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From the Director

The start of 1999 means, for us at UniServe Science, the end of our first year of operation away from the rule of CAUT/CUTSD. It was therefore an opportune time to sit back and think about where we are going. Having undertaken that exercise, two important issues emerged.

Firstly, there is the question of our national presence. Although we are now totally funded by The University of Sydney, we remain committed to trying to keep up the service we offer to science teachers on the national scene. We believe passionately that CAUT was correct when it set up the UniServe network. There was, and still is, a crying need on the part of teachers for information about information technologies. It is not a localized need. Teachers everywhere want this information. If there is an organization to satisfy this need, it makes no sense that it should be restricted to one university. In 1994 CAUT realized that it has to be nationally funded. Unfortunately it isn’t any longer. We are entirely supported by The University of Sydney, and therefore our national presence is being maintained by their far-sightedness – for which our heartfelt thanks.

When we started UniServe Science, we inaugurated a system of having personal contacts in every university science department in the country. It seems to us that it is time to refresh those contacts. Towards the end of last year we started a program of talking, in person, to as many of our contacts as possible. We have visited Perth and Adelaide and held meetings there. They were moderately successful, but we only managed to talk with a fraction of those we would like to have met. We’ll keep doing it, although it is expensive and time consuming. So we will in time get round to the rest of you. But if anyone can think of a more effective way to keep this vital exercise going, please let us know.

Secondly, and perhaps more importantly, there is the question of where we should be directing our efforts. In the four years of our existence we have assembled a lot of (we hope) useful information about software that can be used in teaching. Just go through the searchable database on our web site if you doubt that. Indeed we always called ourselves, “the Australian clearinghouse for educational software in science”.

But recently, our reading of the wider situation is that the use of IT in teaching is subtly changing. There seems to be less emphasis on individual software packages, and more on teaching structures. Indeed some of the important packages we identified when, for example, we were preparing our QuicKards are starting to date – and they don’t seem to be being replaced. Instead what developmental work there is around the country seems more and more to be directed towards organizing whole courses by IT means, particularly on the web.

Therefore it seems to us that we could usefully redirect some of our effort. We believe we need to devote more attention to means for re-engineering how courses are offered. Our searchable database, for example, needs to expand to start cataloguing (and evaluating) web sites, flexible learning tools, and so on. We won’t discard all the items already there, but we will remove obsolete items. For one thing, we believe that in a few years, when universities have become comfortable with the idea of using the web as a flexible teaching and learning environment for their students, developers will again start working on individual packages to be integrated into these new structures. To steal Arnold Schwarzenegger’s line: they’ll be back.

In the meantime, as a first step in this new direction, this year’s national workshop will reflect new orientation. It will be entitled “Tools for Flexible Learning”. (See pages 22 and 23 for more information.) I do hope you’ll be there.
Chemical Structure Drawing and Marking on the Web
Damon Ridley, The University of Sydney and Dave Proctor, Hampden Data Services

This article is reprinted, with permission, from the Proceedings of The University of Sydney Chemistry IT Workshop: Towards Web Teaching, November, 1998.

Background

Current tutorial programs in web-based teaching and learning are limited to text inputs. Thus, in the field of chemistry, while questions may be asked in text or graphic formats, answers may be text only. This has severe limitations in tutorials (particularly in organic chemistry) where the only effective way to teach and to learn is through chemical structure diagrams.

As there are many ways in which a single chemical structure may be correctly drawn, it would be totally impractical to create a library of correct structures against which student structures are to be matched. Accordingly, we have developed ChemMark-WWW, a chemical structure drawing and recognition web interface which enables chemical structures to be drawn and marked. The program automatically creates a structure connection table for the answer given by the student and matches it against the structure connection table for the answer provided by the instructor. Answers can be post-processed so that the student gets immediate feedback, and the lecturer can immediately see what marks have been awarded – and can also see exactly what the student did!

While it is a simple matter for teachers to insert their own questions into the program, the first release of ChemMark-WWW will have a number of already prepared tutorial questions. The questions cover the usual materials presented in First Year Organic Chemistry courses.

Example

The student logs into the server on which the program has been loaded, and enters his/her name and password (Figure 1).
Figure 2. Currently eleven tutorials have been prepared and will be part of the initial release. However, it is a relatively simple matter for the teacher to prepare additional tutorials. The student clicks on the tutorial to be answered.

A screen with the different tutorials is then shown (Figure 2). In its present form, each tutorial has between 10 and 20 individual questions.

A typical example begins in Figure 3. Each tutorial has a preamble through which the student reads and which gives a summary of the chemistry to be learnt/tested in the tutorial. At the bottom of this page the individual questions are listed and the student clicks on the question to be attempted. (Note that marks are progressively awarded and in this case (Figure 3) the student did not get Question 1 correct, but was correct in the answer for Question 10.)

As an example, Question 5 is now clicked and the question is presented, in this case in graphic format (Figure 4). The student then draws the answer using a simple structure drawing program and the answer is submitted (Figure 5). If the answer given is correct, two marks are awarded and the correct answer, and comments, are displayed (Figure 6). If the answer given is not correct, the student is told and is prompted to try again. If the second attempt is correct, one mark is awarded; if incorrect, no marks are awarded. In each case the correct answer and comments are displayed.
Figure 3. Each tutorial has an introductory section that outlines the general chemistry in the tutorial. The specific questions are then listed. The student clicks on the specific question to be answered.

Figure 4. An example of a question presented with a structure diagram. The student clicks on ‘Draw Query’ and the structure drawing program appears.

Figure 5. After the structure has been drawn the student clicks the ‘Back’ button and the question and answer now appear. The student clicks ‘Submit Answer’ and the attempt is marked.

Figure 6. The student then is told whether the answer was correct. If incorrect, the student is asked to retry. Eventually the correct answer, with teaching comments, is presented.
Logging of marks

The teacher may independently enter ChemMark-WWW, and display summaries of marks awarded. Marks are collated per student and per tutorial (Figure 7).

All the boxes are linked to the students’ answers, so by clicking a box the teacher can immediately see what the student has done (Figure 8).

General comments

ChemMark-WWW currently is restricted to structure input only, but stereochemical issues and reactive intermediates can be accommodated. For example, it is possible to ask a question: “Draw the structure of the intermediate formed when propene is treated with HCl”. Here the carbocation required is easily recognised by the program.

ChemMark-WWW allows for multiple answers to be drawn on the one page. Thus, in answer to a question: “Draw the structure(s) of the products formed when toluene is treated with a mixture of nitric and sulfuric acids”, the ortho- and para- products can be drawn in the one diagram. ChemMark-WWW also allows for alternative answers. For example, in answer to a question: “Draw the structure of the alkyl iodide and the carbonyl compound that could be used for the preparation of methylenecyclohexane”, either of the alternatives (formaldehyde/cyclohexyl iodide or cyclohexanone/methyl iodide) are accepted.

On the other hand, ChemMark-WWW does not handle the “arrow notation”, where in any case organic chemists have slightly different interpretations of what is “correct”.

While a number of questions will be available in the first release of ChemMark-WWW, it is a relatively easy task for the teacher to present specific tutorials. Text is entered into a simple word-processor program (for example, Notepad), and questions and answers that involve structures are prepared with the same structure drawing program used within ChemMark-WWW. ChemMark-WWW may be used at all levels in the teaching of organic chemistry and, where mechanistic aspects are required it is a simple matter to present questions that address the structures of the key intermediates.

ChemMark-WWW was alpha tested with a group of students in Chemistry 1 from The University of Sydney in September/October, 1998. Students learnt the structure drawing program in about 20 minutes. They found the program provided a very exciting and
informative way of learning organic chemistry. They liked the immediate feedback on their own answers, and the general comments. They listed a number of features and benefits (Table 1).

ChemMark-WWW is produced by Hampden Data Services, UK, in conjunction with The School of Chemistry at The University of Sydney. It will be available commercially, in Windows and Mac formats, early in 1999.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access through the web</td>
<td>Ease of access</td>
</tr>
<tr>
<td>Practice problems</td>
<td>Student works at own pace and develops skills</td>
</tr>
<tr>
<td>Marked problems</td>
<td>Computer marked structures overcomes need for labour intensive hand marking</td>
</tr>
<tr>
<td>Structure or text input of questions</td>
<td>Versatility; correlates with traditional options for presentation of questions</td>
</tr>
<tr>
<td>Introductory comments to tutorials</td>
<td>Facilitates teaching/learning</td>
</tr>
<tr>
<td>Easy-to-learn structure drawing</td>
<td>Saves time</td>
</tr>
<tr>
<td>Structure input of answers</td>
<td>Works on structure connection tables so accommodates all structure symbols and different structure presentation formats</td>
</tr>
<tr>
<td>Reaction intermediates and stereochemistry</td>
<td>Allows testing of mechanisms</td>
</tr>
<tr>
<td>Library of questions</td>
<td>Repetition helps learning</td>
</tr>
<tr>
<td>Specific questions easy to prepare</td>
<td>Minimal learning of program required</td>
</tr>
<tr>
<td>Available in any language</td>
<td>Allows teaching in all countries</td>
</tr>
<tr>
<td>Student and correct answers presented</td>
<td>Immediate feedback for students</td>
</tr>
<tr>
<td>Comments on answers</td>
<td>Facilitates teaching/learning</td>
</tr>
<tr>
<td>Marks processed automatically and available electronically</td>
<td>Saves time for teacher</td>
</tr>
</tbody>
</table>

Table 1. Features and benefits of ChemMark-WWW

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**Introduction**

Most Computer Mediated Communication (CMC) tools rely heavily on a human teacher to individualise the lesson through personal email or phone contact between instructor and student. The content is almost always static. However, many web-based educational applications are expected to be used by very different groups of users with minimal assistance from a human teacher, and hence there is a need for systems which can themselves adapt to learners with very different backgrounds, prior knowledge and learning goals. An electronic textbook is one of the most promising varieties of web-based educational systems, and is appropriate for the delivery of structured textbook-style content. In this paper we describe an approach for developing adaptive electronic textbooks through InterBook, an authoring tool based on this approach which simplifies the development of adaptive electronic textbooks on the web.

