

Part of a Project Funded by a UC Teaching Grant

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Socrates delivers fully typeset multiple choice mathematical quizzes over the World Wide Web. The student interface offers interactive, unit specific quizzes and a choice of 'tutorial' or 'test' mode. (Tutorial mode gives diagnostic responses to incorrect answers.) The lecturer interface currently provides for the preparation and editing of quizzes. A student record keeping system is still to be fully developed. Both interfaces incorporate a collation and printing facility.

Socrates uses the free IBM plug-in, *Techexplorer*, to display LaTeX-typeset documents, and can be viewed using a number of different platforms, including PC's and UNIX boxes.

Student response to *Socrates* has so far been positive, particularly with respect to the diagnostic responses.

WebLearn: The Experience of Two Years

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WebLearn represents an effort to improve the mode of subject delivery by implementing a student-centred strategy in a World Wide Web environment. *WebLearn* presents problems and questions (multiple choice, multiple answer, short text, etc.) to students and gives them prompt feedback, allowing them to monitor their own progress. It provides lecturers with tools to track and manage a large group of students. Results of, and feedback from, over 3000 students were presented.

Formative Self-Assessment Modules on the Web: Increasing Flexibility for Delivery

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The increasing use of the web for the delivery of teaching and learning materials has led to an increase in flexibility of access for students. A student with access to the Internet is thus able, in a user-friendly non-confrontational way, to access these materials at any time. In First Year Biology the web is being used for many purposes including the delivery of self-assessment materials. One set of materials, known as Self-Assessment Modules (SAMs), consists of a series of formative tests and exercises aimed at helping students monitor their level of understanding of major biological concepts (Franklin, Peat and Mackay-Wood, 1997; Peat, Franklin and Mackay-Wood, 1997). The SAMs draw together related parts of the subject and so help the students to make connections between seemingly unrelated topics in biology while providing an enjoyable feedback and reinforcement

session. A number of different learning modes are utilised by the SAMs so that, by catering for different learning styles, the module encourages students to take responsibility for their own learning, and promotes the development of deeper learning strategies by the students.

Each SAM is designed as a series of mini-topics, with each mini-topic having an entry level which acts as a barrier to progression if the student is unable to complete it successfully. Unsuccessful entrants are advised to revise the topic before trying again. Once past the entry barrier, there are several levels of questions, identified in Bloom's Taxonomy as being of different cognitive complexities (Bloom, 1956). Each level offers an increased level of difficulty and contains a variety of question formats, based on simple computer skills such as drag and drop and text entry. The student can choose to do the levels in any order. Level 1 is the easiest level, with all the answers given, although the student may be presented with a variety of options from which to make a choice. Formats include multiple choice questions (MCQs), dragging correct or incorrect words into or out of sentences, labelling diagrams, completing flow charts and matching words with definitions. Level 2 has question formats similar to those introduced in Level 1, but requiring the student to either type in the answers rather than selecting them, or sort relevant material from irrelevant material. Level 3 questions are more complex, often having more than one part, or requiring the completion of more complex diagrams and tables, while the top level includes summarising information from a number of sources into tables or concept maps and writing short answers to questions.

All questions are marked and summative and formative feedback is provided. The students have control at all times of where they are and where they want to go in the module. They can access information on what levels they have attempted, how much of the topic they have done and how well they have done.

Students have evaluated the SAMs using self administered, web-based, qualitative and quantitative questionnaires. At the end of each SAM is a request for the student to fill in the questionnaire. The results indicated that students thought the modules were user-friendly, study was encouraged by their use, and concepts were more easily understood. They liked the variety of questions and different levels and the facility to work at their own pace.

Delivering the SAMs on the web was a response to increasing student demands for increased flexibility and greater access to teaching and learning materials. Visit the SAMs at http://fybio.bio.usyd.edu.au/sobsfyb/fyb_stud_access/SAMs/SAMs.html

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The Use of the Web in University Science Teaching in Australia

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In Australia, as yet only a small number of academics have got past the initial stage of simply putting up lecture notes and class handouts on a web page, and of those who have done more, it is useful to classify the uses of the web in mainline university teaching into six categories.

