Filling the Role of Staff in Flexibly Delivered Atmospheric Science Practicals

Peter K. Love, Centre for Flexible Learning, Macquarie University
pklove@penman.es.mq.edu.au

Introduction

Atmospheric Science at Macquarie University is taught within Physical Geography. Five undergraduate units are taught: two second year and three third year. There are also Atmospheric Science components in two first year units. To this core, students can add units in earth sciences, mathematics, biology, chemistry, physics and computer science to obtain a BSc with a major in Atmospheric Science. However, only 20 to 25% of the students in second year are majoring in Atmospheric Science. The five core units are each one semester in length and have a pattern of two one-hour lectures per week and one three or four hour practical per week. Traditionally, the practicals have involved a variety of activities including field exercises, computer-based sessions, plotting and interpretation exercises, and application problems. The practicals have also served as tutorials.

Material based on the hypertext markup language (HTML) was first introduced into the programme in 1994 with the development of a four week component on remote sensing in one of the third year units. In late 1996 the Atmospheric Science group was awarded a 1997/98 Macquarie University Flagship Grant to broaden the individual and varied developments that had occurred within the units in the programme since 1994. The aim was that at the end of the two year project the five Atmospheric Science core units, with the exception of essential third year fieldwork, would be deliverable in a flexible mode using Internet technologies.

The on-line material that has been developed for each unit follows a similar pattern and includes: standard unit information (course schedule, assessment details, etc.); lecture material (ranging from overheads to detailed notes); practical material (including HTML interfaces to real-time data, research data, simulation software and complex research models); discussion facilities (mail, bulletin board); and a resource section (including glossary, acronyms, library access, textbook errata, reading list and some World Wide Web links). The two second year units also include on-line summative assessment in the form of multiple choice quizzes.

The delivery of the practicals, which also serve the role of tutorials, in a flexible mode presents particular challenges. In addition to the need for interactive material involving simulations, models, visualisation and animation, the role played by a tutor or demonstrator needs to be filled. These staff provide feedback, guidance and checking of student progress throughout a practical. This paper outlines some examples of these and how the absence of staff has been addressed in the flexibly delivered material.

Examples of Feedback in Practicals

During the course of the traditional Atmospheric Science practicals staff fulfil various roles that are not met by the print-based study guide and/or handouts, or the pre-existing computer-based material. Often the practical times are used by students to ask questions and seek clarification and explanation of various things that are not necessarily related to the practical, and by staff to provide general feedback, and specific feedback to particular students, on a variety of issues (e.g., assignment results, clarification of issues raised by other students). In the flexible delivery mode, the discussion facilities (mail and bulletin board) and ability to easily put new and updated material on-line, facilitate much of this discourse. The degree to which this works, how it compares with face-to-face interaction, and the associated resource issues will not be discussed in this paper. Rather, the following subsections give examples of how the need for specific feedback related to the practical material has been addressed. The examples chosen are:

- questions that have short specific answers;
- numerical calculations;
- plotting exercises;
- problem solving; and
- animation.

They all come from one of the second year units: GEOS216 Atmospheric Environment. This unit can be done entirely off-campus but it still has the two on-campus lectures. However, because of funding cuts, staff only attend about 60% of the practicals.

Questions that have Short Specific Answers

These are questions that have a clearly correct answer. They are usually used in the practicals to check student progress and understanding and build confidence before moving on to other material. Instead of a staff member checking answers, these questions lend themselves well to multiple choice self-checking.

For example, the first of two practicals on aerological diagrams, introduces the skew T - log p diagram, explains its use for determination of moisture parameters and potential temperature, and has an exercise on plotting atmospheric soundings. The diagram has five isolines: isobars, isotherms, dry adiabats, saturation adiabats, and saturation mixing ratio lines. The other major feature is the International Civil Aviation Organisation's standard atmosphere's lapse rate. Temperature and dewpoint from atmospheric soundings are plotted on the diagram and various things such as atmospheric moisture content, stability, and cloud base height are calculated.

During the practical students are presented with a series of familiarisation exercises. To allow them to check their answers themselves, they are given a simple multiple choice selection implemented using an HTML form and JavaScript (Figure 1).

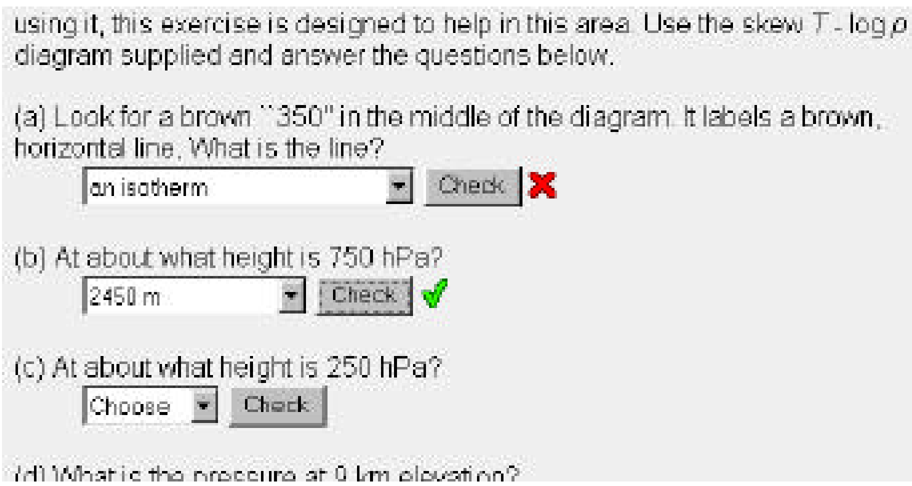

Figure 1. An extract from a practical exercise involving familiarisation with the skew T - log p aerological diagram. Students can choose their answers by making a selection from the pop-up menus and then clicking the "Check" button. An image of either a green tick or a red cross then appears.

In this instance, the only feedback they get is correct (a tick) or wrong (a cross). Multiple choice self-tests that provide greater feedback are used elsewhere. The familiarisation exercises in this practical are optional in that progression through the material does not require their completion. In other instances the correct completion of such self-tests is necessary. However, this hinders revision unless successful completion is logged and allows free access in subsequent use.

Simple Numerical Calculations

Students regularly have to carry out numerical calculations in their practicals. These may be example exercises or they may involve the use of the student's own data. Many of these calculations only require basic algebra, but they still present considerable difficulty to many geography students, particularly those who simply declare that they "cannot do maths''. Even for more able students, errors are easily made as calculations might require using a table or chart to obtain some of the values involved in a calculation. Thus it is important to not only provide the correct answers but to also show the values of various parts of an equation to indicate where a student might have gone wrong. Feedback other than simply giving the correct answer is also important as subsequent calculations are often reliant on earlier ones, or on the ability to repeat earlier methods.

