Web design and learning in agri-environmental education: A UK case-study

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Abstract

The development of websites was traditionally an occupation for those that possessed an in-depth knowledge of computer systems and programming languages. The advent of 'user-friendly' web development software in recent years has made this process less select. The Environmental Challenges in Farm Management project is an educational website developed by a team of non-web specialists both for third-level education and the agricultural community. This paper outlines the design, development and use of the site, and makes recommendations to those new to the task of putting web-based learning on-line, based on the experience gained during the project.

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Introduction

Over the last decade there has been a gradual shift away from a solely productionist orientation towards resource conservation in UK agriculture. This presents new challenges to farm managers and farm management educators (Napier, 1998). At the same time there have been significant changes in UK Higher Education (Park, Rehman and Keatinge 2002), resulting in increased numbers of students entering higher education and also the revision of the curriculum of many degrees to better prepare graduates for future employment. There has also been an explosion in the availability and use of Information Technology (IT) in learning (Jones et al., 1998). Several Agricultural Colleges and Universities offer distance learning facilities, but these do not often address the important boundary between agriculture and the environment. There is ample literature, video material and computer based learning (CD-ROMS, and courseware) available, but few resources which successfully integrate and put forward the environmental challenges facing farmers of the 21st Century.

From an educational viewpoint the authors believed a resource was required that explained the science and policy behind the practice of environmental farm management from as objective a view point as possible. The web-site was originally designed with two purposes in mind: to provide a useful resource to the farming community and to complement a taught agricultural module on sustainability at the University of Reading. However, the latter function has received most attention as the website has been integrated within several taught modules at the University.

The aim of this paper is to present an account of the design, development and implementation of the Environmental Challenges in Farm Management (ECIFM) website (www.ecifm.rdg.ac.uk) for those who may be considering a similar undertaking. This project was undertaken by a group of three academics who at the time had little or no experience of website design and construction. The paper provides a commentary of the process of development from the initial conception, through the design, construction, "marketing" and use of the website. Conclusions are drawn regarding farm-management learning on the Internet and web-design for beginners.

The use of the Internet and in learning

The history of the Internet can be traced back to ARPANET, which was started by the US Department of Defence for research into

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networking in 1969. This has evolved into the now familiar World Wide Web which is a collection of hyperlinked pages of information, distributed over the Internet via a network protocol called HTTP (hyper-text-transfer-protocol). It was estimated that there were about 22 million adult UK Internet users by the end of 2001. Although the use of the web as a tool for learning and teaching is relatively new, a wide range of material related to web-assisted learning (WAL) is already available, for examples see the International Council for Open and Distance Education (see http://www.icde.org).

Those pedagogical principles that ordinarily instruct good practice in more traditional teaching and learning also apply to WAL. For example, such principles include: the importance of having clearly stated learning outcomes; the use of active learning and a variety of teaching and learning methods; the use of formative and summative assessments that assess how well students have learned/performed the learning outcomes; the provision of feedback on assessments; the encouragement of peer-assisted and student-centred learning. Thus, it is important to note that using WAL does not in itself transform the quality of teaching and learning. It can enhance teaching and learning when integrated within the curriculum.

Computer-based learning in general, and WAL in particular, have several advantages associated with it. WAL can promote active learning, particularly when resources are interactive and problem-based (Brooks 1997). It can also foster an individualistic approach to learning in which students can progress at their own pace, and pursue their own interests (within the relevant parameters of the course). This individualistic approach also makes WAL suitable for many distance learners, persons with learning disabilities or special needs. Some researchers claim that there is the potential to save staff time by providing alternative forms of delivery, such as lectures or practicals (Brain, Dewhurst and Williams, 1999), although this saving may be best realised when Computer Based Learning (CBL) replaces repeated class sessions. Websites that are associated with particular modules are extremely useful for the provision of course information, such as course outlines, class location and time, lists of recommended reading, information on assignments and assessment methods provided they are used as an integral part of the curriculum. Online information is typically non-perishable during the timeframe of a single module. As such, websites associated with particular modules can provide a reliable, retrievable and consistent source of information, and are very useful for revision purposes. Educational websites can also provide hyperlinks to other educational sites on the WWW, which can be an extraordinary rich source of information. Unlike books, CD-ROMs and videos, WAL can be dynamic, and can quickly change to respond to students needs, or update materials (Seal and Przasnyski, 2001).

However, the use of WAL is not without its concerns. Most important of these, WAL can be used simply for the modernisation of teaching materials in the classroom, with less regard for its contribution to student learning. For example, some authors worry that the use of PowerPoint as a replacement for overheads in lectures may only serve to better entertain, rather than better educate students (Szabo and Hastings, 1995). WAL may reduce contact time between students and teachers, which may adversely affect students that prefer more personal interaction. Both staff and students may be worried about using such technology, and may require training to become familiar or competent in its use (McGowan and Sendall, 1997). At a university level, sufficient investment in computer technology is required for WAL to be viable. For some students, regular access to computers or up-to-date software may be a problem (particularly in developing countries). Even within developed countries, there may be issues of equity as more affluent students may own their own PCs, and have greater ease of access compared to less affluent students.

