

DATABASE-DRIVEN ACTIVITIES TO SUPPORT WEB-BASED LEARNING

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Abstract

This paper describes and rationalises the use of database driven activities and resources for Web-based learning. Database driven Web resources differ from conventional Web-based resources in that they tend not to exist in discrete forms of HTML but are generated dynamically through such means as learner interaction. Database driven applications are built around the use of the Web as a means to store, retrieve and develop media resource. The applications are controlled by software engines that provide the functionality and flexibility for both teachers and students to interact with Web resources and content. This paper describes various forms of database driven resources for learners and discusses the learning opportunities that result.

Keywords

On-line learning, Web-based learning, teaching strategies, instructional design, courseware development

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Introduction

There are many ways to use the Web as a teaching and learning tool. A number of writers have attempted to conceptualise the Web as a learning tool and in doing so have often identified discrete forms of learning activity that can be supported through Web-based learning. Collis (1997) describes the functionality of potential Web-based learning environments by a mapping process using conventional teaching practices (Table 1). When learning is considered in the form of the discrete processes and forms of which it is comprised, a potential role for Web-based learning can be established. Collis (1997) argues that all activities, which can be observed in the classroom settings for higher education, can be modelled and replicated with Web-based applications.

Components	Description
general	enrolling, reading the syllabus, reading course material
lectures	attending lectures and presentations
group discussions	participating in group discussions and seminar-style sessions
learning events	field trips, practical activities, guest lectures
communication	private communication between instructors and classmates
self-study	supervised practica, unsupervised reading and small assignments
individual projects	major course assignments
group projects	course assignment completed collaboratively
testing	assessment activities.

Table 1. Components of Higher Education Teaching and Learning (Collis, 1997).

In our own work (eg. Oliver, 1998), we have used a model to describe Web-based learning based through the identification of discrete functional forms which Web-based materials and learning environments can assume. The 4 categories we have identified are; information access, networked communications, interactive learning, and materials development. Each of these categories describes a unique attribute and tends to use discrete applications of the Web to provide opportunities for Web-based and on-line learning environments. Table 2 describes these categories and provides examples the various technologies which supports each. This alternative framework describing Web-based learning activities suggests ways in which the technology can support the various classroom activities described by Collis (1997) and provides a means to ground the wide array of learning activities in Web settings.

Web-Based Learning

The development of Web-based learning materials is currently proceeding at a frenetic pace in universities worldwide. Much of the thrust for this activity is driven by an economic imperative (eg. Holt & Thomson, 1998), while in other settings, it is being

driven by a quest for more flexible and open learning settings (eg. Nunan, 1996). In some instances it is even suggested that the use of the web can provide enhanced learning opportunities and outcomes (eg. Ewing, Dowling & Coutts, 1999). Whatever the motivation of institutions, the end result is a burgeoning level of Web-based learning materials and resources being developed. But what of its quality? As with all previous educational technologies, researchers have been examining the forms of Web-based learning to establish how well it is serving the needs of the teachers and instructors.

Learning strategy	Learning Activity	Examples
Information Access	the Web is used to convey information alone to the learner, for example, a course syllabus, a calendar, assignment descriptions, lecture notes, workshop descriptions etc.	PDF files, HTML documents, streaming audio, streaming video, applications files, eg. papers, spreadsheets etc.
Interactive Learning	the Web is used to involve instructional elements that engage the learner, encourage reflection and decision making and provide feedback in response to learner actions	Java Applets, Shockwave movies, animations,
Networked Communication	the Web is used to provide a means for the organisation, communication and exchange of ideas and information among learners and teachers and other parties in the learning process	Listservs, email, chat, discussion groups
Materials Development	when the Web is used as a means for learners to create and publish materials. The WWW is used as a tool for gathering and collecting information and presenting that information in a published form.	Creating and publishing Web pages, Web content, FTP processes.

Table 2. Learning Strategies for Web-based learning Environments

Interestingly, the literature and research describing technology-based teaching and learning applications has not always provided the rosy results anticipated and sought by institutions. Cuban (1986) raised some concerns in his early research which demonstrated that educational technologies rarely return the achievement gains which are anticipated. Hattie (1992) reported findings from a meta-analysis of technology-based learning environments which showed that technology was a teaching and learning tool that provided as much, but rarely more, enhancement to learning than any other form of teaching innovation. The trends in Web-based learning materials and applications seem to be following previous patterns. Dehoney & Reeves (1998) report a tendency for Web materials to be lacking in creativity and interactivity. Mioduser, Nachmias, Oren & Lahav (1999) reviewed 500 Web sites and evaluated aspects of the design and implementation. Their report described the current picture of Web-based learning as “one step forward for the technology, two steps back for the pedagogy” (p. 753). The current tendency for Web-based delivery is for courses built around the electronic delivery of resources and materials with only minimal regard for learning strategies and learner engagement.