An example of such a calculation is in a practical dealing with the measurement and expression of humidity. In one part, students obtain observations of dry- and wet-bulb temperatures using a whirling psychrometer. They exchange their observations with others in the class using the bulletin board. As the practicals are scheduled for on-campus students at four different times during each week, this gives them a variety of observations in terms of location, time of day and potentially under different weather conditions. These observations are used by the off-campus students. This electronic entry by the students also makes it easy for staff to collect the results for use as examples in various situations and future years.

Students then have to calculate saturation vapour pressure, vapour pressure, dew-point temperature, mixing ratio and relative humidity. To facilitate the checking of their own individual calculations they have access for each calculation to a calculator which is implemented using an HTML form and JavaScript. In some instances these calculators simply check that they have correctly used a table of values (e.g., a saturation vapour pressure table). In others, such as the calculation of vapour pressure, their application of an equation is checked with each component being displayed (Figure 2).

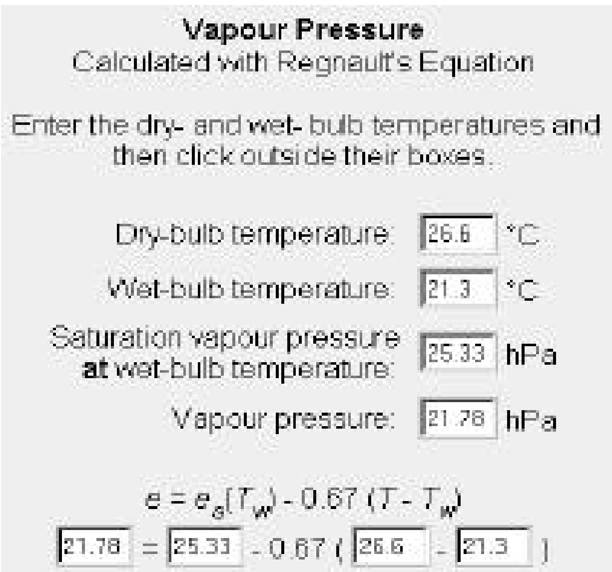

Figure 2. A vapour pressure calculator used by students to check their own calculations. They enter their observed dry- and wet-bulb temperatures in the appropriate boxes and the calculator fills in the other boxes.

Plotting

Often students need to plot and interpret data. Sometimes the data also need to be manipulated mathematically before plotting. When present, staff can check each stage of this process and point out errors to students.

In a flexible mode where staff are not present, a strategy similar to that for the calculations mentioned above has been employed. Numerical calculations are checked with the use of an HTML form and JavaScript, and plotting is carried out by submitting the form to a common gateway interface (CGI) script that then calls programs that do any additional calculations and the plotting.

An example of this is a practical in which on-campus students launch a weather balloon and track it with a theodolite. They then have to calculate the balloon's position and velocity at various heights and plot these on range-azimuth and speed-direction (hodograph) plots. After checking and then submitting the HTML form (Figure 3) the plots are returned along with an identifier (Figure 4). This identifier allows the student to retrieve their data and plots at a later date for revision purposes or if they have to leave the practical at this point before moving on to the interpretation section. Additionally, this storage enables the discussion amongst students of each others results and the use of the data by off-campus students. It also allows staff to build up an archive of useful wind profiles for use in discussions with students and for use as examples in future years.

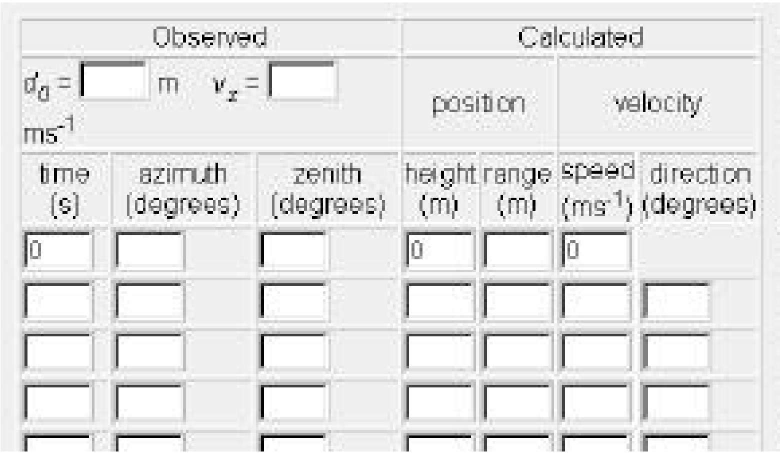

Figure 3. This HTML form and the associated JavaScript are used by students to check their calculations of a weather balloon's position and velocity from their observed theodolite readings. The form can be submitted to generate range-azimuth and hodograph plots (Figure 4).

