxic Legacy – Hazardous Waste and the Lessons of Woburn, Massachusetts
http://www2.shore.net/~dkennedy/woburn.html

Australian Marine Oil Spill Centre
http://www.aip.com.au/frames/amosc.html

Calendar of Coming Events

SCICADE 99
International Conference on Scientific Computation And Differential Equations
August 9 – 13, 1999, Fraser Island, Queensland
http://www.maths.uq.edu.au/~kb/scicade99/
kb@maths.uq.edu.au

AMS '99
IASTED International Conference
Applied Modelling and Simulation
September 1 – 3, 1999, Cairns
http://www.iasted.com/

Virtual CUBE 99
Implementing Learning Technologies in Bioscience Teaching
September 6 – 10, 1999
http://www.liv.ac.uk/ctibiol/cube99/
ctibiol@liv.ac.uk

ALT-C
The Learning Technology Life-Cycle
September 21 – 23, 1999, Bristol, UK
http://www.ilrt.bristol.ac.uk/alt-c99/
inanyeventuk@msn.com

ComBio99
September 26 – 30, 1999, Gold Coast
http://www.sct.gu.edu.au/ASBMB/ComBio.html
asbms@camtech.net.au

Open, Distance, and Flexible Learning: The Challenge of the New Millenium
September 27 – 30, 1999, Geelong
ripvet@deakin.edu.au

34th APS Annual Conference
Psychology: Exploring Human Nature
September 29 – October 3, 1999, Hobart
http://www.psychsociety.com.au/news/fr_news.htm

IMSA '99
IASTED International Conference
Internet and Multimedia Systems and Applications
October 18 – 21, 1999, Nassau, Grand Bahamas
http://www.iasted.com/

EDUCAUSE'99
Celebrating New Beginnings
October 26 – 29, 1999, Long Beach, California, USA
http://www.educause.edu/conference/e99/
conf@educom.edu

WebNet 99
World Conference on the WWW and Internet
October 25 – 30, 1999, Honolulu, Hawaii, USA
http://www.aace.org/conf/webnet/
aace@virginia.edu

ICCE 99
New Human Abilities for the Networked Society
Asia-Pacific Chapter of ACCE
November 4 – 7, 1999, Chiba, Japan
http://www.ai.is.uec.ac.jp/icce99/
icce99@ai.is.uec.ac.jp

ICB-ICUC'99
Biometeorology and Urban Climatology at the Turn of the Millennium
November 8 – 12, 1999, Sydney
http://www.es.mq.edu.au/ICB-99/

Online Educa Berlin
5th International Conference on Technology Supported Learning
November 24 – 26, 1999, Berlin, Germany
http://www.online-educa.com/

ASCILITE 99
Responding to Diversity
December 5 – 8, 1999, Brisbane
http://www.tals.dis.qut.edu.au/ascilite99/

Second International Conference on Science, Mathematics and Technoplogy Education
January 10 – 13, 2000, Taipei, Taiwan
Ifisher@info.curtin.edu.au

GeoSciEd III
3rd International Conference on Geoscience Education
January 17 – 20, 2000, Sydney
http://www.agso.gov.au/geoscied/
glewis@agso.gov.au

M/SET 2000
International Conference on Mathematics/Science Education and Technology
February 5 – 8, 2000, San Diego, California, USA
http://www.aace.org/conf/

Apple University Consortium Academic and Developer Conference 2000
New Millenium, New Technology, New Worlds of Learning
April 25 – 28, 2000, Wollongong
http://auc.uow.edu.au/

CUMREC 2000
May 14 – 17, 2000, Arlington, Virginia, USA
http://www.cumrec.com/cumrec00/

ED-MEDIA 2000
World Conference on Educational Mulitmedia, Hypermedia and Telecommunications
June 26 – July 1, 2000, Montreal, Canada
http://www.aace.org/conf/edmedia/
aace@virginia.edu

UniServe Science is funded by The University of Sydney through the College of Sciences and Technology, the Faculty of Science and the University Information Technology Committee