Enhancing Teaching & Learning

For some time now, educational researchers, classroom teachers and curriculum developers have been exploring ways to increase the effectiveness of teaching programs and in particular, learning in flexible environments. The learning theories have always suggested that what is needed is more active involvement of the learners in the learning process. Theories of learning have been developed which explain the way in which learning is achieved through knowledge construction (eg. von Glasersfeld, 1989; Duffy & Cunningham, 1996). The integral role of communication between learners has been explored and the value of collaboration and co-construction of knowledge developed (eg. Billett, 1996; Vygotsky, 1978). At the same time, curriculum developments have moved from descriptions of the content to be learned to environments where outcomes of learning have been made discrete. Student-centred learning environments have been proposed, some for example, with authentic learning settings (eg. Brown, Collins, Duguid, 1989), and others with problem-based learning tasks (eg. Sage & Torp, 1997). The role of assessment has been recognised and given a more fundamental place in the learning process. The sum of these developments suggests a changed direction for educational planning and technology, in particular Web-based technologies, appear to offer many opportunities for teachers and learners.

The new educational technologies emerging from multimedia and on-line developments support highly interactive student-centred learning and provide many new opportunities for both learners and teachers. These technologies support contemporary teaching in a number of ways. For example, through:

- the provision of improved access to education (eg. Oliver & Short, 1996);
- support for customised educational programs to meet the needs of individual learners (eg. Kennedy & McNaught, 1997);
- the provision of increased opportunities for learning in authentic contexts (eg. Laffey, Tupper & Musser, 1998);
- the provision of opportunities for active and engaging learning environments where students are able to communicate and collaborate (eg. Freeman, 1997); and
- the provision of tools able to enhance students' cognitive powers and processes (eg. Jonassen & Reeves, 1996).

In response to our heightened understanding of how learners learn, we are now seeing changes proposed to the nature of the teaching and learning environments across all sectors of education. A number of writers have sought to describe the changes which are now flowing through education systems worldwide in response to a growing awareness and understanding of how learning occurs (eg. Duchastel, 1998). Some of the more characteristic aspects of the changing learning environment include:

- A move away from specified content to learn to specified learning outcomes;
- An acceptance of diversity in outcomes among learners rather than the goal of common results;
- A focus on the process of learning as well as the product;
- Evaluation of outcomes in practical contexts and in terms of tasks as distinct from discrete knowledge; and
- An acceptance of the role of social cognition in learning.

These characteristics are difficult to embed in conventional forms of learning environment. Their achievement requires open and flexible forms of instructional design and our research and activity suggests that these forms of learning environment are achievable through particular forms of Web-based materials and learning settings. The

particular forms we have used and have found to be extremely promising from a pedagogical perspective are those derived from database-driven Web resources and activities.

Database Driven Web Resources and Activities

Conventional Web materials are those that are developed in HTML formats and stored as discrete files for delivery across the Web. Every Web user will be familiar with this form of resource. Database driven Web resources are different. They tend not to exist in discrete forms but are generated on the fly through learner interaction. Both these types of Web materials exist in many forms but typically they are characterised by differences in their delivery and their contents. Typical HTML pages are generated by teachers to carry information, content and descriptions of learning activities. They tend to be static pages often used several times before they are updated. Database driven Web pages, on the other hand, are generated dynamically as they are served. They still carry information and content but are often the object of the learning activity rather than a description of it.

Figure 1. shows a database driven Web page. It contains text and information. It could contain images and pictures but does not in this example. This page was not created by the teacher but rather by the students. It changes each time a learner uses it and is being continually updated as learners access and use the page. The purpose of the page in this instance is to support an on-line debate. It serves to convey information to learners and also to stimulate learners' thinking and reflection on their learning. It also encourages learners to articulate their knowledge and understanding.