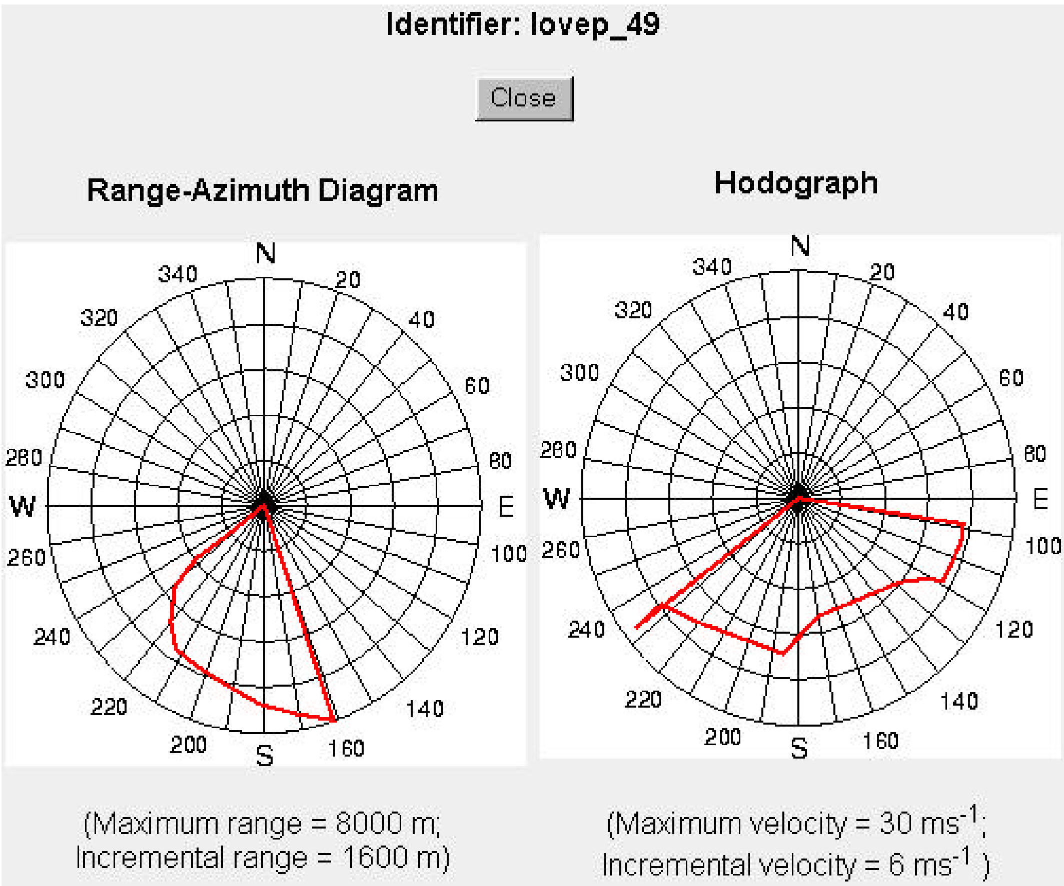

Figure 4. Part of the response from the weather balloon position form (Figure 3). The identifier at the top allows students to retrieve their plots and data at any later date.

Problem Solving
Students are given application problems to show how the concepts they are learning can be brought together and applied to real-world examples. One of the important things staff do in practicals is assist students in understanding how to go about solving these problems. Most of the difficulties the students have with the problems are not the actual algebraic manipulations. Their difficulties are predominantly in knowing how to approach the problems. To simulate the role of a staff member students can access the final numerical answer to see if they have got it correct. They then have the option of building up a model solution by working through a series of steps. At each step they are given the opportunity to complete the problem themselves. To encourage them to do this, each step might contain hints, references or HTML links to lecture or practical material.

These stepped solutions are simply a series of appropriately linked HTML pages. However, to facilitate their generation and maintenance they are sourced from a single file that contains the sequence: part of final solution, hint/information on how to solve, part of final solution, hint/information on how to solve, etc. The HTML pages are then generated by processing this file with a simple script.

For example, in a problem involving the surface energy budget students are given various bits of information and then asked to calculate, amongst other things, incoming solar radiation. The first step starts by re-iterating very simply the objective. It then indicates that a diagram should be drawn and gives some references (Figure 5). The next step gives an appropriate diagram and introduces the associated energy balance equation (Figure 6). This example then proceeds with the identification and calculation of the various components from the information supplied in the problem. As each known variable is identified its colour on the diagram is changed to black. At each step the relevant equations are represented on the diagram as well as in the text.

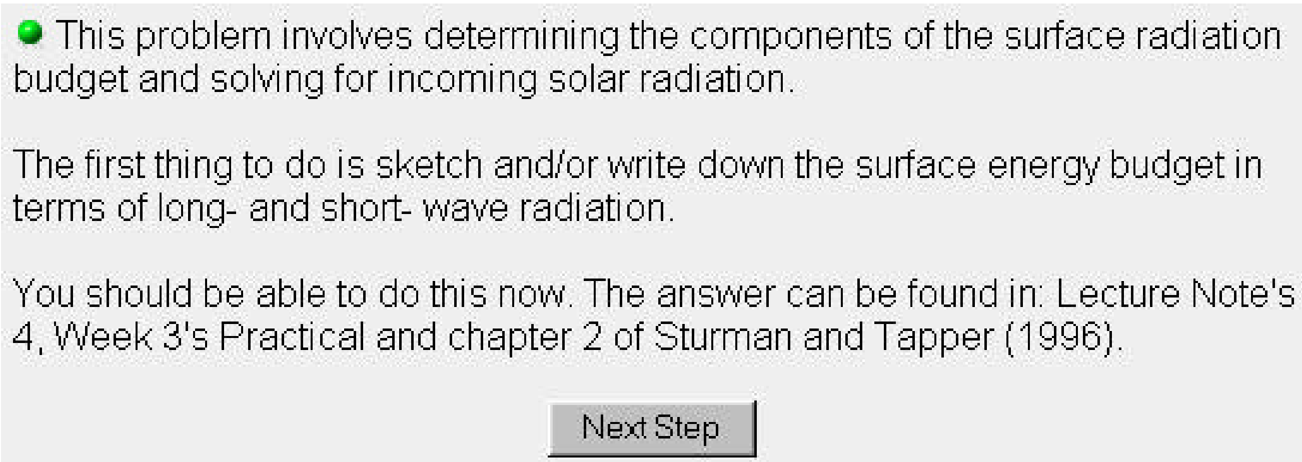

Figure 5. The first step students are given in a problem requiring them to calculate incoming solar radiation. They are given the important step of constructing a diagram and some references to help them. The next step is shown in Figure 6.

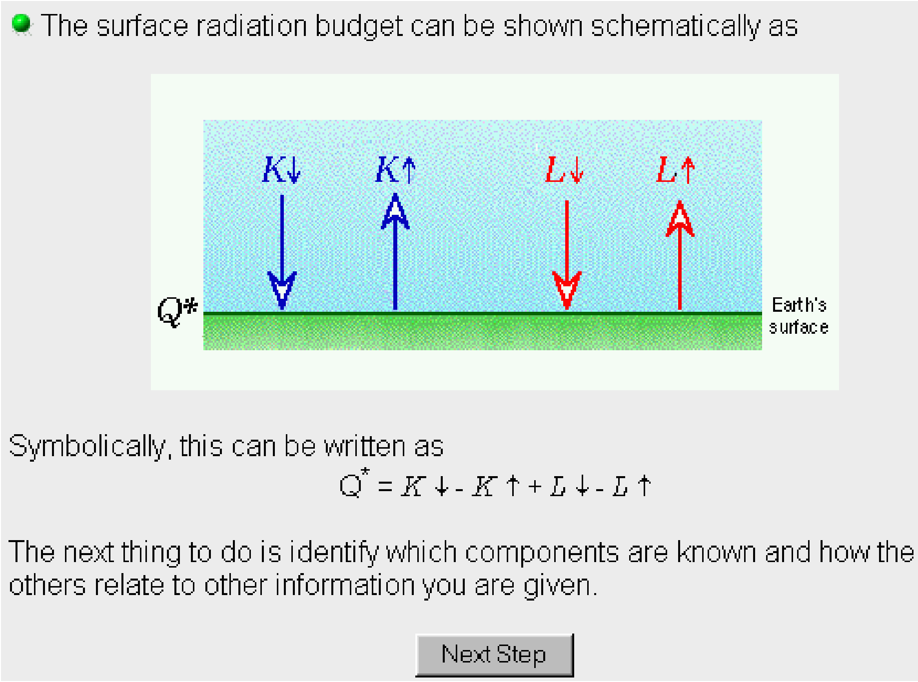

Figure 6. The second step students are given in a problem requiring them to calculate incoming solar radiation (*cf.* Figure 5). They are given a diagram and the mathematical relationship between the variables in the diagram. As these variables are identified in subsequent steps their colour changes to black. The variables are also replaced on the diagram by the equations needed to calculate them.