The teacher as client

Many web sites which are specifically designed to be a repository of information about, and sometimes suppliers of, teaching materials. These are designed to be consulted by *teachers*, not students. UniServe Science's web site is an example of these (<http://science.uniserve.edu.au/>).

The student as client: Informal use

The simplest thing that many academics do when they first discover the web, is to "put up" their lecture notes, *PowerPoint* slides and course handouts for students to consult if they want to. In time these can develop into very rich collections of teaching materials. See for example the "Virtual Resources Room" for first year students, run by Biological Sciences at The University of Sydney (http://fybio.bio.usyd.edu.au/sobsfyb/fyb_StuRes.html).

The student as client: Formal teaching via the web: (1) Delivery of material to be learned

A step beyond the last category is where the web is used as the prime means by which the course (or some part of the course) is taught. Here there is some sort of compulsion for the students to consult the web. A useful example is the entry web site for students enrolled in Engineering Computing 1, a course which is completely "on-line", at Murdoch University (http://www.murdoch.edu.au/online/units/units_fr.html).

The student as client: Formal teaching via the web: (2) Student/teacher interaction

There are many schemes which seek to replace the interaction between teacher and student with an asynchronous mode of communication, most often email. A good example of this is the discussion group page for students enrolled in Engineering Physics 1 at the University of Technology, Sydney. Contact the author, David Green, at David.Green@uts.edu.au

The student as client: Formal teaching via the web: (3) Formative assessment and feedback

This is an area where much more work has been done. It combines the three main advantages that the web offers: flexible access, immediate feedback and platform independence. See for example the computer assessment system *WebMCQ*, developed by James Dalziel at The University of Sydney (<http://www.webmcq.com/>).

The student as client: Formal teaching via the web: (4) Summative assessment examinations

No department in Australia known to us attempts to carry out *all* final assessment for a whole course through the web, mainly because of inflexibility of question format and security issues. One example is the NEST system, which is used by The University of Melbourne. Contact Craig Burton at c.burton@eng.unimelb.edu.au



Online @ RMIT and Question Mark Perception

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RMIT provides a supported infrastructure for the development of Internet teaching and learning environments called Online @ RMIT. This infrastructure has been designed to meet the learning needs of an increasingly diverse range of students. Online @ RMIT includes a variety of teaching and learning approaches, different tools and applications that support greater flexibility, networked systems, standards and support infrastructure. Included in recommended tools and applications is *Question Mark Perception*.

This infrastructure is being benchmarked during Semester 1, 1999 in 31 subjects and with 1900 students participating.

Two locations within RMIT where *QM Perception* will be used are:

- the Faculty of Biomedical and Health Sciences and Nursing; and
- the Library.

Faculty of Biomedical and Health Sciences and Nursing – Department of Human Biology and Movement Function

QM Perception will be used in Human Structure and Function 1 for ongoing revision exercises. Students will participate in 12 weekly tests which will not be graded. Each test will be attached to one of 12 modules.

QM Perception will be used in Human Biology and Movement Sciences, Anatomy 3 and Gross Anatomy 2 for continuing assessments. The results from the testing will count as 10% of their final assessment. The assessment will be open book and the students will be permitted to complete it on or off campus.

RMIT Library

The library is in the process of developing on-line learning materials to be part of a first year program inducting students into tertiary study. This program has a working title of RMIT 101. In order for students to receive recognition for their study of the library materials it will be necessary to assess the students. The assessment will be conducted on-line after the students complete the library component of the subject.

The Application of Dazzler 5 for the Development of Interactive Tutorials in Biomechanics by the School of Physiotherapy (University of South Australia)

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The University of South Australia is the State's largest university with 25,000 students, 2,000 staff and six campuses. There are six academic divisions and various faculties and schools that are incorporated within and responsible to each of those divisions.

The School of Physiotherapy is responsible to the Faculty of Health and Biomechanical Sciences which is incorporated within the Division of Health Sciences. The School of Physiotherapy offers programs and research in both Physiotherapy and Podiatry and is located on the City East Campus of the University of South Australia. The School occupies a modern building with well equipped teaching facilities including five research laboratories, a computer pool and both Physiotherapy and Podiatry clinics.