**Teaching and knowledge**

Before InterBook in particular or adaptive systems in general are introduced, it is worthwhile considering issues of teaching and knowledge, and how they are represented in instructional systems. One of the most fundamental and persistent questions in teaching and learning in both real and virtual environments is that of learner control. Jacobs¹ in a review of hypermedia and discovery-based learning demonstrates that there is a long history of this issue before the advent of hypertext or computers. How closely should a learner be monitored and directed? What freedoms should they be given to follow their interests and learn of their own accord? How should their progress be modelled and what kind of intervention strategies should be used to guide them in their learning? Instructional Technologists call it the instructionist verses constructivist debate, in educational computing it is known as the question of the locus of control.

**Knowledge-based systems**

Certainly the potential of courseware to interact with the student has improved over the years, largely because designers of software can write for more powerful computers. Entry-level computers can provide excellent graphics, mass hard-disk storage, several megabytes of memory, and sound capabilities. Developments in peripheral devices such as CD-ROM provide scope for developers of educational software to encode more complex routines using this more interactive media. Multimedia has enhanced the cognitive
flexibility of computer based learning through its ability to restructure knowledge presentations to meet changing situations.

These new features of microcomputers have become available in a very short time, and affordable hardware continues to develop at a startling rate. There is therefore good reason to think that the capabilities of tutorial software written for the next generation of computers will far exceed today’s standards, and provide a platform for a far more natural discourse between the student user and the computer. However, the success of the media as an instructional aid relies as much on its ability to parallel the cognitive processes of the learner through tracing the student’s acquisition of knowledge as it does on its ability to present the lessons in a stimulating and interactive way. The recent improvements in computer hardware, interface design and multimedia presentation have not addressed the problem of providing the computer with an understanding of the user, which we maintain is a critical attribute of an effective teacher. The complex field of user modelling is another new research area that has arisen from attempts to address exactly this problem.

Since microcomputers were introduced into education in the late 1970’s one of their primary uses has been as a teaching tool through the use of educational software. Some of the tutorial software, or courseware, over the past decade has been little more than a screen by screen presentation of content with questions which, when correctly answered, progress the student to the next screen of information. A common complaint, among many others related to implementing tutorial software in educational settings, has been an incapacity to adapt to the particular learning needs of the student user. An experienced teacher would know from the individual responses of the student which aspect of the work requires repetition, how explanations can be restated and what questions to put to the student before additional material can be given. The teacher can be considered to have developed a cognitive model of the student, that is, an understanding of the learner’s current knowledge in the subject domain, and has at his/her disposal a variety of teaching strategies to be deployed depending on student feedback and the nature of the information to be presented. The tutor works with a student model, a teaching model containing strategies for effective teaching, and an understanding of the lesson content including the relationships between the component parts in the knowledge domain, and is able to make adjustments to the flow of the tutorial by responding to the student.

While it has been generally argued that one of the strongest reasons for using computers in education is their ability to provide individualised instruction in tutor mode, one of the problems in making computer software more individualised and the student-computer discourse more natural is that as more branching capabilities are required to meet the enormous number of possibilities in student responses, it soon becomes impossible to implement. This is one of the reasons for the development of intelligent tutoring systems and subsequently adaptive educational systems.

Adaptive Educational Systems

While adaptive hypermedia is a new direction of research within the area of adaptive and user-model based interfaces, the goal of adaptivity has featured in the design of intelligent systems for a considerably longer period. It is worthwhile at this point to ask “What is adaptivity?” Adaptive hypermedia systems are capable of altering the content or appearance of the hypermedia on the basis of a dynamic understanding of the individual user, to adapt the content or presentation to certain characteristics of the user. The noted psychologist Piaget described intelligence as the ability of an organism to assimilate and to adapt its environment, and it is generally accepted that there are organisms which are more or less intelligent than others.

An Intelligent Tutoring System is typically strongly adaptive, working in a well-structured information space; gathering data about the user’s movements and using this information to dynamically modify the presentation and functionality of the system in clearly defined ways. It is also important to remember that adaptivity is not a technology, but a goal. Adaptivity is a common functional goal of intelligent systems. In summary, for a system to be called an adaptive hypermedia system it must have the following characteristics:
• be based on hypertext (or hypermedia);
• have an explicit user-model which records some features of the individual user;
• have a domain model, which is a set of relationships between knowledge elements in the information space; and
• be capable of modifying some visible or functional part of the system on the basis of information contained in the user-model.

Adaptivity may be at the content level or at the link level. Content-level adaptivity is the dynamic generation of content based on a user model. Link level adaptivity on the other hand assumes a static content, and the appearance or prominence of the links connecting elements of this hyperspace is altered. This is what is termed adaptive navigation support. Adaptive navigation support includes the use of user model based maps, link sorting, hiding and annotation. Adaptive annotation augments the links with a comment which provides the user with information about the current state of the nodes behind those links. This method has been shown to be especially efficient in educational hypermedia and this is the particular technology used in InterBook. Link annotations can be provided in textual form or in the form of visual cues, for example, using different icons, or colours, font sizes, or font types and so forth.

**InterBook - An adaptive educational system using link annotation**

As a web-based computer mediated courseware delivery tool, InterBook has no conferencing facilities, and may be best described as an environment in which structured textbooks could be presented in a multiply-navigable interface. Any knowledge base that contains reasonably specific and identifiable knowledge elements that can be organised hierarchically into sections, subsections and indexed in detail is suitable for delivery through the InterBook system. Technical and software manuals are an excellent example of suitable material. InterBook takes the structures commonly found in such a textbook (such as tables of content, indexes and glossaries) and delivers them on the web with navigation support, providing individualised assistance to each learner. All InterBook-served electronic textbooks have a generated table of content, a glossary, and a search interface. In InterBook, the structure of the glossary resembles the pedagogic structure of the domain knowledge in that each node of the domain network is represented by a glossary entry. Likewise each glossary entry corresponds to one of the “domain concepts”. All sections of an electronic textbook are indexed with “domain-model concepts”.

The knowledge about the domain and about the textbook content is used by InterBook to serve a well-structured hyperspace. In particular, InterBook generates contextual links between the glossary and the textbook. Links are provided from each textbook section to corresponding glossary entries for each of the involved background or outcome concepts. Similarly from each glossary entry which describes a concept InterBook provides links to all textbook units that can be used to learn this concept. This means that an InterBook glossary integrates features of an index and a glossary. These links are not stored in an external format but generated ‘on the fly’, in other words dynamically, by a special module that takes into account the student’s current state of knowledge represented by the user model.

InterBook uses coloured bullets and different fonts to provide adaptive navigation support (Figure 1) through link annotation. Annotations are evident in the individual section of the text (in the textbook window) as well as in a local overview map (on the navigation bar). Wherever a link appears on a page (in the table of content, in the glossary or on a regular page), the font and the colour of the bullet informs the user about the status of the node behind that link. Currently four colours and three fonts are used. A green bullet and bold font means “ready and recommended”, i.e. the node is ready-to-be-learned but still not learned and contains some new material. A red bullet and an italic font warn about a not-ready-to-be-learned node, while white means “clear, nothing new” (i.e. all concepts presented on a node are known to the user). Violet is used to mark nodes which have not been annotated by an author. A check mark is added for already visited nodes. A node is annotated green when all of the prerequisite concepts for that node have been met. In other words, the particular user has previously visited a node or nodes which have those prerequisite concepts listed as outcome
concepts. Obviously the initial node will have no prerequisite concepts, only outcome concepts. A node is annotated red (a not-recommended node) when it contains prerequisite concepts that have similarly not been met. Outcome concepts are ‘met’ when a node is simply visited.

Figure 1. Adaptive link annotation in InterBook using the traffic-light metaphor

Certainly, in order for this form of markup to be useful, the textbook needs to be used in a particular way: It assumes that the path of a user will be approximately linear (in the sense that ‘linear’ means the same path through the information space as is the optimal path sequenced by the author). Suppose for example that a learner decides to enter the textbook at section 2 rather than section 1. They may decide from the headings that this general topic is rather simple and not want to begin at section 1. In this case they would receive ‘not recommended’ annotations throughout their subsequent movement through the hyperspace. This problem, and the fact that InterBook assumes that a page is learned when it is simply accessed, prompted the development of embedded tests in later versions. Later versions of InterBook integrate all three methods of annotation: history-based (on the basis of where the user has been), prerequisite-based (on the basis of what prerequisite nodes the user has visited), and knowledge-based (on the basis of the user’s demonstrated understanding of the content).