Animation

Often staff use handwaving and drawing successive things in different colours and/or erasing and re-drawing to indicate temporal or other changes in physical state. In some instances this type of feedback can be achieved in the absence of staff by the use of animation. This is particularly successful when students can construct their own animations for their own cases.

An example of this is soil temperature profiles, their diurnal variation and how they depend on characteristics of the soil. A simple HTML form interface (Figure 7) is used to allow students to choose soil type and depth, and the length in days and speed of an animation of the soil temperature profile. At the end of the animation three hourly profiles are shown in colour on a single still frame (Figure 8).

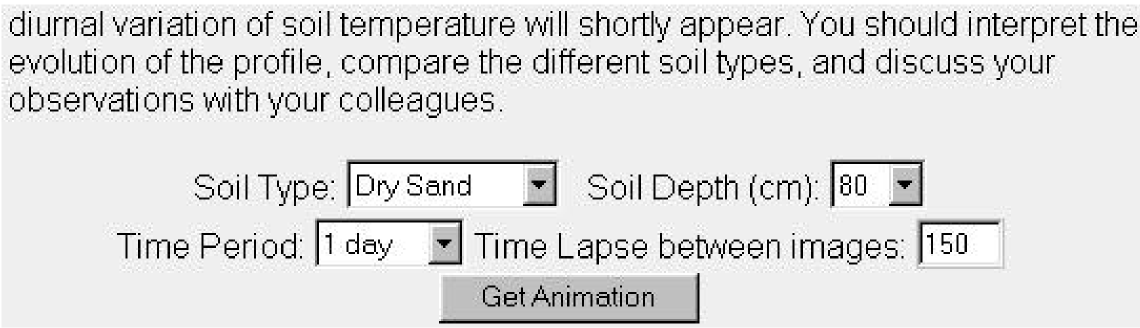

Figure 7. An HTML form interface which produces an animation of a soil temperature profile. At the end of the animation a still frame with three hourly profiles is displayed (Figure 8).

Conclusion

Some of the ways in which the absence of staff can be compensated for in flexibly delivered Atmospheric Science practicals have been shown. All of the examples here were used in a second year undergraduate Atmospheric Science unit in first semester, 1997 and are being used in first semester, 1998. Some evaluation has been done and more is in progress. The evaluations to date have not been focussed on the feedback mechanisms mentioned here, but some of the open comments received relate to them.

Overall, student response towards the material based on Internet technologies is very positive. When presented with the statement “I would be more likely to enrol in a unit like GEOS216 if it offered a program with similar on-line access” the number of responses in each of the categories no response, strongly agree, neutral, disagree, strongly disagree and not applicable were 0, 20, 19, 12, 3, 2 and 1, respectively. That is, 68% of students agreed with the statement and approximately 89% agreed or were neutral. However, one consistent comment received was that more feedback was required in the practicals.

This highlights the importance of including feedback mechanisms such as those discussed here and the need to introduce and intersperse more of these throughout the material. To do this effectively will require some analysis of actual student use of the material. This is essential in order to identify to what extent the different mechanisms are actually utilised in each learning context.

Another consistent comment was the need for more staff presence in practicals to answer queries at the time of a problem. This comment needs to be considered in the light of a very poor attendance at the practicals where staff were available. However, there is no doubt that in many situations students do benefit from individual feedback at the time a query arises. One solution to this problem for spatially distant students would be to have staff available at particular times for synchronous communication. This should be implemented along with encouragement for peer response and interaction via the communication facilities. Greater HTML linking between practical and lecture material might also assist.

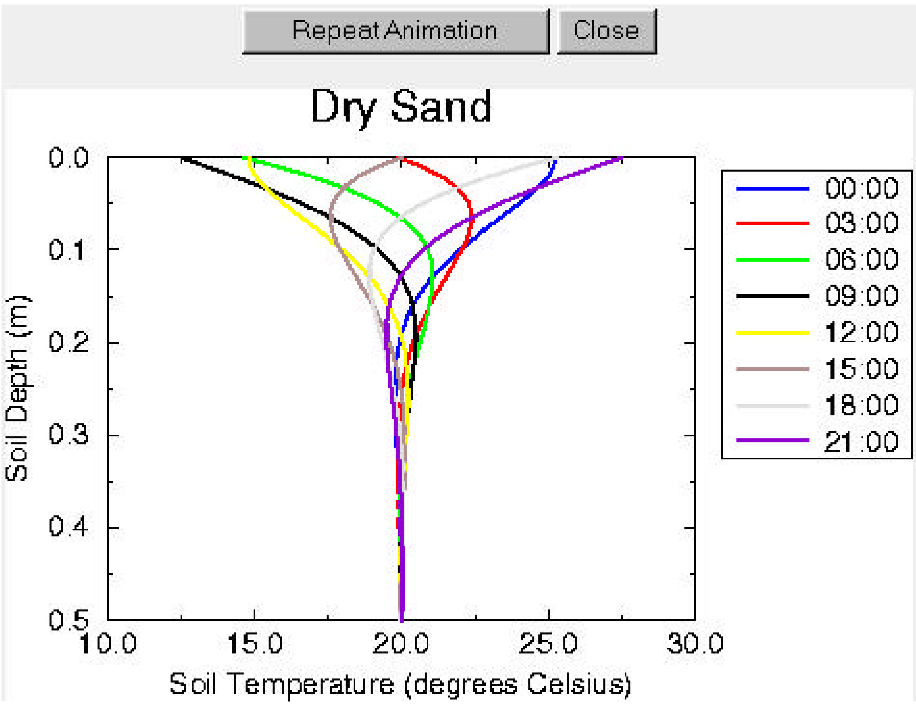

Figure 8. The still frame with three hourly profiles that is displayed at the end of a student constructed animation of a soil temperature profile (see Figure 7). The different profiles are in colour.