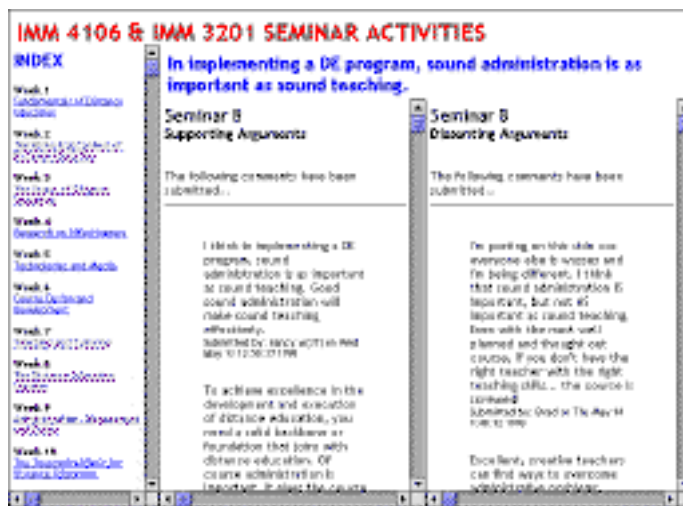


Figure 1. A dynamic Web page with database elements and functionality

The database driven Web page is a very flexible form of text because it is created by a software engine in response to interactions with the learner. The software engine must be

designed by the teacher to provide the forms of interactivity and functionality required for the various learning activity. Our experiences with designing these forms of learning resources have been very positive. Whereas in previous Web-based design activities, much of the time was spent in collecting resources and information and planning how these might be displayed for the learners, with database driven activities, the majority of the time is spent in planning how the learners might interact the forms of learning activity in which they will be engaged.

Forms of Database Activities

a. Bulletin Boards There are many forms which the database driven Web activities can take. In their simplest forms, they can be discussion boards which enable learners to communicate and to post responses to a public bulletin board. In database driven applications, once the comments and reflections of the learners have been posted to the bulletin board, they can be reused and revisited in many forms. Depending on the design of the accompanying software engine, the various components of the discussion, the students' responses, teachers' responses etc. can be edited, manipulated and redisplayed in different forms according to different needs. There are now many outstanding examples of collaborative and supportive communication systems being used by teachers of higher education throughout the world based on these forms of database driven activities (eg. De Boer & Collis, 1999).

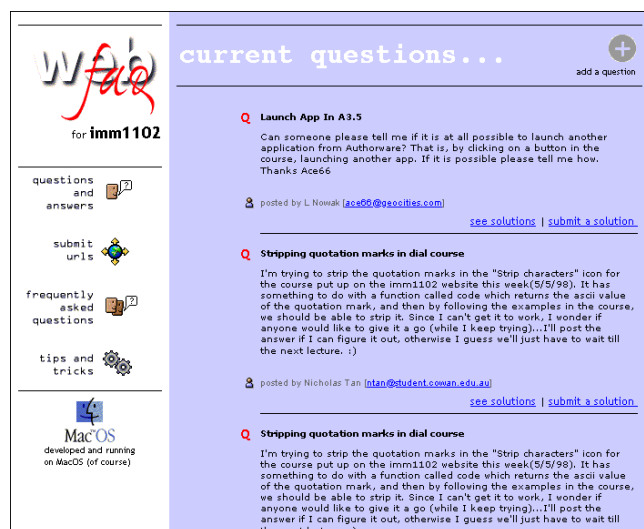


Figure 2. WebFAQ: A Web page supporting file uploads and downloads to a database

b. Frequently Asked Questions Another form of database driven application is exemplified by the WebFAQ system developed and implemented in an introductory authoring class at our University. This system was developed to support students learning new concepts in settings where direct communication with tutors, teachers and other students was not always possible. The WebFAQ system enabled students to upload

their programs and descriptions of the difficulties they were experiencing to a public bulletin board. More experienced students in the class were provided with inducements and encouragements in the form of assessment credits to answer these queries by downloading the problem code and endeavouring to isolate the difficulty and to provide feedback to the learners.

This system provided immediate support to the learners but as a database activity held many more possibilities as well. The problems posted by the students could be flagged to show as frequently asked questions. The solutions posted could also be flagged to help other students placing simple requests into the database. In all cases, the scope of the system was limited purely by the creativity of the teachers and the functionality of the software engine (Figure 2).

c. Problem-based Learning A third form of database driven application which we have used successfully has been in a problem-based learning setting. This Web-based activity provided a framework to base student learning around collaborative problem activities, undertaken and implemented through Web-based communication, information seeking and collaboration. The students worked in groups to create solutions to a weekly problem which was posted to a Web system and processed and displayed in a variety of forms to support and enhance the learning setting. The database functionality provides a way to coordinate and manage the problem solving process and to manage and reuse the solutions in many flexible ways.

d. Integrated Learning Resources The Mathematics Education On the Web (MEOW) Web site has been designed to support student teachers during their practicum teaching and into the initial teaching years (Herrington, Herrington & Oliver, 1999). It incorporates a variety of database driven applications including a large set of teaching resources that can be accessed by querying the dataset. The database of teaching ideas will continue to develop as students and teachers post new ideas for inclusion. The resource is a dynamic set of materials which takes advantage of the collaborative and communicative components of the Web as well as its powerful data storage opportunities.