Despite these potential drawbacks, well-managed WAL has the potential to contribute to the learning experience and environment, and it was against this backcloth that the ECIFM website was constructed.

ECIFM: project preparation

Several formats for the delivery of the information package were possible, for example, video, CD-ROM, printed literature, a web page or some combination of these. Critical factors in deciding on a format included the ease of
updating material, as well as the need of, and costs of preparation and distribution. Use of the Internet as a delivery device suited the author’s requirements particularly well. An initial survey investigated the availability of online and other information regarding environmental challenges in farm management, and was conducted by several methods. These primarily focused on the following:

- Entering key words (such as agriculture, environment, farm pollution etc.) into internet search engines (Lycos, Alta-vista, Excite, Hotbot, Ask Jeeves and Google)
- Examination of University websites
- Telephone survey of local agricultural colleges
- Examination of government websites such as Department of the Environment, Food and Rural Affairs (http://www.defra.gov.uk/)
- Examination of Non Governmental Organisation (NGO) websites such as Friends of the Earth (http://www.foe.co.uk/)
- Examination of resource databanks such as those provided by the Learning and Teaching Support Networks (see http://www.ltsn.ac.uk/)

These initial surveys produced a vast array of website addresses, many of which provided detailed information on specific areas of the remit. Some universities and colleges place lecture notes on the web specifically for use by their students, but few are available in the public domain. However, a large amount of this information was presented with a given objective in mind, that is, to present the views of an NGO or pressure group, or with the ultimate aim of selling a product, generally machinery or agrochemicals. Against this background, the ECIFM website was developed with four main objectives in mind:

1. To support academic courses in the teaching of agri-environmental issues at degree level
2. To provide a reference tool for the farming community and related industries
3. To provide a collation of internet, paper and multi-media information regarding agriculture and the environment
4. To be free of charge, and to present information from a comprehensive cross-section of sources

Pedagogical issues of site design
Understanding and using the internet effectively involves a considerable learning effort, although much of this can be by entertaining experimentation (Harrison & Williams, 1995); the same could be said for web design. For us the process of web design was initially hindered by lack of knowledge of the software, which represented a steep learning curve. The majority of this learning was achieved from self-help books supported by staff training courses at The University of Reading, and peer discussion. The University's central IT facility advised on publishing to the server and acquisition of a suitable Uniform Resource Locator (URL, an address giving a location on the Internet, consisting of a protocol, computer name, and file location). Once the knowledge of the software was acquired, the fundamental time-consuming factor became the actual acquisition and assimilation of relevant information and content for the web pages.

Information was sourced from textbooks, the Internet, academic journal articles and papers, governmental and NGO publications, websites and from colleagues in The University of Reading. The information presented on ECIFM could be loosely classified into four categories and utilisation was dependent on the subject area:

- Opinion - Based on views of organisations, key publications and/or experts in each field
- Conceptual - such as sustainability, based on published literature, expert opinions et cetera.
- Agricultural policy/- DEFRA codes of good practice, farm waste management plans et cetera.
- Scientific - based on research findings, for example, pesticide levels in water, nitrate leaching rates et cetera.

The majority of subject areas contained a combination of information from the above categories to provide a representative viewpoint. Information was grouped under eight subjects and each subject consisted of a number of topics (Table 1). For each of these topics, learning objectives were provided in the subject introduction. For example, for the topic 'Agricultural Support' in Subject 2, readers could learn how to both 'Describe the basic reason why agriculture is financially supported by the government' and 'Discuss the possible 'knock-on' effects of proposed future changes in agricultural policy'. These learning objectives were clear statements for readers on
what should have been achieved on completion of a topic. Additionally, from the point of view of a course provider, learning objectives facilitate assessment of the relevance of information that should be included.

To further enhance these learning objectives and to encourage readers to both reflect on their learning experiences and to recall factual information, so-called 'Pause for thought' questions were designed. These comprised of two styles of question that could be generally categorised as either thought provoking (e.g. designed to stimulate new insight into a particular subject and to encourage lateral thinking) or a test of memory recall.

Each page begins with a relevant photograph and an opening statement such as: "At the end of the 19th century my 500 acre farm would have employed in the region of 25 people..... now I do all the work myself and do some part-time lorry driving" (ECIFM 2001, Subject 2.). These statements were intentionally thought provoking, being designed as a precursor for the 'Pause for thought' questions on a particular page.

Practical issues of site design

Overall, the workload for ECIFM consisted of approximately four days for each page (i.e. topic) with a further day for proof-reading and changes, equating to about one month for each of the eight main subjects. This time scale included the time required to learn how to use the software, information collation, research discussions, site construction, and site management. Given the experience acquired, a similar project undertaken by the same person would now require significantly less time. The ECIFM website was designed using Microsoft Frontpage 2000® and currently consists of 72 web pages and over 270 picture files, all individually named. Modern browsers display the page title at the top of the page so that when the cursor is placed over a picture or hyperlink, a text box with the name of the file is displayed. This requires that all file names are understandable and/or explanatory. Lettering and background colours were selected to give a 'rustic environmental look', without distracting from the subject matter.