Acknowledgement

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First Year Biology Teaching on the Web: To Lure and Catch the Imagination of the Students

Mary Peat and Sue Franklin, School of Biological Sciences, The University of Sydney
maryp@bio.usyd.edu.au sue@bio.usyd.edu.au

The School of Biological Sciences, at The University of Sydney, teaches first year biology to 1200 students each year, in almost every faculty on main campus, resulting in a student group with a wide range of abilities and background in biology. The teaching involves repeat lecture series, multiple concurrent laboratory sessions, and vast numbers of reports and examination papers to mark.

Computers were initially introduced to the learning environment to help students understand topics which are difficult to conceptualise and are often difficult to demonstrate in the laboratory. Currently computer-based learning modules, assessment and web-based materials are delivered in four, sixty seat laboratories (Franklin and Peat 1995). These materials are also available in a student resources room which contains ten networked computers, models, microscopes, reading materials and other resources. With an increasing use of computers in the laboratory and more materials becoming available for review and revision in the “actual” resources room, the pressure from students to open the room for much longer hours forced us to consider alternative ways of increasing their access to the materials.

The web has allowed the development of a “virtual” resources room which offers students a flexibility of use that the real resources room could never offer. Students can access materials 168 hours a week, use them at a time convenient to them and can go back to the materials as many times as they need. In the current economic climate, with students juggling university commitments with employment, and thus potentially missing some of the structured teaching and learning sessions, the existence of virtual delivery is a timely addition to our resources. Our Virtual Resources Room (VRR) is a web site which contains course materials and packages, allowing both learning and self-assessment opportunities. It also facilitates communication between staff and students via email and discussion lists. The VRR can be accessed via the First Year Biology web address (http://fybio.bio.usyd.edu.au/FYBSOBS/FYB_welcome.html), however students must log in with a User ID and Password.

The VRR presents materials in a non-confrontational, user-friendly way offering students the benefits of different learning modes, depending on their preferences, thus putting the onus on them to take responsibility for their own learning, but in a way which caters for all learning styles. In addition, all information in the VRR is searchable. For example students can search for a particular topic within a lecture. From the VRR students can jump to web sites of: The University of Sydney; The School of Biological Sciences; and First Year Biology.

Materials available in the VRR are:

- Current timetables for all first year courses;
- Paper-based materials such as answers to homework and self test quiz questions, copies of the sample exam papers for the various courses and materials required for assignments;
- Lecture notes (posted on the web after the lecture has been given). Lecturers’ email addresses are included so the students can contact them directly if they wish;
- Computer-based learning material such as tutorials, pre-lab modules and revision modules (Franklin and Peat, 1995; Franklin, Peat, Mackay-Wood and Chambers 1996);
- Student Self-assessment Modules which enable students to take a series of formative tests and exercises aimed at helping them monitor their level of understanding of major biological concepts (Peat, Franklin and Mackay-Wood 1997);

- Interactive, web-based materials which allow students to mark, and receive feedback on, a “mock” exam which is held two thirds of the way through Semester 1; and
- Remedial materials, aimed at enhancing understanding of major topic areas, for students identified to be “at risk” by the “mock” exam.

An important innovation in the VRR is the asynchronous **communication link** with staff and other students. Students can email staff via a **CyberTutor** and ask questions about the course content and organisation. Staff check the CyberTutor email inbox and reply to any questions, or send the questions on to a more appropriate authority. A **Discussion Group** allows students to post questions, or discuss any topic with their peers. Students can either join a topic currently under discussion or start a new topic for discussion.

Students **emailed comments** on the VRR include:

- “Biology web site extremely useful and well organised”
- “You have done an absolutely fantastic job…I appreciate it very much and so no doubt do many other ‘silent’ students”
- “Overall this message is mainly to compliment the staff on an excellent set of resources and to encourage you to continue developing them”
- “In response to the idea for putting the CAL modules on line. I think it’s a wonderful idea. I can’t express how great I think that idea is…”
- “Just a note to say thanks. FYB definitely makes more of the on line resources than most other subjects”

Of the **student enquiries** in 1997:

- 35.5% were questions relating to the general content of the courses, usually on laboratory material, or concerning assignments related to laboratory experiments.
- 39%were questions related to the lecture material. The majority of these messages concerned the actual lecture content, however 20% of these messages contained positive comments about the lecture material on the “virtual” resources room site.
- 13.5% concerned information regarding exams.
- 12% were internet related questions, such as how to reference internet sites for assignments, server problems and when would material appear on the “virtual” resources room site.

Conclusion

The launching of the Virtual Resources Room was in response to increasing student demands for greater hours of access to our Resources Room. Moving the materials onto the web is in line with The University of Sydney, Faculty of Science policy on equity of access and availability of teaching materials. Access has been greatly enhanced by the opening of student computer laboratories (one with 24 hour a day access) across the University campus. This has enabled students without home-based computers, who previously may have been disadvantaged, to have 24 hour access to the web.

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Online Resources — A Systematic Solution

Ian Roberts, Adelaide Science Online, The University of Adelaide
iroberts@science.adelaide.edu.au

Strategic background

In 1997 the Faculty of Science at the University of Adelaide re-assessed the nature of its commitment to the provision and use of information technology into the future. We sought to articulate the IT needs of staff and students and describe the key attributes of a system that would best meet those needs.

While flexible and remote delivery haven't been seen as priorities for the University of Adelaide (as an established sandstone University with a desirable address) but, for obvious reasons, the need to participate in this area is growing.

It is recognised that IT can and must support effectively our teaching, research and administrative activities but will fail to do so without careful planning and a strategic approach.

The description of the characteristics of a suitable IT system for us has encouraged us to adopt a particular approach to the development and management of our on-line resources.

Phase change

As always in the area of IT, we appear to be on the cusp of a new era. In the past, enthusiasts have created WWW sites based on HTML files organised in rudimentary directory systems. A substantial personal commitment has been needed to come to terms with a fairly ugly mark-up system and the server directory structure of the on-line resources has been manually hard-coded into the hyperlinks needed for WWW navigation.

We have realised that such an approach is no longer feasible. If we are to manageably place online a substantial proportion of our teaching, research and administrative business then we need a system that will allow the development of online resources, their management and access systems that will be scalable and minimise contact with the seamy side of WWW publication.

Characteristics of a supportive system

What would such a WWW system be like?
Firstly, it should not require ordinary users to deal with the technical details of WWW publishing while allowing enthusiasts to use advanced features if necessary – WWW publication without HTML etc. expertise.

We also need to preserve our content uncontaminated by the artefacts of WWW delivery.