The user model in InterBook is initialised from the registration page via a stereotype model, and is modified as the user moves through the information space. The user model consists of an individual file in a folder called “users”, which is updated as the student progresses through the material.

The InterBook approach uses two kinds of knowledge: knowledge about the domain being taught (represented in the form of a domain model) and knowledge about the students (represented in the form of individual student models). The domain model serves as a basis for structuring the content of an adaptive Electronic Textbook. The simplest form of domain model is just a set of domain concepts. What we call ‘concepts’ are named differently in different research papers – attributes, topics, knowledge elements, objects, learning outcomes, but in all cases they are just elementary pieces of knowledge for the given domain. A more
advanced form of the domain model is a network, with nodes corresponding to domain concepts and links reflecting several kinds of relationships between concepts. This network represents the structure of the domain covered by a hypermedia system. The domain model provides a structure for representation of the student’s knowledge of the subject.

For each domain model concept, an individual student’s knowledge model stores some value which is an estimation of the student knowledge level of this concept. This type of model (called an overlay model) is powerful and flexible: it can independently measure the student’s knowledge of different topics. The overlay student model can be kept up-to-date relatively easily. All student actions (page visits, problem-solving, quiz answering) are tracked and used to increase or decrease knowledge levels for involved concepts.

Another component of the student model is the model of a student’s individually assigned learning goal. Adaptive guidance mechanisms will ensure that the student achieves a sequence of assigned learning goals.

Authoring an adaptive electronic textbook can be divided into 5 steps. In brief, an Electronic Textbook is prepared as a specially structured Word file and the task is to convert this file into InterBook format. InterBook recognises the structure of the document through the use of headers using predetermined text styles. The second step in the authoring process involves concept-based annotation of the Electronic Textbook to let InterBook know which concepts stand behind each section. An annotation is a piece of text of special style and format inserted at the beginning of each section (between the section header and the first paragraph). For each unit the author provides a set of outcome and background concepts. In this way, each section is annotated with a set of prerequisite concepts (or terms which exist in other sections which should be read before the current section), and a set of outcome concepts (terms which will be assumed known once the reader has visited the section).

Once the annotations are complete the file is saved in RTF format. The RTFtoHTML program (http://www.sunpack.com/RTF/) with some special settings is used to convert the Electronic Textbook into HTML format. Then the “.html” extension on the file is manually altered to “.inter” so that it can be recognised by the Interbook system. Lastly, when the InterBook server starts, it parses all InterBook files in its “Texts” folder (i.e. all files with extension .inter) and translates it into the list of section frames. Each unit frame contains the name and type of the unit, its spectrum, and its position in the original HTML file. The obtained LISP structure is used by InterBook to serve all the available textbooks on the WWW providing the advanced navigation and adaptation features. The content which is presented to the student is generated on-the-fly using the knowledge about the textbook, the student model, and HTML fragments extracted from the original HTML file. These features of InterBook are based on the functionality of the Common Lisp Hypermedia Server.

Application of adaptive systems to flexible delivery in higher education

We believe this tool significantly simplifies the design of an adaptive electronic textbook on the web. It provides full support in preparation and serving such a textbook for authors who need only to be familiar with a word processor.

Brusilovsky, Eklund and Schwarz made the case for the use of knowledge-based systems in higher education as one which provides a unique solution to the fact that students are entering web-based instruction with very different knowledge, goals and backgrounds. Most courseware is aimed at the ‘average’ student, and does not account for minority groups, such as those with language difficulties, exceptional skill or poor subject knowledge. Accordingly, three steps in courseware development were suggested: first, the development of the content implemented with a variety of instructional strategies such as questions, interactive examples and problems; second, the refinement of the materials to suit the requirements of the current student population; and third, the use of adaptive mechanisms which personalise the hyperspace of individual students to account for individual knowledge and preferences. Personalising course materials on these three levels of granularity is not only part of the process of authoring effective courseware, but also critical in utilising the computer as an instructional medium offering some of the benefits of one-to-one human tutoring.
Conclusion

This paper supports the use of knowledge-based systems, in particular adaptive educational systems, for the flexible delivery of course materials in higher education. These systems recognise the importance of individual learner knowledge, as adaptive systems can customise courseware and take part of the role of the human teacher in individualising instruction. We have based our arguments on a practical model of the role of knowledge in teaching and learning, and demonstrated adaptivity in computer based educational environments through InterBook, a tool for delivering adaptive textbooks on the World Wide Web. InterBook uses adaptive annotation technology, a form of adaptive navigation support, to augment hyperlinks with a comment which informs users about the current state of the nodes behind the annotated links, and does this on an individual basis by adapting links through a user-model, an individual record of a student’s progression through the courseware.

References

Two “Promoting Active Learning in Introductory Physics Courses” workshops were held in January, 1999, one in Sydney and one in Melbourne. They were organised by UniServe Science on behalf of the National Science Foundation in the United States and its Chautauqua project. The presenters were Priscilla Laws (Dickinson College), David Sokoloff (University of Oregon) and Ronald Thornton (Tufts University). The workshops attracted Physics lecturers and teachers from most Australian states, New Zealand and a number of lecturers from Asia through Asian Physics Educators Network (AsPEN) sponsored by UNESCO.

This short course certainly lived up to its name! It provided a wide range of appropriate opportunities for students to actively revisit conceptual aspects typically covered in a first year tertiary physics course. The scope of the written materials and microcomputer-based laboratory (MBL) tools is even broader than this as it would also be put to extremely good use at a high school level.

I greatly appreciated the generosity, wisdom and extensive experience of the presenters in highlighting methods to ascertain “where students are at” through conceptual assessment. Laboratory exercises adopted to enable students to grapple with and come to better understand conceptual aspects of physics were also extremely pertinent. Furthermore the materials expose students to mathematical modelling using the MBL software and spreadsheets, and interpretation of real life motion is able to be conducted by the provision of interactive video analysis. An extensive library of video clips was included for analysis and instruction was provided regarding the production of “home-made” video clips for analysis.

The instructional materials presented were highly practical, illustrating a commonsense, straightforward approach. Categorically I would say students would truly enjoy learning physics if they were given the opportunity to adopt the use of these learning tools!
The ASCILITE 98 Annual Conference of the Australian Society for Computers in Learning In Tertiary Education (ASCILITE 98) was held at the University of Wollongong from 14th to 16th December 1998. The conference was attended by over 250 delegates from all states of Australia, as well as New Zealand, United Kingdom, Europe, Africa, Asia and North America.

The programme included four keynote speakers, over 50 paper presentations, 20 shorter presentations on works-in-progress and 10 poster presentations.

The keynote addresses followed the theme of Information Technology: the past, present and future.

Geoff Hamer (Centre for Educational Development and Interactive Resources, University of Wollongong) delivered a short history of IT drawing largely on his personal experiences. Many who attended this address are probably still wondering what IBM really does stand for.

Two different views of the present were presented by Betty Collis from the University of Twente, The Netherlands and Beth Cavallari from the University of Queensland.

Betty demonstrated a project, TeleTOP, currently being used in the Faculty of Educational Science and Technology. This project has involved the redesigning of all of the courses within the faculty reflecting a new instructional approach and makes substantial use of the web as a mechanism for support within the course.

While acknowledging the success of many Australian-developed multimedia packages, Beth questioned the lack of foresight, support and funding being directed towards development of educational software. She made a plea for Australian universities to collaborate in the research into the effectiveness of multimedia as an educational tool, and also, the planning, funding, application for grant monies, production and marketing of IT resources.

In his address about the future of information technology, David Jonassen from Pennsylvania State University, discussed some directions in which technology might transform education.

Contributed papers covered a variety of technology uses with, as might be expected, a high proportion of web-based applications. From the papers I attended, it appears many academics are using the web for communication with and between students, both synchronous and asynchronous, and a number of interesting projects were discussed. While many institutions are using commercially developed web tools such as TopClass and LotusNotes, some locally produced packages such as WebTeach (UNSW) were demonstrated. Assessment is another area where there has been some interesting web-based projects e.g. WebMCQ (The University of Sydney). The resource page on the inside back cover of this publication contains a brief description and URL for web tools that were highlighted at the conference.

Another topic that attracted a number of presentations was the use of technology to facilitate learning environments such as problem based, role play and open-ended learning.

Presentations of science based teaching materials included a CAL module for the interpretation of satellite meteorology, flexible learning modules for fundamental concepts in electro-magnetism, interactive multimedia package for teaching photosynthesis and other resources for introductory biology practicals.

A full transcript of the proceedings in Acrobat format can be found at http://cedir.uow.edu.au/ASCILITE98/ ascpapers98.html

Congratulations to the recipients of the ASCILITE Awards. Successful projects included:
Best student project
Lori Lockyer (University of Wollongong) – Health and Health Behaviour.

Best small project
Mary Peat and Sue Franklin (The University of Sydney) – Photosynthesis Experiments.

Best large project
Ingrid Scholten (Flinders University) – The Dynamic Swallow.
John Hedberg (University of Wollongong) received a highly for StageStruck.

Best Internet or World Wide Web usage project
Mark Freeman (University of Technology, Sydney) – Anonymous Asynchronous Web-based Role Play.

