It's not about putting lecture notes on the web!

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Introduction

The use of the World Wide Web as part of flexible learning delivery is now well entrenched. To many people, it seems, flexible learning is synonymous with the use of information technology. Flexible learning is, of course, a much broader concept.[1] In this article I describe examples of the use of web technology in teaching of undergraduate and postgraduate subjects. The examples chosen show that there are a number of exciting options for using the web that have little to do with transmission of content and much more to do with interactions amongst students, teachers and the body of knowledge.

The following table is a suggested hierarchy of web-based activities and indicates where examples have been described in this paper.

Level	Classification of Web-based Activity	Example
6	**Student Designed and Controlled Activities**	
5	**Teacher Structured Asynchronous Activities**	
	Role Plays and Debates	✔
	On-line Learning Dialogues	✔
4	**Informal Interactions with Class Members**	
	Talk with peers and/or teachers (typically this might take the form of a "café" chat area within their learning system)	
	Informal Questions and Answers On-line	
3	**Information Retrieval/Analysis**	✔
2	**System Interaction Activities**	
	Interactive Web-based Multimedia Packages	✔
	Self Monitoring of Progress[2]	
	On-line Testing (multiple choice etc.)	✔
1	**Downloadable Content**	
	Multimedia (animation/audio/image)	✔
	Static Content and Hypertext Documents	✔

Level 1(a): Static content provided on-line

A strategic initiative by the University into flexible learning prompted the development of a virtual Physics Learning Centre (vPLC) to provide some of the same support functions of the "real" PLC (primarily one-to-one tuition and up-to-date information). Worked answers to tutorial and past exam problems were provided in digital form (by scanning). The problems were selected in response to student email requests or after enquiries in the PLC. An analysis of usage of the virtual centre indicated that these hints and solutions were by far the most sought after aspects of the site. Level 2 activities including on-line multiple choice diagnostic tests (see below) were utilised to a much lesser extent. On-line discussions of open questions (level 5) from the tutorial book were hardly visited at all and not utilised.

Students perceived that having 24-hour access to materials was of great benefit. The same materials could now be printed in a booklet and 24-hour access would still be guaranteed! Indeed the web server statistics shown in Figure 1 paint a somewhat grim picture for student study habits in the lead up to the final examination. Each vertical bar corresponds to server "hits" each day. The final day of semester and the two first year physics examinations (life sciences and physical sciences/engineering) are evident in the graph.