We need to ensure that links for WWW access are automatically generated and maintained for resources as they are created.

Flexible container

A suitable system must be able to accommodate the range of resources currently in use, being produced or envisaged including:

- content (syllabus material, quizzes, interactive simulations, etc); and
- conduits for access to other resources (discussion groups, FAQ facilities…).

Whatever their content or format, these items can be considered to be documents that need to be shared with others.

Access control

WWW publishing must be viewed as a continuum ranging from narrow-casting (sending a message to a colleague or group of collaborators) to broadcasting a report on the WWW for open and anonymous access. We need to be able to devolve the ability to create and upload these resources and share the authorship of that material if necessary without compromising the security of the server and its operating system. The system must readily support editorial access where appropriate. Such a shared environment requires the provision of an audit trail that automatically tracks data on the date, source, revision history, etc. of each item. Multiple levels of access must be able to be provided systematically.

WWW Navigation systems

Is it any wonder that the wilfully unstructured and anarchic WWW so often frustrates surfers intent on a systematic pursuit?

The WWW stands on two pillars (hangs by two threads) – the content of the WWW pages being viewed and the hypertext links associated with that content. Perhaps the biggest management nightmare associated with the WWW is associated with these links. Of these, I identify two categories: heuristic and systematic.

The heuristic links embody the structureless WWW metaphor. Those familiar, perhaps idiosyncratic snail trials that can be followed throughout the WWW. Typically each one of these links is manually created and vulnerable to changes. The creation of these links requires source and destinations information to be provided and remain valid. These links are time-consuming and remain indispensable.

However, to date, a similar technique has been used to develop the systematic links that are essential to provide formal, structured access to WWW resources. Akin to the table of contents of a reference book, these have been manually created and maintained on millions of home pages throughout the WWW.

While the first set of links remains substantially within the province of teachers and students to define and maintain, the latter is amenable to a systematic treatment - such as those provided by any contemporary database.

Whether heuristic or systematic, hypertext must be as reliable as possible. Semi-automatic checking and manual updating is the only option for non-systematic links.

However, a sophisticated approach to WWW delivery can automatically create and update systematic links within a WWW site. This makes the provision of multiple routes feasible. Indexing systems are possible to meet the different needs of different users or the same user at different times.

We should not regress as we move from existing technology to new media. Any text book provides the reader with at least three approaches to its contents:

- Browsing (linear or random page turning);
- Table of Contents; and

- Index.

This should set a lower limit on the level of the service our WWW systems provide.

Databases

The terms in which we have described the problem make it clear that a database solution is needed to manage our online resources. We opted to give *Lotus Notes* a try as its core functionality appeared to match our needs – the reliable and secure sharing of documents.

Perhaps the most attractive aspect of the current version(s) of *Lotus Notes* is the automatic and relatively seamless WWW access provided to Notes databases by Lotus's Domino server technology. We have adopted the principle that fairly standard WWW-browsers should be the delivery mechanism while a mixture of browser and Notes clients should be used for authoring tasks.

But we needed to determine whether the product lives up to the claims made for it? Our experience to date looks promising with stable and fast server performance (10K hits/day).

In particular the rendering and caching of massive number of dynamically generated index pages is remarkable.

Automatic full text indexing and searching is effective – the Notes server even drills into the contents of attached files (of common formats)!

We've also used database devices to automatically expire WWW notices etc.

Multi-level access

We have been able to create a multi-level system for WWW publication based on three main groups:
- Public;
- Student; and
- Staff.

Public access resources allow anonymous access while users are challenged for a user-name and password for the other resources and the information is checked against pre-defined groups of registered users.

Access control is managed with standard Notes database tools using data from the University's Student and Management Information Systems. A spin off of the access control lists so developed is that they also serve as e-mail lists.

Access restrictions are currently being maintained at database and document level. Further security can be implemented including field encryption and Secure Sockets Layer although we have not yet felt that need.

Free lunch?

No. By redefining the task of WWW-publication to suit a database treatment we are replacing one set of challenges with another. We need not:
- get our hands dirty with HTML;
- settle for limited indexing of resources; or
- manually update time-dependent notices.

However we need to address the challenge of cataloguing our online resources in a manner that is helpful to a range of readers. This task is non-trivial but the rewards are much greater.

Much larger resource sets can be managed and accessed and within the meta-data of the database lies the knowledge. This approach allows substantial value to be added to the resources.

Database design

ASO has been working with a number of staff to refine a number of templates for WWW teaching. We have developed several applications from scratch and used some of the standard templates as-is or with minor modifications.

Documents

An important step in database conception and design has been to define what a document might be. A Notes document is equivalent to a record in other databases and can contain the typical range of data types up to and including Rich Text Fields into which can be:

- imported a reasonable range of file formats (including Macintosh and MS-Windows clipboard formats);
- attached any file at all – these need appropriate browser plugins or other run-time software.

Databases have been deployed with documents that hold:

- individual teaching resources such as image files, spreadsheets, *HyperStudio* stacks;
- lecture aids such as *PowerPoint* presentations;
- student and staff submissions to guided, online discussion groups;
- student project submissions;
- complete course information and material;
- clinical and research reference material; and
- general notices.

Metadata

Perhaps the hardest task is to explain the process by which apparent structure created by building sorted and categorised views that combine a number of database fields – a few minutes of hands-on experience proves very convincing.

Summary

I believe that we're addressing the needs of the second phase of innovation of delivery of teaching material.

While we can rely on the enthusiasts to march ahead and make course elements for use in their courses we need to help them cope with the growth of their resources and, more importantly, we need to provide a supportive environment that will allow other interested (but less skilled/committed) staff to fill in behind these ground breakers.

The range of resources being created and purchased need to be assembled in a systematic way and convenient access provided.

Lotus Notes appears to be providing us with the tools we need to build a system for the management of a WWW-based learning environment.

Exploring the Value Of Integrating WWW-Chemistry Teaching with the Hawkesbury Shell

Deidre Tronson, School of Science, **Deborah Veness**, Flexible Learning Unit
University of Western Sydney, Hawkesbury
d.tronson@uws.edu.au

Introduction

- This is a non-technical presentation: the URL of our site is available if you want to browse at: http://www.hawkesbury.uws.edu.au/features/UWSHshell/CH101A/index.shtml
- This talk will be centred around the words "value" and "integrating" in the title — with a brief explanation of the role of the Hawkesbury "shell".

Part A: the "shell"

What?

The Hawkesbury Shell project aims to provide an infrastructure and co-ordination umbrella for staff wishing to experiment with any form of IT application to their teaching. It will also be Hawkesbury's face to the world: the interface between us and any off-campus students.