The conference dinner was a journey to the land of the “Arabian Nights”. Belly-dancers, Middle Eastern music and a snake man entertained dinner guests. Anne Porter from Wollongong proved she has skills beyond statistics by winning the belly-dancing competition.

The theme for ASCILITE 99 is “Responding to Diversity”. It is to be held in Brisbane at the Queensland University of Technology from 5th to 8th December 1999. The website is http://www.tals.dis.qut.edu.au/ascilite99/

Sue Franklin and Mary Peat (UniServe Science Director) with their award for Best Small Project.

Apple University Consortium Conference – Flexible Learning: Exploring the myths and realities

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The 1998 conference was held in Melbourne over two and a half days and attended by over 300 delegates from twelve Australian and six New Zealand universities belonging to the Apple University Consortium. The theme “Flexible Learning” was picked up by each of the keynote speakers and between them they explored the issues of delivery using technology, how to support flexible thinking with interactive multimedia, enhancing relationships in educational organisations with the use of technology, and the development of high bandwidth classroom resources. The conference had a special focus on distance education over the Internet.

Dr Blaine Price from the Open University, UK discussed how they have moved away from the traditional delivery modes of paper, cassette and video to using the Internet to deliver courses to Britain and Europe. The sheer size of the operation is mind-boggling but it is now successfully operating in IT mode. Blaine also talked about the service that is being provided to British primary and secondary schools that links them with high-speed low-cost wireless connections to the University’s backbone. This provides them with fast Internet access as well as the University’s high-speed servers and caches. This service deserves some consideration by all our universities.

Highlights of the conference included a discussion of “High Tech” versus “High Touch” and a demonstration of a piece of software (InterBook) that has been developed to support this approach. The software was being trialled by John Eklund at the University of Technology, Sydney. In “High Touch” learning, the teacher modifies the material delivered to the students depending on his/her level of understanding of previous content. InterBook attempts to mirror this behaviour by highlighting topics in the table of contents in earlier sections. Students still have the freedom to follow their own path through the
material and not follow the recommended path. For more information, see the article on page 8 of this publication. Further details about InterBook can be obtained from http://www.contrib.andrew.cmu.edu/~plb/InterBook.html

A number of sessions were dedicated to new technologies and some revisited old technologies being used in an innovative way. These included AppleScript being used to automate complex routine tasks (Andrew Winter, Architecture, The University of Sydney) and QuickTime Virtual Reality (QTVR) (Roy Tasker, University of Western Sydney Nepean). QTVR can be used to interactively rotate objects or move around inside a 360 degrees panorama using a mouse. Roy has used QTVR to not only rotate models of chemical compounds but also to change the way in which the model is displayed. By moving the mouse vertically in the movie, the chemical model changes from a ball and stick to electron density, chemical formulae, or specialised chemical notation. A demonstration can be found at http://vischem.cadre.com.au/html/qtvrobjects.html

WebObjects is a powerful Internet tool for accessing information contained in any number of dissimilar databases anywhere in the world and delivering it to a single web page. Marie-Therese Barboux Couper (The University of Sydney) is doing some innovative work with the package. WebObjects can be seen at http://www.apple.com/webobjects/

WebByte No 4
Using TopClass in Biochemistry

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TopClass (WBT Systems) is a web-based education program which the University of Technology, Sydney (UTS) has adopted for use in its flexible learning program. In 1998 it was decided to introduce TopClass into the clinical biochemistry subjects that UTS offers to senior undergraduate and postgraduate students. These subjects were chosen because many of the students enrolled in them also work part-time or full-time in laboratories throughout the Sydney region and have difficulty in attending the university outside the scheduled class times. However, most have access to the Internet, either from home or from work, and can therefore make use of web-based materials. TopClass operates as a secure system in so far as users must be registered class members in order to gain access to the relevant course materials. Each course comprises one or more units of learning material (ULMs) which may include lecture notes, hyperlinks to other web sites, and tests of various kinds. TopClass also enables students to view announcements relating to their classes (e.g. lecture and practical schedules, due dates for assignments etc), facilitates communication with other students and instructors through an internal message system, and allows users to see and contribute to discussions through subject specific discussion lists. Learning materials provided for clinical biochemistry students comprised course notes, links to other sources of information including the web sites of various professional and scientific associations, and a series of multiple choice tests relating to each of the broad topics covered in the subjects. The tests were included only for the purpose of self-assessment and normally provided feedback on incorrect answers, mostly through hyperlinks to the course notes since comment boxes were restricted to 256 characters. In addition to the above, a limited number of discussion topics was set and students were invited to contribute. Participation in discussions was taken into account in the formal assessment of students in the subject. When the subjects were evaluated it was revealed that 83% of the 46 students who responded to the questionnaire agreed or agreed strongly that the self-assessment tests were useful in assessing their understanding of the subject. On the other hand, only 54% wanted more use of the discussion topics,
though 24% gave a neutral response to this question. Given that student learning is largely assessment driven and that the self-assessment tests were constructed in a way that assisted students to prepare for their formal examinations, the results of the evaluation are perhaps not surprising. However, they are encouraging and the system is to be used again in 1999, refined so as to place greater emphasis on feedback through the self-assessment tests. The value of web-based discussions for undergraduate students is uncertain but as the response was generally neutral to favourable it has been decided to retain them but to offer a wider variety of topics in an attempt to engender greater interest. In summary, our early work with TopClass has shown us that web-based materials can assist students through providing greater flexibility in their studies. However, our experience also suggests that they are most valuable as enhancements to, and not simply as replacements for, other forms of learning.

WebByte No 5

**GEOSKILLS: An Introduction to Spatial Data**

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*Geoskills* is a computer aided learning package designed to give earth scientists a better appreciation on how spatial data are collected and used and some of the assumptions made along the way. It is hoped that geographers, geologists, planners, anyone who handles spatial data will find *Geoskills* useful.

The CD opens with a brief introduction illustrating how spatial data might be used in monitoring and managing floods. There are 6 main modules, the first of which deals with the ways in which we model the Earth, covering topics such as the size and shape of the Earth, map projections and coordinate systems.

The second module gives a brief overview of methods of collecting spatial data using conventional surveying, photogrammetric and global positioning systems. The third module covers cartographic problems with an emphasis on the problems of scale and symbolisation. The fourth module is concerned with how the third dimension of elevation is modelled. An introduction to Geographic Information Systems is the subject of the fifth module and the final module covers remote sensing, including an introduction to satellite remote sensing and digital image processing.

The CD includes animations, interactive exercises and a workbook in *Adobe Acrobat* format on the CD. A sample of some of the *Geoskills* modules may be found by going to my home page at http://www.une.edu.au/ajones/ajones.htm At this stage negotiations are under way for publication of the CD. If you would like to know more please email me at ajones@metz.une.edu.au

**Congratulations**

Congratulations to regular contributors, Dr Nathan Scott and Professor Brian Stone, of the Department of Mechanical and Material Engineering, University of Western Australia. They won the inaugural Australasian Engineering Education Award for innovative teaching.

The Australian Award for university Teaching in Science was won by Professor Richard Russell, School of Biological and Chemical Sciences at Deakin University.
The Integrator for Biological Psychology

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This package sets out to supplement some second or third year topics as presented in a related textbook, “Biological Psychology” by James Kalat (same publisher as CD-ROM). The function of the software is primarily designed (although not explicitly stated) for teaching concepts, for use in the classroom, and for testing students. The package can be used by students without supervision (ideal), by students in laboratory classes, or by teachers during lecture classes (with the associated lecturemaker package). The material covered is factually correct and probably pitched at the right level for the users at second Year University level. The navigation options allow students to explore the material in any order they choose, or to follow the logical within-chapter order as given. The inclusion of animated explanations and interactive parts of the study enhance the topics considerably. The factual information present in the package is insufficient for a standalone study tool.

The aspect of the package designed for lecturers is easy to use and allows images and animations to be assembled into a lecture/presentation. This can be managed with the supplied software or can be exported to Microsoft PowerPoint for delivery. The flexibility here is very reasonable, but would be further improved if some of the Microsoft drag and drop attributes were supported.

The documentation is sparse, but the user should not have to consult the user manual or readme files. One annoying feature is for floating descriptions to appear when the mouse hovers over a hyperlink. While the information is welcome, it covers up the other choices in the list.

The major drawback with the package is the assessment/quiz section. The answers have to be exactly as the authors decided the answer should be. For example, critical period was “incorrect”; the “correct” answer given was sensitive period or critical period. This is one example of many.

Overall, fairly impressive, but should be used as an adjunct or teaching aid for a textbook covering the same material – it will probably assist sales of Kalat’s text.

(See page 21 for product information)

Interactive Biochemistry – Metabolism

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The CD-ROM, Interactive Biochemistry – Metabolism, has been developed by staff of the Department of Biochemistry and Molecular Biology at Monash University. The package is directed at students studying in that department, but has also been designed with a view to the South East Asian market. The format comprises a series of tutorial exercises on the following topics: Role of Water in Biology; Metabolic Release of Energy; Biosynthesis of Carbohydrates and Lipids; Amino Acid Metabolism; and Integration and Regulation of Metabolism. Each tutorial contains a mixture of static text screens, interactive screens, and animated diagrams such as those in the Electron Transport topic within the Metabolic Release of Energy tutorial. Here there are excellent representations of the movement of electrons between the redox carriers, the movement of protons from the mitochondrial matrix to the inter-membrane space, and the synthesis of
ATP occurring as the protons move back to the matrix via the F0F1 – ATPase. Cell-signalling mechanisms, covered in the Integration and Regulation of Metabolism tutorial, are also depicted using excellent animations.