The screenshot shows the MEOW website interface. At the top, there are navigation links for 'lesson plans', 'strategies', 'web resources', 'message board', and 'contacts'. Below these is an 'age select' dropdown menu set to '3-5'. The main content area is titled 'Lesson ideas' and contains a table with the following data:

Number	Space	Measurement	Pattern	Statistics	Probability
Make 5 Popstick numbers	Box collection 3 eggs in a tray		Clap clap patterns		
Smarties	Simple 4 piece tangram	Biggest handful Which one holds more?		3 things in a matchbox	
CAN make 10 Hidden caterpillar		How many ways to make a dollar? Largest potato	Red and green rods	Clown faces	
Colour a half Addition boxes	One cut square	How high? How far?	Surrounding patterns	What do you eat in a day?	
Make Connections Jump to 48	Overlaps	20 facts about me 12 squares and perimeter?		Sports outfits	
Split 19 Ink blots	Giles symmetry	Ten people coming to a party 5 cubes greatest surface area	Rectangles - Skemp	Favourite crisps	

Figure 4. MEOW: Mathematics Education on the Web

Teaching and Learning Advantages

This paper commenced with a discussion of conventional forms of teaching and learning and the Web-based settings which typically are created for these. There are many limitations observed in terms of the quality of the learning environments that result from the mapping of traditional classroom learning into Web-based settings. The use of database driven applications seems to break new ground. It provides opportunities and alternatives to re-engineer the learning setting to take advantage of the electronic delivery format in ways that have never been possible before. Teachers who develop and use Database driven applications in their teaching and learning must necessarily be creating active and engaging learning environments. The process stimulates effective teaching and learning. Some of the advantages which derive from this form of learning environment include:

- **design emphasis**, when teachers plan and use database driven solutions, their planning and organisation revolves around the design of learning activities and tasks. The emphasis is on the learners' learning more than on content delivery;
- **content free**, these applications can be divorced from content and as such provide much more flexibility to the teacher to plan how learning will be achieved;
- **flexibility**, the various learning can be based on learning strategies and can therefore be applied across subjects and disciplines. The various tools and resources required have use and application way beyond the initial setting;
- **efficiency** of effort, learning using database activities necessarily builds learning resources. Teachers using such tools find themselves with large amounts of resources and materials with which to plan future activities.
- **content currency**, the learning activities help to maintain current and up to date learning resources. The dynamic nature of the learning environments reflects in the resources that remain at the end of the semester;
- **scalable**, the tools and resources work just as well, if not better for large cohorts as they do for small groups of students. The tools suit settings where the numbers of learners can be variable and are flexible in the ways in which they are implemented;
- **ease of implementation**, database driven applications do not require teachers to be able to work and develop with HTML. The process of creating Web materials revolves around a process of uploading and placing resources of any form into database fields and leaving the hard parts to the technology.

Apart from the convenience, functionality and flexibility factors associated with Web-based teaching and learning, the use of database driven applications has the potential to return many enhancements to teaching and learning:

- **learner-centred**, these forms of learning activity create powerful settings for independent and student-centred activities;
- **collaborative learning**, the systems necessarily connect learners and provide meaningful ways for learners to learn with and from each other;
- **learner engagement**, the activities and materials encourage the learners to work with the information and content, to reflect on the material and to articulate their learning, all desirable processes in learning settings;
- **scaffolding**, the activities provide ways for teachers to support student learning without the need for high levels of direct intervention;
- **authentic settings**; the nature of the activities provide considerable scope for teachers to create learning activities that use real-life settings and reflect the ways learners will need to use the knowledge in settings beyond the classroom; and

- **lifelong learning**, the learning activities encourage learners to work with tasks, with each other and to manage aspects of their own learning, all useful and desirable generic skills associated with lifelong learning.

Summary and Conclusions

Our work with these forms of learning materials and associated learning activities continues to impress us with the advantages and opportunities that can be gained. The tools we have developed for use in one classroom setting often find their way into other classrooms where they are used for similar purposes but to different ends. We find that our attention is drawn to designing learning strategies and activities and less towards developing Web-based materials. We find ourselves using all forms of media in our teaching and matching the best attributes of the various media to their learning potential.

The use of database driven activities in Web designs does not in itself create effective learning. It is more the ways in which the activities are designed and implemented that creates the required effects. But database driven activities encourage and support the development and implementation of constructivist-based learning activities. There are of course overheads in terms of development costs for these forms of teaching applications. However, our activities have demonstrated that such applications promote reusability and offer efficiencies for many forms of reuse. We expect to see many more examples of this form of Web-based resource development in the future as more and more people come to see the advantages derived from this alternative approach to Web-design.

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