In 1998 the School of Physiotherapy was awarded a University Innovative Teaching and Learning grant to produce interactive tutorials in Biomechanics for web-based and CD-ROM delivery. The aims of the project are:

- to develop a teaching resource that will be used as core material by undergraduate Physiotherapy and Podiatry students and as update material by postgraduate students;
- to develop four on-line interactive tutorials in the subject Applied Biomechanics designed to enable students to check their knowledge of material presented in the lecture program;
- to provide a flexible learning environment enabling students to progress at their own pace; and
- to complement the web-based material with a CD-ROM containing high quality animated graphics, photographs and video clips providing a clear description of the three-dimensional motion and functional anatomy of the chosen content.

The project entails translation of previously developed CD-ROM based tutorials (*Lumbar Spine, Pronation and Supination of the foot, Normal Gait*) into a format suitable for on-line delivery and the development of a new tutorial on the Biomechanics of the Hip and Pelvis region.

Dazzler 5 was the preferred authoring environment since the software makes it possible to develop interactive tutorial material for CD-ROM delivery that can also be delivered on-line through the use of the Java applet creation abilities of *Dazzler*. The construction of multiple choice questions was achieved with minimal effort and other styles of question or presentation such as 'Drag-and-Drop' or 'Point-and-Click' were also managed with a high degree of programming simplicity. The manner in which *Dazzler 5* creates and 'packages' each applet totally 'web ready' reduced the number of hours that would have been required to program the tasks manually directly in Java. The packaging capabilities of *Dazzler* also eliminated the need for compiling which would have been required if the applets had been written in some other programming language and also overcame any browser or platform specific problems.

The interactive tutorials in Biomechanics developed by the School of Physiotherapy make use of the power and flexibility of on-line and CD-ROM delivery. Evaluation of the learning outcomes from the implementation of this project will provide the foundation for modification and refinement of the tutorials and the findings will provide the impetus for the development of other innovative web/CD-ROM based teaching and learning materials in the future.

ChemMark-WWW: Chemical Structure Drawing and Marking on the Web

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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, *ChemMark-WWW*, a chemical structure drawing and recognition web interface which enables chemical structures to be drawn and marked, has been developed. 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 students 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.

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 are 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 which 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. 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.

ChemMark-WWW is produced by Hampden Data Services, UK, in conjunction with the School of Chemistry at The University of Sydney.

Flexible Learning and Assessment Package for Teaching Data Analysis and Chemometrics in Analytical Chemistry

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Instrumentation for analytical chemistry has become enormously productive and convenient to use in recent times. However, despite successes in automation and computer software, the person driving the instrument is still of prime importance. In the wrong hands, even the very best computer controlled instrumentation will only produce more meaningless data faster. In analytical chemistry it is the quality of the data produced that is of the utmost importance. A related issue is the spread of chemometrics into the workplace for solving routine analytical chemistry problems in areas, which include everything from the petroleum industry to the environment to foodstuffs to forensic science.

Students do learn about quality and data analysis principles in a statistics unit that they undertake but usually they are unable to make the connection between what they learn in statistics and what they learn in analytical chemistry. In any case, generalist statistics units don't go far enough to prepare students for using chemometrics software packages in professional life.

In order to cater for student needs in these areas a package of flexible learning modules has been developed and used with 2nd and 3rd level students in analytical chemistry. These modules are web-based and include the following features:

- students can use them in an on-line mode using an Internet connection;
- students can obtain an installer program on a floppy disk which installs the system onto a home or work computer for off-line use;
- in off-line mode students can do everything except submit answers for on-line checking and connect to the discussion forum;
- the package is integrated with discussion forum software which allows students to keep in close contact with staff and to cooperate more effectively with each other;
- each module contains a set of "real life" analytical data for the students to analyze and interpret;
- students can use a variety of software tools for data analysis and visualization, including *Microsoft Excel*, *Statlets* and *Matlab*;
- once the students have finished the analysis they are required to answer a series of questions, some of these questions are multiple choice or tick the box and these are automatically computer checked for rapid feedback;
- for convenience of teaching staff the web software writes student results directly to an *Excel* spreadsheet; and
- other questions require students to display deeper reasoning skills and are marked manually.

These modules are set in the early part of the semester before laboratory classes start. Where possible the laboratory program has been designed to link in with the data analysis modules. The skills developed with *Microsoft Excel* (and other software) greatly assist students with general laboratory report writing in the later part of the semester.



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