In addition to the tutorial topics, there are two exercise sections. The first, The Great Metabolic Race, tests the students’ understanding of the catabolism of carbohydrates and lipids. The second, The After Race Banquet, deals with the synthesis of carbohydrates and lipids.

Students are tested in a number of ways: answer true/false questions; ‘drag and pull’ answers to the correct boxes, click on the correct answer and type in the answer. Points are awarded in these exercises. There is also a separate selection of multiple choice questions from past exam papers. No points are awarded for performance in these questions, but the student is advised whether or not his/her answer was correct.

Several of my students have ‘reviewed’ the CD-ROM for me. Without exception they enjoyed using the program, found that it was easy to use, and said that they would like to have access to the program at university. They all saw it as supplementing their lectures, rather than replacing lecture material.

The content in the topics is comprehensive, and some universities may not cover all the material available on the CD-ROM in their lectures. However, my students readily identified what was applicable to their course. There is reference to a set of notes that accompany the computer program, but I did not receive these with the CD-ROM.

The CD-ROM is available as a single purchase or as a site licence. The cost seems acceptable to the market as students indicated they would be prepared to purchase the package. Technical requirements are Windows 3.1, SVGA 800x600, 256 colours. A potential problem with running the program is with machines having SCSI CDs. I am told that most modern CDs have IDE drives, so this is not likely to be a major problem. However, one of two computers in our library has a SCSI CD, and would not accept the program. The CD-ROM is currently available from the developers.

I believe the package to be an excellent aid to studying Metabolism. It gives a visual dimension to what can be difficult conceptual ideas. For example, it leads students through metabolic pathways step by step, showing the changes happening in a dynamic way. I believe students would benefit from having access to the program. In fact, I liked it so much I have ordered it for myself!

(See page 21 for product information)

Psyche: Experiments that Changed Psychology

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Psyche: Experiments that Changed Psychology is a multimedia CD-ROM that provides “hands on” experience for first year psychology students to some of the most famous experiments in psychology. There are 5 experiments from social psychology (incl. attitudes, personality and communication) and 11 experiments from cognitive psychology (incl. perception, attention, memory and learning). After each experiment, the student’s data is compared with the real data. The experiments are supplemented by an accurate, though moderate, amount of background material, discussion of the results, references, and further questions. Vital terms are highlighted so that the student may obtain a definition with a click of a button. Psyche: Experiments that Changed Psychology could be used by students working independently at their own pace. Alternatively, the package could be used in a group setting for administering the experiments with background information and follow-up discussion supplied by the instructor. Psyche has a colourful interface that should be mastered by students with even modest computer experience. Cartoon characters also adorn the display, although some instructors may find them a little “childish” for a university
setting. The fact that the “brainlinks” section begins by zooming in on a dog’s head only to show a human brain inside may be disconcerting to some. Nevertheless, this brainlinks section is a highlight as it lets students perform virtual lesions to pinpoint which brain areas are relevant to each experiment (excluding social psychology). The final feature is a discussion of report writing. Though the discussion is brief, it is wonderful to see this important topic included in a package aimed at introductory psychology students. 

Psyche does contain some limitations. For instance, it is not possible to print out the text from each section. It is also unfortunate that a wider cross-section of experiments was not sampled as courses often include other topics, such as development and psychopathology. Nevertheless, Psyche is a quality product that has the potential to improve the quality of teaching in first year psychology.

(See product information below)

The Video Encyclopedia of Physics Demonstrations

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The Video Encyclopedia of Physics Demonstrations is a set of 25 twelve-inch laser discs containing an archive of 600 standalone Physics demonstrations. The target audiences are high school and junior year university students. The whole range of physics at this level is covered: mechanics; waves; sound; fluid dynamics; heat and thermodynamics; electricity and magnetism; optics; and modern physics.

The physics content and its presentation is excellent. In the School of Physics, The University of Sydney, the Encyclopedia is used in two ways. To provide alternatives to lecture demonstrations when the equipment for a live presentation is unavailable, and as an inspirational resource for a lecturer preparing a new course. The demonstrations on the laser disc show what apparatus is required to illustrate a particular point and how it can be used to greatest effect.

The twelve-inch laser disc is not a common medium in Australia. This has two consequences. Firstly, each individual lecturer must become familiar with the use of the laser disc player and remote control to select the particular demonstration on the disc. Although it is possible to quickly move from one item to another on a single disc, it is not as easy as using a mouse to select an item on a computer screen.

Secondly, the financial outlay goes well beyond the cost of $US2995 (plus shipping and handling) for the laser discs and will cause many to have second thoughts. We spent an additional $A1172 (tax-exempt price in 1995) on a Sony MDP-A3 CD/CDV/LD player with remote control. A large screen television receiver that accepts the US standard output from the laser disc player may be an additional expenditure.

Product Information

The Integrator for Biological Psychology is available from
Brooks/Cole Publishing Company
511 Forest Lodge Road
Pacific Grove, CA 93950-5098, USA
Tel: (408) 373 0728

Psyche: Experiments that Changed Psychology is available from
Jacaranda Wiley
PO Box 1226
Milton, Qld 4064
Tel: (07) 3859 9755

Interactive Biochemistry – Metabolism is available from
Department of Biochemistry and Molecular Biology
Monash University
Clayton, Vic 3168
Tel: (03) 9905 3740

The Video Encyclopedia of Physics Demonstrations is available from
The Education Group
1547 Sunset Plaza Drive
Los Angeles, California 90069, USA
Dr Roy Lundin is Senior Lecturer in Education at the Queensland University of Technology (QUT). He has been an educator and trainer for 41 years at all levels of schooling, college, university and private industry. In 1970 he became one of Queensland’s first of 25 secondary teacher-librarians. He has specialised in and pioneered the use of communications technology for open learning, distance education, business and industry, particularly for continuing professional development, training and management. He has had over 40 major consultancies across Australia and internationally in the past 20 years dealing with all aspects of teleconferencing, distance education, open learning, system training networks and government policy. He was responsible for obtaining $4.5 million from the Queensland government for the Queensland Open Learning Project of which he was General Project Director, 1989 to 1991. He has worked with the Queensland government on several projects, including trialing and evaluating satellite and videoconferencing applications for government services and training. He has had over 120 papers, chapters, books and reports printed and published, including training manuals in the applications of teleconferencing in education and training, and he has presented over 220 conference papers.

He has worked with a large range of professional groups, including teachers, nurses and health workers, engineers, IT industry vendors and consultants, accountants and government public servants. For example, he was Project Director of two major consultancies on Open Learning for Teachers’ Professional Development for the Australian Department of Employment, Education and Training, he produced a National Report for the Australian Principals’ Associations Professional Development Council (APAPDC) and was Project Director for the recent implementation of three pilot projects using technology for the flexible delivery of principals’ professional development programs. In 1995 he was Project Co-director on a major consultancy Project on Rural Health Communication and Information Technology (PRHCIT) funded by the Commonwealth Department of Human Services and Health. Since 1994 he has been a Principal Researcher working on a four year project investigating rural women’s use of communication and information technology. From 1990 he has worked with the Institute of Chartered Accountants for the development of their programs for professional development by audioconferencing, interactive satellite and computer communication.

He has investigated all aspects of telecentres, open learning centres and telecottages in North America and Europe (including Sweden where telecottages originated) as well as with the telecentre initiatives in Australia. He was Founder and President of the Australasian Teleconferencing Association (ATA) in 1992–93 and 1995–96, and editor of the ATA Newsletter and The Australian Teleconferencing Directory. His research work focuses on the instructional design of teaching and learning programs using various forms of interactive media, including global networking. During 1997, QUT granted him six months Professional Development Leave and funded his investigations in North America and Europe to look at flexible delivery of professional development programs. In collaboration with Professor Barry Brown, University of Saskatchewan, Canada, he is jointly producing an on-line ‘living book’ on the Internet on this topic.
UniServe

S C I E N C E

W O R K S H O P

Tools for Flexible Learning

The fourth annual workshop will be held at The University of Sydney on Friday, 9th April, 1999

Registration: $75.00

Programme

Keynote Speaker— Dr Roy Lundin, Queensland University of Technology

Web Tools — Demonstrations and Discussions
TopClass, WebCT and WebTeach

Papers — Strategies for Flexible Teaching and Learning

Posters — Assessment in a Flexible Learning Environment

For information updates, on-line registration, programme, abstracts and accommodation information, see the workshop web page at http://science.uniserve.edu.au/workshop/flearn/

Proceedings of previous workshops are available at http://science.uniserve.edu.au/pubs/procs/
The Role of Videoconferencing in Enhancing Teaching/Learning Via a “Virtual Faculty”

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Introduction

This project investigated the feasibility of developing a “virtual faculty” for the teaching of upper undergraduate, honours and postgraduate chemistry specialisations at regional and remote universities. The project was a collaborative, inter-university one and involved staff at Central Queensland University, Deakin University, the Northern Territory University, and the University of Tasmania. The project came about as a result of the recognition that such endeavours provide opportunities for students in regional universities to participate in a wider range of specialisations while remaining within their home institutions. This could have a direct impact on retaining honours and postgraduate students within these institutions. Additionally, it was seen that the future of many small university departments are under threat as a result of the current trends in education, that is globalisation and economic rationalism, and ways need to be found both to maintain existing facilities and to increase the viability of course offerings.