Another aim of those involved in developing the shell is to initiate a variety of collaborative learning prototypes.

How?

In the context of worldwide trends in new technologies, the convergence of on- and off- campus modes of teaching and practical matters like over-stretched budgets, the University of Western Sydney, Hawkesbury (UWSH) has provided funds to be allocated on a competitive basis. The projects funded should have the potential to either increase student enrolments or generate income for the University.

Two of the projects funded in the initial round in 1997/98 were the Infrastructure (Shell) Project and the project to adapt the external chemistry and biology subjects for www-delivery.

These projects were linked even at their conception, and are now integrated in the sense that part of the Introductory Chemistry subject is providing the "content" for one of the pilot projects for the shell.

Why?

Tony Bates (1997) describes the "Lone Ranger and Tonto" — the lecturer and the graduate assistant with a grant to develop a course. He comments that some of the most innovative ideas are generated this way, but in his experience not many of the courses so started are actually developed into fully fledged, working courses. At UWSH, it was felt that an overarching shell could help overcome this problem by:

- providing a standard for IT involvement in courses and subjects;
- choosing and supporting software that was adaptable and user friendly to staff, students and administrators;
- developing collaborative learning prototypes;
- providing a mechanism for students not enrolled in UWSH courses to pay for individual modules (e.g. for HSC revision or pre-tertiary Bridging Courses); and

- eventually providing a mechanism for students to submit assignments or write exams on line.

Where we are at:

- *WebCT* (developed at UBC) has been chosen as the software. The choice was a complex one; a compromise based on cost, ease of use and ability to cope with collaborative learning packages;
- the first web-based module of Introductory Chemistry (CH101A) is being adapted for the *WebCT* software *as we speak*. This is suitable as a revision/bridging course module when the system can cope with payment by students; and
- simultaneously, a collaborative learning prototype course is being developed as another pilot project on the *WebCT* software.

Some comparisons

As a slight diversion, I will mention some comparisons between our resources and those of the authors of the two references I have used:

- Tinker (1998): the FLAP project is part of the Learning Technology Program in the UK. A paper-based program in physics and maths was delivered in 1995 after 3 years of development and an investment of $US 1 million. An electronic version is due out in 1998.
- Bates (1997): at UBC there are now 26 technology-based distance education courses developed in 2.5 years. Staff members are part of a Canada-wide telelearning consortium which has won a contract of $C13.5 million.
- Tronson & Veness (1998) at UWSH: the Shell project grant was $170,000 and the grant for the Chemistry/Biology WWW-adaptation was $30,000 (some of which is to be paid back when we make a profit from the bridging courses).

Part B: The Chemistry/Biology Project

UWSH has a long history of catering for "external" students. Traditionally most of these students have been studying for the BAppSc in environmental health. A wider range of students now studies one or more subjects in the external mode. To facilitate this, the on- and off-campus delivery of some subjects has converged.

What?
The students who take these particular chemistry subjects (either on- or off-campus) are not science-majors. As well as the environmental health students, we now cater for students of horticulture, agriculture, environmental management, food technology as well as students undertaking some Diploma courses.

As a couple of Lone Rangers with our respective Tontos, Shelley Burgin and Deidre Tronson set out on our horses, quite sure we could achieve all our aims:

- to rewrite the two semesters of the biology external course;
- to adapt this for WWW-delivery; and
- to adapt the newly-rewritten two semesters of the chemistry external course for WWW delivery.

Why?
A traditional first-year chemistry course is NOT suitable for these students — neither are many of the www-sites I have visited. We wanted to think about the pedagogical reasons for re-thinking our subject. Our main aims were to provide an alternative medium to help students:

- see logical connections between facts, observations and implications;
- visualise the macro and micro world in **3-dimensions;**

- visualise the submicro world of atoms and electrons; and
- have some ownership of their learning.

We were determined **NOT** to reproduce the text-based material as html. These aims were mirrored in the article by Tinker (1998).

How?
To achieve our aims, we intended to use:
- links within the site and to other sites we chose;
- questions and accessible answers on each page — feedback; and
- animations where appropriate ... **without** the use of sophisticated software that we had already determined many students did not have access to.

Where are we at with the Chemistry project?
We have achieved something concrete. We have one module of Introductory Chemistry on a stand alone web site and part of an organic module being developed. This module is being used as the first content-based pilot project for the *WebCT* software under the shell project.

It was found that the reconceptualisation required to adapt one's lifetime habits of teaching to the electronic medium was a lot of fun, but took a lot of T-I-M-E.

The setting up of prototypes and databases for the web-site, keeping the whole subject in mind, also took Tonto a lot of time. This is not time wasted, as it will be easier and more straightforward for anyone taking on the project later: but it was a surprise.

We have established a valuable link with the Flexible Learning Centre and the shell project. However, during the process of collaborating with those creating the shell, it was found that our aspirations and theirs were diverging. The shell was more concerned with developing collaborative learning. While thinking that this would be useful further down the track, we set our priorities more on imagining ways to use the web to provide visualisation, feedback and links to other sites.

What about the biology project?
The first semester subject has been rewritten and the second semester subject is being rewritten.

Contacts have been made with a major publisher and ideas discussed for the eventual adaptation for WWW.

Where to now?

Immediate challenges:
- We obviously need future funding — but from where? (CUTSD is an option).
- We need to expand time — but how?
- We need to keep working on the collaboration between the chemistry project and the shell now that we are in a productive phase. This means asking for and accepting more support — which also takes time and effort.
- We need to think carefully about integrating the ideas of the Lone Ranger with the technical ability of Tonto: is there an ideal mix of talents? Bates (1997) states that the lecturers will find there are some things they do not want to do. Some of us have other time consuming commitments as well — students and research for example.

The Future

No-one has yet discovered all the interesting or valuable uses of the new technologies we have at present. How can we best assemble people, their ideas and skills to make efficient and effective electronic delivery of real subjects happen?

We need to consider the tensions between:

- teams vs individuals;
- integrated Flexible Learning Units vs support people within the faculties; and
- support (when does it become "control"?) vs academic freedom.

We also need to consider:

- Being a competent teacher does not mean being competent at designing and delivering electronic-based courses.
- Educationalists and science lecturers may have overlapping techniques but vastly different approaches. They need to speak the same language — or realise the need for a translator.
- How much do we rely on technical support, and how much do we need to organise for ourselves?

Conclusion

We have succeeded in providing some web-based material for our Introductory Chemistry subject as an alternative to more conventional modes of delivery. We never intend this to replace what we have, but to provide more flexibility and choice for the students.