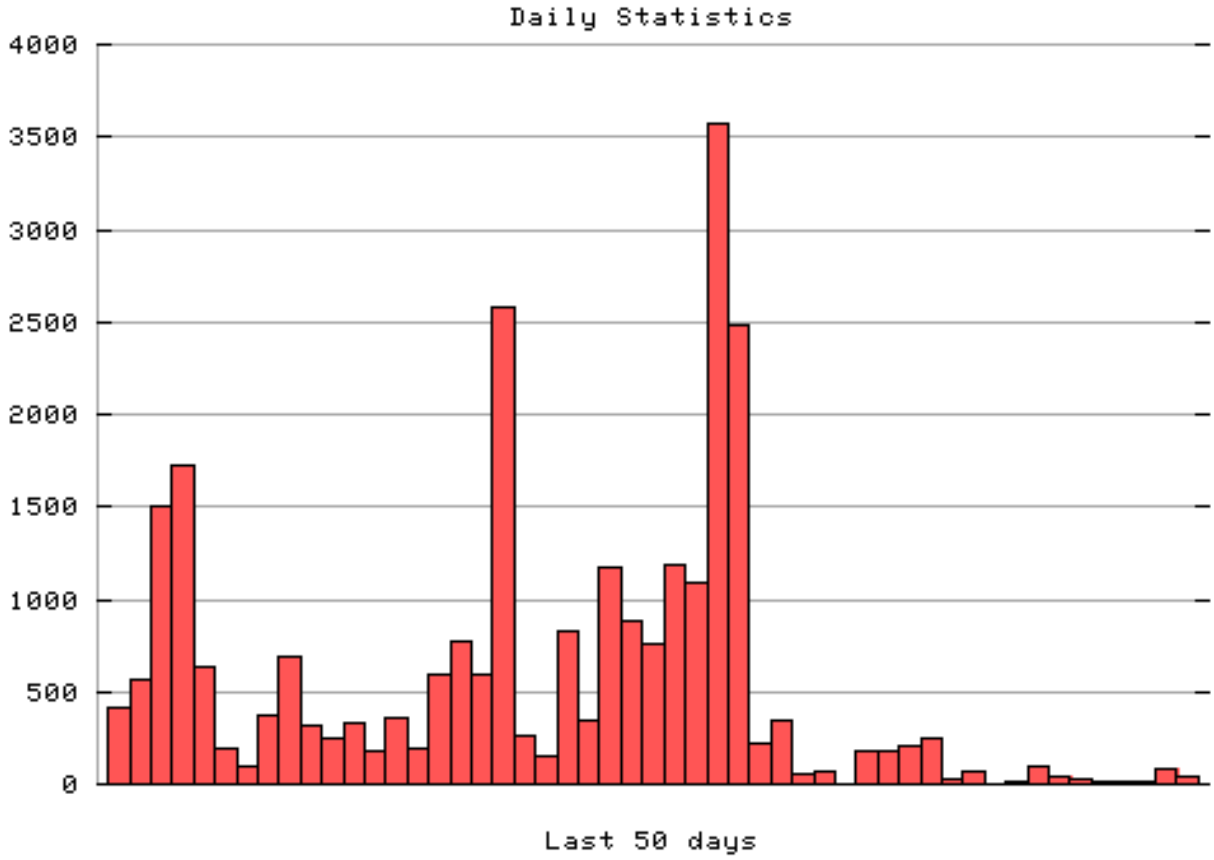

Figure 1. Daily server hits for the period including the last week of semester and examinations in first year physics subjects

Levels 1(b) and 2: Multimedia content and packages

One circumstance in which web delivery of static content can be considered more appropriate is where the content itself is genuinely digital in nature, and especially when linked with other forms of communication amongst class members. The versatility of the WWW for delivery of graphics, video and audio, as well as electronic attachments is now well understood and makes it possible to design content rich learning activities for on-line delivery. Of course, much can also be burnt onto CD-ROM and posted out.

The magnetic properties of materials are an example of macroscopic-microscopic duality. The use of the computer simulation *MagSim* to help explain magnetic behaviour by *simultaneous* display of microscopic and macroscopic realms has been an ongoing development.[3,4,5] The package was designed to simulate experiments by having options and adjustable parameters. On-line processing of this data returns an embedded *QuickTime* movie *on the fly* (see Figure 2). Regrettably, fully interactive use of the package has proved to be too demanding of network and server hardware so a pre-packaged (CD-ROM compatible!) version is used as part of a revision class.

Figure 2. *MagSim QuickTime* animation used as stimulus in a web-based revision class

Level 2: On-line diagnostic tests

For a number of years all new students who undertake first year physics at UTS have been given readiness tests. The tests cover Science, Mathematics and Physics concepts with multiple choice questions. This strategy was ported to the web and was promoted within the virtual centre early in the semester. The tests are a good example of formative assessment and students are encouraged to re-sit the tests later on.

Level 3: Bringing information skills into the frame

A guest book web server application was used to encourage students to develop their skills in information retrieval *and* critique of web-based information. As part of the learning activity, students are introduced to search engines and how to use them and then asked to go out and find a URL and to *explain* the relevance of their finding to the subject matter. A standardised format for the contributions was possible within the server software. Naturally, any system that documents hyperlinks and allows student comments could be used. Some examples include:

- NOVACAP's Technical Brochure: Ferroelectric Ceramics has been contributed by Jenni *because* it provides a good summary of ferroelectric ceramic characteristics and takes the subject just a bit further than what's done in class. It also concentrates on barium titanate, which is of interest at the moment, but discusses the advantages of using other ferroelectric ceramics instead.
- How Things Work: Magnetically Levitated Trains has been contributed by Iain *because* it helps to summarise some of the magnetic section of the subject.

Level 5(a): Open questions and asynchronous discussion systems

A strategy has been developed to engage students in on-line dialogues with each other, with the teacher, and importantly, internally with themselves. The benefit of this *semi-formalised* "thinking aloud" has been recognised as an important attribute of computer mediated discussion.[6] The asynchronous discussion format provides a flexible and interactive vehicle for this thinking and dialogue to take place.

The important elements of the strategy are:

- open questions as the stimulus (room for interpretation in question and answer);
- exploration of the question can usually take place at several levels;
- each question (module) starts a fresh newsgroup;
- questions are set as prework for next class (often revision of earlier studies);
- virtual tuition (comments/arguments) from peers or teacher;
- self review later in semester; and
- participation in the discussions forms a small part of the assessment.

Newsgroup software (*HyperNews*) which supports multiple threading and indentation of responses was used for its simplicity and robustness. The software supports a variety of modes for the attachment of messages including a "smart text" as well as HTML and the embedding of entire URLs.

Figure 3 shows schematically the life cycle of a module down the right hand side with the key teacher inputs on the left. A module will remain "active" for at least 4 weeks to allow stragglers to complete (commence) the module. The input from the teacher feeds in, where necessary, to ensure discussion proceeds productively. Critical stages have been found to be just after the module stimulus is posted, and at the end, when contributions from students are synthesised into a summary record. To encourage student involvement, the students' participation in modules is assessed.