Description of the project

Using Chemistry as a test vehicle, the CUTSD project aimed to examine the role of inter-university collaborative teaching via videoconferencing. Students undertaking final year, honours or postgraduate courses in small universities may be considered to be disadvantaged because of the limited specialist expertise that is within the institution. Because Chemistry is a discipline that is characterised by a remarkable diversity, only very large departments can afford the staff to cover all the areas outside the core offerings. Thus, chemistry departments tread a thin financial line between capital investment in equipment and additional teaching staff, both of which are essential for a well-rounded chemical education. This is a particular concern to regional universities who need to have both the equipment required and highly qualified staff in order to be able to offer viable courses. Most regional institutions have foci of expertise, albeit though small, which, if combined together, would represent a formidable range of teaching talents. Collaboration between universities could also be considered as the only means of maintaining some courses in specialised areas where numbers are too small in one university to make the offer of such a course viable. The wide scale adoption of telecommunications technologies across Australian universities offers a viable avenue for linking together clusters of expertise to form a “virtual faculty”. By means of a “virtual faculty” senior Chemistry students in small science departments at regional universities were able to access classes offered by experts at distant centres. This exposure to a range of experts encouraged not only cross fertilisation of ideas between lecturers and students but also broadened isolated students exposure to a range of expert knowledge. The use of videoconferencing in this context promoted opportunities for peer and collaborative learning and thus provided richer learning environments for small groups of geographically dispersed students (Bourdeau, Ouellet and Gouthier, 1998).

This project was seen as a crucial test of inter-university cooperation and a key option in enabling smaller universities to maintain vigorous, high quality degree programs in the face of competing demands on finances in a climate of increasing budgetary constraints.
Outcomes of the project

There were several significant outcomes of the project that had positive benefits for students, staff and institutions. These included:

- the involvement of students and staff from participating universities in chemistry studies that were not necessarily available from their own universities;
- enhancement of students learning experiences by providing both a broader educational base and the opportunity to participate in very specialised units of study through exposure to a wider range of specialist expertise;
- the opportunity for small group tutoring and interaction with the remote lecturer which provided for in depth exploration of topics in a supported environment;
- the opportunity for participating students to interact with peers from other locations and different learning backgrounds;
- a unique opportunity for staff development through learning from the specialist expertise of colleagues at universities remote from their own; and
- student willingness to accept inconvenient class times and timetable clashes in order to be able to participate in what they consider a unique and valuable opportunity to broaden their educational understanding of their discipline.

Considerations for Teaching and Learning

The introduction of technology into the teaching and learning context can encourage the redesign of teaching and learning activities which focus more on the learning benefits that can be provided for students using these environments. This means that more student-centred approaches to teaching and learning can be integrated into courses and units of study. In this project both staff and students could see the opportunities for interaction and students in particular were keen to take advantage of these opportunities (Burke, Lundin and Daunt, 1997). However, in the early stages of using technologies such as videoconferencing interaction is unlikely to occur in a spontaneous fashion (Klease, Andrews and Druskovich, 1996). In order to cater to this, interaction was planned as part of the teaching and learning process with activities built in that provided opportunities for interaction. This process of changing from a didactic model to a more interactive one requires both considerable staff development and instructional design input, highlighting the team nature of effective technologically mediated teaching and learning environments (Knox, 1997). Students as well require assistance to develop the skills and abilities to operate effectively in more student centred teaching and learning environments. Most students find such approaches beneficial and comment that they have a positive effect on learning, but there is a period of adjustment which needs to be actively supported.

Considerations for effective implementation of “virtual faculties”

There are several important considerations in developing “virtual faculties” including institutional compliance, staff development and student preparation. The existence of institutional compliance is a critical success factor in establishing “virtual faculties”. Projects such as this require considerable cooperation and collaboration between participating universities, lecturers, administrators and technical support staff (Barajas et al, 1998). Consideration needs to be given to the following issues:

- clear understanding of roles and responsibilities of all participants and participating institutions;
- adequate forward planning and lead time;
- timetabling;
- sharing of resources – facilities, staff, units of study;
- appropriate technical support;
- administrative support;
- unit and course accreditation;
- assessment;
- embedding into university structures – prioritisation and strategic planning;
- intensive, comprehensive, ongoing staff development is required to assist staff to successfully adapt their teaching and learning practices to a videoconference environment – this adaptation includes the planning, design and delivery of teaching and learning activities best suited to this
environment and the ability to operate effectively in what can be a “fragile” environment; and

- student preparation for learning in technologically mediated learning environments is an important factor in encouraging participation and interaction in videoconferenced teaching and learning activities.

Both staff and students from participating institutions acknowledge the enhancement of teaching and learning opportunities provided by such “virtual faculties”, particularly where effort is made to directly involve the students in the teaching and learning process (Schiller and Mitchell, 1993). Students felt that in spite of inconveniences such as early start time and the occasional technological glitches, the opportunity to participate in additional or different areas of chemistry specialisation greatly enhanced their overall knowledge and understanding of their discipline as well as further developing their problem solving skills. This opportunity also provided them with an understanding of their level of knowledge and skills in relation to students at other universities, an experience which served to increase their confidence regarding the quality of their previous learning experiences.

References


The Virtual Cell Biology Laboratory

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Introduction

A number of major difficulties limit effective instruction in cell biology. Chief among these is that cell biology relies heavily on advanced microscopes for the acquisition of data. These microscopes are expensive ($200,000 for an electron microscope, $300,000 for a confocal scanning laser microscope) and require skilled personnel for their instruction as well as a substantial investment in infrastructure. Not surprisingly, these facilities are rarely available for undergraduate teaching and where they are available, instruction is limited to brief superficial demonstrations. Moreover, this equipment is housed in small dark rooms that are highly soporific and not conducive to a good teaching environment. The number of students that can be accommodated around a microscope is usually fewer than five. Student access to microscopy images is typically restricted to a small variety of pictures in textbooks. As a result, students do not acquire
skills needed to interpret real images and gain little understanding of the complimentary information that different techniques provide. In an attempt to address these difficulties, we have developed a CD-ROM based microscope simulator that is embedded within an interactive laboratory environment.

**Description of the project**

The aim of the Virtual Cell Biology Laboratory (VCBL) project was to develop a set of computer based interactive programs that allow students to research problems using state-of-the-art laboratory techniques. At the heart of the project is a gallery of stored images taken from light, confocal and electron microscopy experiments. These images are linked to the various experimental procedures and are accessed by students through choice-directed pathways. The selected images can be manipulated to simulate changes in magnification, contrast, filters and focus.

The simulated research project revolves around a laboratory environment (Figure 1), termed the Workbench, in which choices are made from ‘drop down’ menus for specimen preparation, staining reagents and type of microscopy. Students are aided in their choices by information pages, which explain the VCBL, describing each microscope system and its simulation, and providing a basic introduction to cell biology with annotated examples and references to more comprehensive primary resources.

From the Workbench, students launch the microscope simulator that they wish to use to examine their specimens. Each of these interfaces allows the user to manipulate the principal controls on the instrument and is intended to provide a feel for the capabilities of that microscope. Since most students are familiar with light microscopy, a good starting point for their observations is the conventional light microscope simulator (Figure 2).

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Figure 1. The “Workbench” environment is central to the VCBL. Students make point-and-click decisions about which specimens, reagents, and microscopes are to be used in each experiment.
The user can change objective lenses and adjust brightness, as well as selecting advanced modes such as fluorescence, phase and interference-contrast microscopy. The confocal microscope simulation (Figure 3) includes three-dimensional reconstructions of the specimen, including rotating views, which are shown as movies. Similarly, the transmission electron microscope interface (Figure 4) includes a variety of lens and aperture choices. At the end of each virtual experiment, students may return to the Workbench to set up another specimen/stain combination, or alternatively, run the self-assessment module.
Each of these simulations uses an extensive picture gallery providing multiple images of the chosen specimens, at different magnifications and photographed in a number of modes. These images were produced directly from microscope imaging systems (except electron microscopy where an intermediate negative was used). Since they represent actual views obtained from each instrument they allow students to develop interpretative skills that can be transferred to a ‘real world’ laboratory environment.

Two alternative approaches are provided for working through the available material in the VCBL. Since the VCBL allows students to independently design and carry out experiments, it is readily integrated into problem-based learning protocols. However, it can also be used with more structured learning approaches allowing students to negotiate through the material using a step-by-step guide that is provided in a window which stays on top of the simulations as a constant reference source (Figure 5). These approaches are not mutually exclusive.

Figure 5. Problem-based learning can begin immediately, using the information package attached to the “Project Problem” (centre screen) which introduces the problem to be solved. Structured learning is also facilitated by the step-by-step “Guide” window (top left), which cross references entries in the information package. Student experiments and their notes are logged in the “Lab Book” (lower left).