It has been valuable to integrate the development of WWW-based chemistry teaching with the Hawkesbury Shell project: without support and nurturing, the embryo may die.

We realise we need to make a "leap of faith" — but intend to keep pushing on with this project.

HI ... HO... SILVER!.

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Rohan Tronson, *Research Assistant - alias Tonto*

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A Virtual Resources Room: A Model in Equity, Access and Communication

Sue Franklin, Mary Peat and Rob Mackay-Wood
School of Biological Sciences, The University of Sydney
sue@bio.usyd.edu.au

First Year Biology Teaching at The University of Sydney involves repeat lecture series, multiple concurrent laboratory sessions, seemingly never ending reports to mark and vast numbers of examination papers to grade. The sheer size can lead to impersonal interactions between the staff (in dwindling numbers) and the students (in increasing numbers). Since the late 1980's teaching methodologies and scenarios have been put in place to put the emphasis on small group teaching in large classes and student centred learning (Franklin and Peat, 1996). Since 1992 the use of computers in our laboratories has led the way to an explosion of material and delivery modes for teaching (Franklin and Peat, 1995) and assessment tasks (Franklin, Peat and Mackay-Wood, 1997). More recently the web has allowed the development of virtual communication between the staff and students.

The poster will illustrate the use of the web in first year biology for delivery of course materials (such as CAL, Self-Assessment Modules, lecture notes and handouts), for formative assessment and for general communication with students. In particular the evolution of a "virtual" resources room (VRR), a web site accessed via the First Year Biology web address will be described. (http://fybio.bio.usyd.edu.au/FYBSOBS/FYB_welcome.html). The VRR contains many of the resources that are available in the "actual" resources room which is physically present in first year biology. It was developed to provide students with greater access to our materials than they had previously, as a result of the restricted opening hours and accommodation in the "actual" resources room, and to give them greater flexibility in their learning. The VRR is available to all students via log in access with a User ID and Password. The usage by students, and their perceptions of the "virtual" resources room will be presented.

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Student Responses to the World Wide Web as the Primary Educational Medium in the Classroom

Scott Gazzard and James R. Dalziel, Department of Psychology, The University of Sydney
scottg@psych.usyd.edu.au jamesd@psych.usyd.edu.au

In 1997 the Department of Psychology at The University of Sydney initiated a project to develop a "Reasoning and Argument" tutorial using the World Wide Web for the presentation of material. This format was chosen for a number of reasons, including cost-effectiveness, flexibility, and accessibility. This Web-based tutorial (WBT) was designed primarily for use in a classroom situation (unlike much web-based content), but also as a stand-alone resource which students could access from points external to the University. Student evaluations of the WBT were undertaken to determine students' reaction to the use of this new format. Results presented here show that overall responses were very positive, although some time problems were found to detract from students' enjoyment. Students completed the WBT in pairs in their usual tutorial classes, and evaluations indicated that the social interaction afforded by other students and tutors was a positive experience. Other positive aspects included interactivity, the inclusion of informative and stimulating content, and the ability to revisit material at the student's convenience. Student evaluations of this project have encouraged further development of teaching materials using the World Wide Web, and the feedback obtained from students has proven to be a valuable aid to the design and application of future Web-based tutorials.

The "Reasoning and Argument" Web-based tutorial (WBT) may be viewed at:
http://psychalpha.psych.su.oz.au/teach.htmls/psych1/p101/reasoning/Welcome.html

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Option(s) for Mathematical Notation on the Web

David Green, Department of Applied Physics, University of Technology, Sydney
dcg@phys.uts.edu.au

Many universities and colleges are embracing the world wide web as part of their teaching strategy. For scientists, mathematicians and engineers, there is a genuine need to use scientific notation as part of the way we communicate. To do so *interactively* on the web has been, *at best* inconvenient, and *at worst* almost impossible.

There are several ways to produce web compatible mathematics for static web pages. These include exporting from word processing packages and scientific typesetting programs the text as HTML which incorporates scientific formulae as a gif image. One can even digitise handwritten formulae. These approaches work well, but are only appropritate if you write the equations for the web once, load them onto a web server and then leave them alone.

A student or a teacher in a technical discipline who is trying to communicate via the web using newsgroups, chat rooms and the like has great difficulty with anything more complex than superscripts and subscripts and a few special symbols. The latter are supported in standard HTML sequences like ² for ^{2} and ° for °. Libraries of special symbols can be accessed but the flow of thought is severely disrupted by needing to gather special symbols from out on the internet. The MathML standard will improve this situation somewhat, by supporting math layup more naturally within the web document.

The package that we have developed makes creation of mathematical notation as simple as using a web browser. No special markup language is needed, and it handles matrices, sums, integrals, fractions and includes superscripts, subscripts, greek and a variety of special symbols. The package provides WYSIWYG (what you see, is what you get) HTML, and allows the user to have their equation as either, HTML, LaTeX source or as a rendered GIF image stored on a server for easy reference and later use. A new version which is MathML compliant is planned.

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Student-created Hypertexts and the Understanding of Psychology

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

Teaching psychology in a Faculty of Science presents some interesting, and slightly unusual academic challenges. Students are convinced that psychology is a “helping profession”, and that gaining a degree with the word “psychology” in it will prepare them for a rich and rewarding career assisting individuals to improve their well-being. Academic psychologists know, of course, that Psychology is a Scientific Discipline, and that a good education in the intricate, and extremely diverse, theories which support it, as well as a solid dose of statistical training, must precede any opportunity to be let loose on an unsuspecting public. The difficult balance between science and practice in psychology provides a never-ending source for curriculum design and redesign, professional accreditation anxiety, and a steady stream of disillusioned students.

The CAUT-funded project which I conducted in 1995 and 1996 was designed to allow me to implement and evaluate the usefulness of collaborative, student-created hypertext as a teaching method in a conventional psychology subject (PSYC311, Associative Learning). The intention was that hypertext creation would lead to more effective understanding of the theoretical content in this subject. What was revealed, however, is that allowing students more scope in the kinds of media which they may employ to meet assessment requirements created an environment in which they could successfully articulate the relationship between this theoretical content and the practical application of this knowledge. Students created quite beautiful hypertext markup language documents with almost no instruction; documents which revealed their understanding of how associative principles may influence behaviour with far greater diversity than any single academic could hope to achieve. In this poster I will report on the quantitative analysis of the students’ evaluations of the teaching method, display some of their work as hypertext, and show a video taken at their laboratory presentations. I hope that these will reveal the value and enjoyment which can be derived from the use of “homespun hypertext” in any educational context.