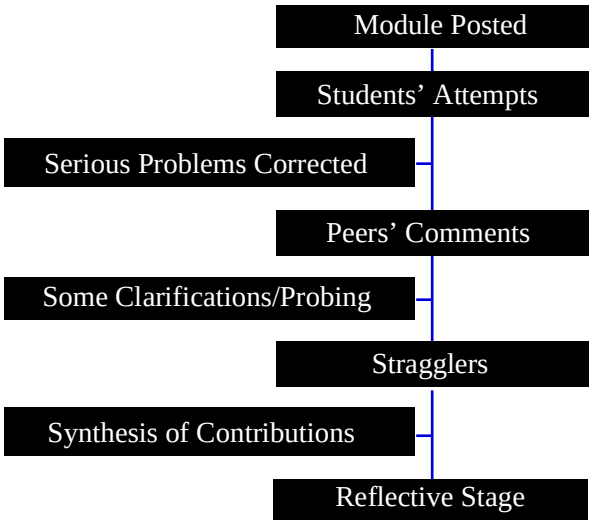

Figure 3. Schematic diagram showing the timeline of a learning dialogues module. The involvement of the teacher at key points in the process is shown as inputs from the left.

Level 5(b): Role play using asynchronous discussion

Dr Rob McLaughlan, National Centre for Groundwater Management at UTS has had considerable success in his teaching in environmental decision making by incorporating an on-line role play as a major component of the student activity in a subject in Environmental Management.[7]

The objectives of the simulation are to identify political, social, economic and scientific dimensions to decision making, to identify responsibilities and responses to environmental issues and for the students to develop their communication, negotiation and decision making skills.

The activity was structured with four weeks of preparation (orientation to web-based teaching tools etc.), two weeks of on-line persona development (Figure 4), nine weeks of the live role play followed by a two-week de-briefing phase at the end.

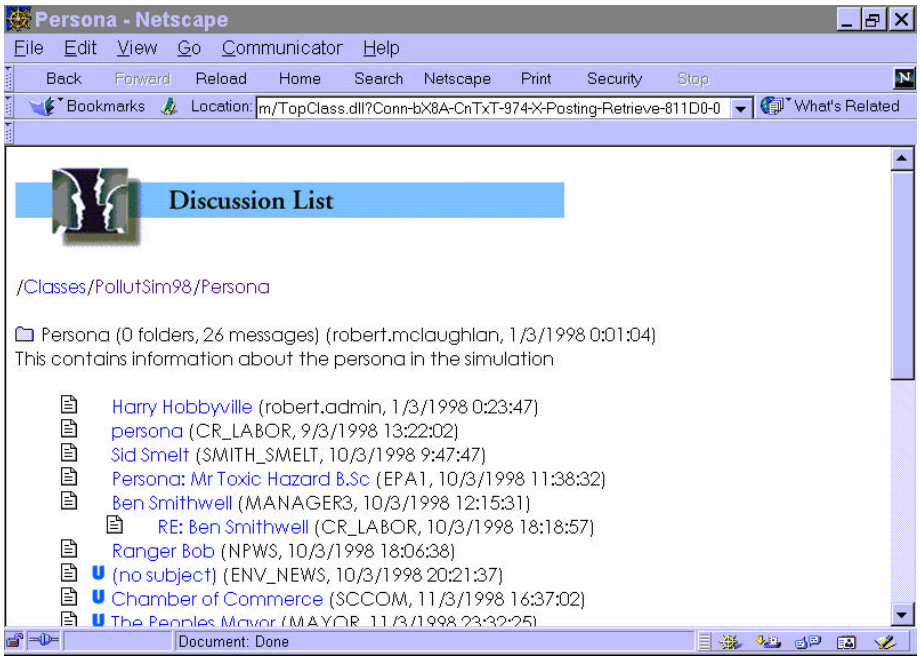

Figure 4. Students develop personae for the role play and post them into the newsgroup

Summary

In the examples one can see an increasing sophistication in the way the web-based tools can be used to encourage discussion and dialogue amongst students. Far from being definitive, the hierarchy presented gives an indication of the range of options for flexible learning using the web, especially learning environment packages.

In all of the higher level activities, the teacher plays a crucial and non-traditional role. They are responsible for the design of the activity, the "nuts and bolts" of producing it on-line, and of monitoring and facilitating the progress of students. They are, as such, still teacher controlled learning experiences.

The suggested top-level activity (student designed) could potentially provide powerful learning opportunities but might not be appropriate in some circumstances. For instance, the mechanics of developing the activity might distract from the real message.

Software packages that are better able to support student-constructed pathways, and allow greater student autonomy, as well as supporting more natural communication (i.e. non-typing) are still around the technological corner. That said, there is still a great deal that can be done with existing learning systems that isn't just putting lecture notes on the web!

References

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[6]Laurillard, D. (1993) *Rethinking University Teaching: A framework for the effective use of educational technology*, London: Routledge (p104).

[7]McLaughlan, R. and Kirkpatrick, D. (1998) Developing Effective Frameworks For Electronically Supported Simulations, in *Proceedings of HERDSA International Conference*, Auckland.