Comparison with other strategies

When we initiated this project the existing CD-ROM based teaching aids were essentially electronic textbooks with mainly still images and the occasional movie clip. The present project differs significantly from these in that it not only provides a gallery of images but also laboratory simulations involving various microscopes and bench techniques. We are aware of one other microscope simulation, The Virtual Microscope\textsuperscript{1} that was developed by the Department of Earth Sciences and the Institute of Educational Technology at the Open University to introduce students to microscopy of geological specimens. There is also a commercially available interactive program, the Microscopy-Tutor, as an aid in teaching the basic concepts of bright field light microscopy\textsuperscript{2}.
Continuing development

The project was designed to allow the incorporation of additional cell biology problems which can be added in a modular fashion. Additional modules on RNA and protein trafficking are planned. It is envisaged that newer technologies such as the DVD format will allow a more extensive collection of images, animations and movies to be accommodated on a single disc. In addition, this project could be installed on a server to allow Internet access by students either on campus or at remote locations. Finally, this project should be considered as a paradigm for the teaching of any techniques or processes that utilise expensive equipment or require costly infrastructure such as X-ray crystallography, nuclear magnetic resonance and mass spectrometry.

Acknowledgments

We would like to thank Sue Hamilton of this Department for her invaluable advice and enthusiasm for this project. We are grateful to Athol Reid (Biochemistry) for his help with obtaining microscope images and collating the data sets. Thanks are also due to members of The University of Queensland’s Educational Multimedia Services Unit especially, Beth Cavallari, Adrienne Winzar, Tim Dunn and Cathy Stephens for art work, software development and media design.

References

1 http://met.open.ac.uk/vms/vms.html
2 http://www.ravenpress.com/media/m1208.htm

“ChARM-ing Mechanisms” – an integrated approach to improve student learning in organic chemistry

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I faced a challenge in my organic chemistry unit: However hard I tried to woo the students into appreciating the value and use of organic mechanisms, they remained unengaged. Unit evaluations consistently cited mechanisms as the least liked part of the unit. This was in spite of the lectures being delivered with enthusiasm and multicoloured PowerPoint presentations. Clearly I needed a different strategy.

I decided to use a two-pronged approach to enhance student learning. Firstly I reduced the content to allow me time in which to promote peer learning (Ramsden, 1992, Fuller, 1997). Secondly I introduced an additional learning resource, an interactive multimedia package, ChARMs (Capon, 1997, Crisp and Pike, 1998), to complement the text.

During the course I did not introduce mechanisms by giving a traditional lecture. Instead I divided the class of 24 into five groups and set them each a task. Each group had to use the available resources, texts, ChARMs CD-ROM, (and me), to answer a given question. Typically they had 30-45 minutes to prepare an answer which they presented to the class. They had access to a whiteboard, overhead projector and the facility to project the ChARMs screen.

The effect on the class was electric. Instead of a quiet, attentive audience I now had a roomful of active students. The demonstrator who took them for the practical session afterwards summed it up by saying “What have you done with them today, they are TALKING ABOUT CHEMISTRY”. For me that simple statement encompasses a huge shift in the students’ attitudes. Chemistry no longer washed over them in the lecture; they were in there grappling with it.

The short introductory session, group work and subsequent presentations fitted into the 90 minute lecture slot. This enabled me to reinforce the material with a summary in the following lecture.

The particular value of the ChARMs CD-ROM was that it enhanced the students’
visualisation of mechanisms at the submicroscopic level (Johnstone, 1991, Garnett, 1998). Now, in addition to the traditional representation of mechanisms in the plane of a page and with electron movements represented by arrows, they could watch a three-dimensional representation of the reaction occurring. This was especially valuable where a change of configuration between stereoisomers occurred.

In summary, the changes to this unit involved a sacrifice of content material (ca. 10%), I also found that more preparation time was required. However, I am satisfied the changes were worthwhile, both in terms of greater student engagement and the “lectures” were more enjoyable for both myself and the students.

ChARMs was run on a Sharp laptop, Pentium 133 MHz, Windows 95, 32Mb RAM linked to an Epson projector. The students also had access to the CD-ROM outside lecture time for their own study.

At the end of the unit I evaluated the introduction of group work and ChARMs with a simple questionnaire. The feedback was very encouraging with 73% of students agreeing that “after completing the exercises and having a summary lecture, do you now feel confident that you could answer questions on this topic”.

ChARMs CD-ROM was very well received with 86% agreeing with the statement “after viewing the simulations do you now think you have a clearer understanding of how reaction mechanisms occur”.

References
Fuller, R. (1997) “Improving Student Learning, Teaching and Learning Forum”, Faculty of Science, Engineering and Technology, Edith Cowan University.

WWW-based resources for first year chemistry students who do not like chemistry

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At the University of Western Sydney Hawkesbury (UWSH), I co-ordinate first year subjects covering general, organic and biochemistry (“Introductory Chemistry” and “Biological Chemistry”). These courses are taken by non-chemistry majors: students from biology, food technology, horticulture, environmental health, environmental management and agriculture. These subjects are also offered in “external” mode supported by extensive printed material, audiotapes and a 3-day residential workshop each semester.

I am developing WWW resources in order to cater for the wide range of learning styles and previous experiences of the students.

Over the last two years, I have obtained funding competitively within UWSH in the form of Academic Development Funds, which have enabled me to employ assistants to help set up the WWW site. As a part-time academic who is doing some research, I have great trouble doing the development work on my own.

In parallel to this project, a consortium within UWSH is developing a “WebShell” (now called HawkesburyWise) infrastructure system using WebCT. I have chosen to collaborate with this consortium, which will be able to support me with technical help and pedagogical advice.
At the start of the first semester in 1999, my students (both internal and external) will find:

- background material and summaries of topics of the first few weeks’ lecture content (initially developed in 1998);
- on-line self-assessment questions and feedback (extended from that available in 1998);
- simple animations and other imaginative devices we feel may be useful;
- links to a limited number of sites that will provide either more detailed chemical information, some general background or practical applications of the topics being studied;
- access to discussion groups (which will be monitored weekly);
- access to a bulletin board (where, among other things, students will be encouraged to list sites they would recommend and sites they would drop);
- email links to the lecturer and/or tutor; and
- evaluation forms for feedback to us.

As the semester progresses, we will extend the range and variety of material available. Before the mid-semester test, practice examinations will be available – “practice” for the students as well as for me. I want to get experience in manipulating the statistics and feedback on the types of questions the students find difficult.

My aim is to provide a “tailor made” and easily navigated site. Many of the chemistry sites available are simply too detailed for these “special” students. They need to be encouraged to (a) explore some of the basic chemical concepts and (b) see the usefulness of chemistry to their chosen profession. For some, chemistry is their least favourite subject; they do not need to be “put off” any further by being confronted with a seemingly complex set of things to learn. I do not ask my students to simply read chapters A to X of any textbook; I do not intend to use the available WWW-resources this way either.

We are exploring ways in which the WWW is most useful – we do not want to reproduce a large amount of text or a set of lecture notes. I will encourage the students to use the site in the ways that best suit their own learning needs: revision; a more detailed explanation of chemical theory; an overview of the usefulness of chemistry; and/or communication with other chemistry students and staff through the discussion group, etc. I hope that the students will give me oodles of feedback about their experiences so that I can keep designing more effective resources for them.

Recently, UWS has been successful in gaining a large grant from the DETYA Capital Development Pool in order to develop a Greater Western Sydney Learning Network. This will be a high reliability communications network linking the seven UWS campuses with more than 100 TAFE colleges and secondary schools in the area. I am confident that my WWW site will be one of the first available through this Network. My material is suitable for Bridging Courses and HSC revision tutorials as well as “introductory” or “taster” chemistry courses at tertiary level. I am hopeful that through collaborative initiatives such as this, we will be able to muster sufficient resources for continual development and maintenance of our sites.

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

- UniServe Science News is available on-line and in Portable Document Format (PDF)
- Proceedings of UniServe Science Workshops are available in PDF (Dry Labs workshop, Computer Assessment workshop and University Science Teaching and the Web workshop)
- UniServe Science QuickKards summarise the software most commonly used in Australian universities for teaching first year classes and are available on-line
- CAL-laborate is a collaborative publication from UniServe Science, the UK CTI centres for Physics, Chemistry and Mathematics and the Swedish Council for Renewal of Undergraduate Education and is available on-line and in PDF
- Proceedings of UniServe Australia Workshop Putting you in the picture is available in PDF
The main aim of introductory psychology is to teach foundational knowledge in psychology and introduce the principles of scientific research. Often teaching of first level content is separated into theory and practice components, with the result that students frequently fail to appreciate the link between the two. This is further complicated given the popularity of psychology combined with the discipline’s broad application.

The Psychology Electronic Warehouse (EW) was conceived as an integrated educational and technological solution to delivering the introductory psychology units at Deakin University to off-campus students and to on-campus students located on three different campuses (Burwood, Geelong, Warrnambool). Students taking first year psychology at Deakin University are characterised by their relatively large numbers (i.e. in excess of 1200) and their diverse backgrounds.

The EW has been constructed to incorporate Interactive Multimedia (IMM), Computer-Assisted Learning (CAL), and Computer-Managed Learning (CML). Interactivity (i.e. animations, graphics, quizzes) and multimedia are used to enhance the learning environment. As students progress through the EW, new research methodology concepts are introduced and old ones reinforced. The full complement of research methodology normally taught in introductory psychology is included in the EW. However, research methodology is not treated as a separate topic of study. Rather the EW adopts a problem-solving approach to the research process so students can see how knowledge in the discipline is acquired.

Evaluations indicate that students enjoy the real-time data collection and analysis components of the EW, and appreciate the learning checks built into the workshop programs which constitute the EW. Members of staff appreciate the capacity to track student progress.

History of the project

The School of Psychology in association with Dale Holt, John Hinchy and Andrew Bigelow of the Deakin Centre for Academic Development (DCAD) successfully sought internal funding support from Quality Assurance monies to develop the EW. Following a year of experimentation in 1995, a first version was developed during 1996. A pilot year during 1997 involved the development and implementation of four workshops (the basic learning unit of the EW). During the second half of 1997, further funding was gained for 1998-9 through a grant from the Committee for University Teaching and Staff Development (CUTSD).

CUTSD funding has been applied to the ongoing achievement of three main aims:

- developing 20 workshops to provide electronic support for the range of topics in introductory psychology;
- extending the delivery of the EW to distance students and introducing the use of software through personal computers for both on and off campus students; and
- incorporating communications facilities with the software that encourage electronic collaboration between students and between students and staff.

Progress to date

Workshop preparation

Four workshops were released to students in 1997 and have undergone extensive revisions and programming changes. Content for an additional 14 workshops has been prepared by the School of Psychology. Of this content,
nine workshops have been completed (that is programmed as interactive, multimedia workshops). This brings the total number of workshops available for release to students during Semester 1, 1999 to 13. Content for an additional eight workshops will be prepared and programmed throughout 1999.

Remote access to EW
A strategy for delivery of the software to off-campus students has been developed. This was piloted in Semester 2, 1998. A CD-ROM based version of the software is being produced which incorporates a minimalist connection strategy. In contrast to when working on the software in Deakin ITS computer laboratories, this version of the software requires only one connection to the Deakin University Electronic Warehouse server per workshop. In this way, ISP costs to perform the data exchange functions of the software (i.e. for the purposes of student tracking and transfer of laboratory experimental results) are kept to a minimum and reliance on being connected to the network to use the software is greatly reduced. Three workshops have been piloted with a group of 12 off-campus students who used a variety of ISPs to connect to Deakin. The delivery strategy appears to have been effective and relatively trouble-free.

It is planned to release the software to approximately 100 students studying first year psychology in off-campus mode in Semester 1, 1999. At this time the software will also be made available on CD for on-campus students who wish to use the EW on computers external to Deakin ITS laboratories.

Communications facility
A web page for the EW with asynchronous chat facilities for students and staff is currently being finalised. As part of this web page it is planned to have a discussion or chat room for each of the modules offered as part of introductory psychology units, together with a downloadable user manual. These discussion areas will be supervised by teaching staff in the School of Psychology to provide an opportunity for students to ask questions about the material in specific workshops and to discuss other aspects of the course such as assessment and study materials. The discussion areas on the web page will be monitored through the staff in the School of Psychology rostered to respond to queries from external students in the off-campus consultation room. The web page will be commissioned early in 1999 subsequent to the release of the new School of Psychology web site.

Other activities
With an expansion of the number of workshops available to students and continued trialling and evaluation of the software, a number of issues have arisen regarding the design of the interface, the navigational devices used in the EW, and the relationship between the software and the administrative database used to track students. As a result, the interface and navigational devices used in the EW have been redesigned in line with the feedback from users. Content prepared with the old interface has been “refitted”. The database issues are currently being addressed.

It is anticipated that the EW will be fully functioning by the end of 1999. Further information can be obtained by contacting Hilde Lovegrove (hilde@deakin.edu.au) or Christine Armatas (armatas@deakin.edu.au).

WANTED
UniServe Science is seeking to interview (via email) scientists who are working in exciting and different areas of science. The interviews will be used to set up a web site which will be a valuable resource in promoting science as a career. If you are interested, or have a colleague or former student who may be suitable and willing, please contact us at BioSciCH@mail.usyd.edu.au
Web Tools

As more teaching goes on-line, educators need to be aware of the tools available. This page lists those software packages and Internet services that have been highlighted in recent conferences and articles. It is by no means a complete list but may be of assistance if you are searching for the right tool. We would welcome comments about how you may have used any of these tools or details of any additional Internet tools that you have experience with.

**TopClass** is a management tool for web-based education and training. Features include course development and delivery, communication, assessment and reporting.
http://www.wbtsystems.com/

**WebCT** is a tool that facilitates the creation of sophisticated WWW-based educational environments. Features include course development and delivery, communication, assessment and reporting.
http://www.webct.com/

**LearningSpace** facilitates the creation of a distributed learning environment. Features include course development and delivery, communication, assessment and reporting.
http://www.lotus.com/

**WebMentor** is a development, delivery and management tool.
http://www.avilar.com/

**Web Course in a Box (WCB)** is a course management system that allows instructors to easily develop and deliver instructional materials via the web.
http://www.madduck.com/

**Convene Learning internet Platform (CLiP)**. Features include on-line course registration, interactive on-line testing, audio and video conferencing, student lounge and real-time chat.
http://www.convene.com/

**FirstClass Collaborative Classroom** is a package that includes email, electronic communication and collaboration products.
http://www.education.softarc.com/

**WebMCQ** is a service that provides an easy way to create and publish quizzes or surveys on the web.

**QMark Systems** supply authoring software for the creation of multimedia presentations and the delivery and analysis of tests, quizzes and surveys. Products include Question Designer, Dazzler and Question Mark Perception.

**Blackboard** offers a variety of solutions depending on your needs through their packages Classroom, CourseInfo and Campus.
http://www.blackboard.net/

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http://www.blackboard.net/

**InterBook** is an adaptive tutoring system that simplifies the development of adaptive electronic textbooks on the web.
http://www.contrib.andrew.cmu.edu/~plb/InterBook.html

**PAT Online** is an adaptive tutoring system.
http://domino psy cmu edu/patonline.html

**WebTeach** is a web-based communication package that caters for discussion, brainstorming, class quizzes and task setting.
http://www.pdc.unsw.edu.au/webteachdemo/welcome.html

**References**


Calendar of Coming Events

Tools for Flexible Learning
UniServe Science Workshop
April 9, 1999, Sydney
http://science.uniserve.edu.au/workshop/fflearn/
PhySciCH@mail.usyd.edu.au

10th International Conference on College Teaching and Learning
April 14 – 17, 1999, Jacksonville, Florida, USA
http://www.teachlearn.org/
jchamber@fccj.org

EDUCAUSE IN AUSTRALASIA
Doing IT Right – “People and Technology”
April 18 – 21, 1999, Sydney

AusWeb99
Australian World Wide Web Conference
April 17 – 20, 1999, San Antonio, Texas, USA
ausweb99@scu.edu.au

CATE’99
Computers and Advanced Technology in Education
May 5 – 8, 1999, Philadelphia, USA
http://www.iasted.com/
iasted@cadvision.com

CUMREC ’99
Breaking Through: 2000 and Beyond
May 9 – 12, 1999, Ballarat and Melbourne
k.whyburn@ttu.edu

World Wide Web 8
International World Wide Web Conference
May 11 – 14, 1999, Toronto, Canada
http://www8.org/
info@www8.org

Computer Assisted Assessment Conference
June 16 – 17, 1999, Leicestershire, UK
http://www.caacentre.ac.uk/
M.Danson@lboro.ac.uk

WebCT 99
First Annual WebCT Conference on Learning Technologies
June 17 – 18, 1999, Vancouver, Canada
http://web1.webct.com/public/conference/
michelle@webct.com

ED-MEDIA 99
World Conference on Educational Multimedia, Hypermedia and Telecommunications
June 19 – 24, 1999, Seattle, Washington, USA
http://www.aace.org/conf/edmedia/
aace@virginia.edu

CBLIS 99
Computer Based Learning in Science
July 2 – 6, 1999, Enschede, Netherlands
l.deBruijn@tn.utwente.nl

CONASTA 48
The Spirit of Science
July 4 – 9, 1999, Adelaide
http://pene.science.adelaide.edu.au/sasta/conasta/conasta@cobweb.com.au

ACSE’99
Computing Education to Shape the Future
Future Shape of Computing Education
July 7 – 9, 1999, Adelaide
http://www.cs.flinders.edu.au/Events/ACSE99/acse99_contact@cs.flinders.edu.au

Education: Weather, Ocean, Climate
International Conference on School and Popular Meteorology and Oceanographic Education
July 5 – 9, 1999, Ballarat and Melbourne
http://www.shm.monash.edu.au/ewoc99/ewoc99@vortex.shm.monash.edu.au

Innovative Approaches to Teaching Science
Doing it Differently in Science
July 12, 1999, Sydney
http://science.uniserve.edu.au/other/uwsconf/e.deane@nepean.uws.edu.au

CUBE 99
Implementing learning technologies in Bioscience teaching
July 13 – 14, 1999, Liverpool, UK
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

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

EDUCOM’99
October 26 – 29, 1999, Long Beach, California, USA
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.ucc.ac.jp/icce99/icce99@ai.is.ucc.ac.jp

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

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