A database of photographs was compiled, greatly aided by the purchase of a digital camera, and over 300 digital images were taken specifically for the project, ranging from field margins to urban decay and brownfield sites, edited and enhanced using MGI Photosuite III ® (www.mgisoft.com) software. Networked computers within the University do not have loudspeakers (to reduce disturbance to fellow users), thus video clips with commentary were not used. Two short silent clips of early morning milking and traffic congestion in a rural area were included. All charts and graphs were produced with Microsoft Excel. Flow charts and farm plans were created using a combination of Microsoft Paint®, Microsoft Powerpoint® and Microsoft Clip Art®. The navigation structure was as comprehensive as possible, and aimed to maximise access from a particular page to other main subject areas. This ease of navigation was greatly facilitated by a hierarchical design of navigation toolbars such that as one progressed further into the website, navigation bars for each of the previous levels were available. (Table 2, Fig. 1).

The overall presentation style was kept as simple as possible for ease of reading and to maintain interest levels. Particular design problems arose in scientific discussions where detailed facts and figures may need to be represented graphically. The presentation, (i.e. large brightly coloured

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Table 1. Outline of the subject areas of the ECIFM website. More detailed topics are provided within each subject, and these are listed for Subject 2., as an example.

<table>
<thead>
<tr>
<th>Subj. Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Historical perspective on agriculture and the environment</td>
</tr>
<tr>
<td>2</td>
<td>The current state of UK agriculture and the environment</td>
</tr>
<tr>
<td>3</td>
<td>Agricultural contribution to environmental degradation</td>
</tr>
<tr>
<td>4</td>
<td>Quantifying the environmental effects of agriculture</td>
</tr>
<tr>
<td>5</td>
<td>Sustainability and sustainable development</td>
</tr>
<tr>
<td>6</td>
<td>Land protection and environmental schemes</td>
</tr>
<tr>
<td>7</td>
<td>The Countryside Stewardship Scheme</td>
</tr>
<tr>
<td>8</td>
<td>Case study farm</td>
</tr>
</tbody>
</table>
Table 2. Overview of the hierarchical navigation structure of the ECIFM website. The top row indicates the actions that lead to the next level of the website. Note the sequential inclusion of the 1°, 2° and 3° navigation bars as one progresses through the levels.

<table>
<thead>
<tr>
<th>Home Page</th>
<th>Click 'Course Directory'</th>
<th>Click on a subject</th>
<th>Click on a topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Directory</td>
<td>List of Subjects 1-8 (= 2° navigation bar)</td>
<td>List of topics (= 3° navigation bar)</td>
<td>Topic details</td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glossary</td>
<td>References 1-8 (= 1° navigation bar)</td>
<td>References Search engine (1° navigation bar)</td>
<td>External hyperlinks Search engine References (2° navigation bar)</td>
</tr>
<tr>
<td></td>
<td>Search engine (1° navigation bar)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

charts) should not distract from the information presented, but must be attractive enough to warrant further investigation. A way to overcome this obstacle was to insert a 'Pause for thought' question directly below a complex chart, that is, Examine the chart above and comment on....... The public and media section (www.ecifm.rdg.ac.uk/agimage.htm) was exclusively represented by external links to national newspapers and the BBC archives. These were articles representing agriculture or the environment, interspersed with 'Pause for thought' questions based on the assumption that the reader had followed the links and read the editorial.

Copyright issues
There is some confusion regarding legislation of copyright issues and rules for external links on the Internet. The majority of websites, specifically Government organisations such as DEFRA, contain detailed disclaimers and copyright statements on the inclusion of external links to their site and provide clear guidance on the reproduction of material. The ECIFM project took no unnecessary risks with copyright issues. The authors sought permission from those organisations that did not provide explicit information on the use of their website as an external link. This was time-consuming, but provided an opportunity to request the inclusion of the ECIFM website as an external link from the organisation being contacted. Only one of the organisations contacted refused a link, insisting they needed to see the whole site before giving consent for a link. Several NGO articles were reproduced within the site and consent was given on condition that the relevant organisation was properly credited.

Dissemination
One of the important questions associated with placing open access material on the web is how to raise the profile of the site so that potential readers know of its existence. One of the most efficient ways to disseminate a website is via both search engines and its inclusion as a link from other sites. A search engine is a database of web pages compiled by a software spider that searches for new or changed web pages (Horton, 2000) that it adds to an index (search engine database). This process can take up to a year. However, the priority and ranking of a site may be increased by registration with a search engine company (at a cost of about £100). About 85% of web users use search engines to find various kinds of information (Horton, 2000). However, search engines are currently lacking in comprehensiveness and timeliness, and do not index sites equally (Lawrence and Giles, 1999). It is estimated that search engines only pick up 16% of sites in the public domain. This has been compared to "a phone book which is updated irregularly, is biased toward listing more popular information, and has most of the pages ripped out" (Lawrence and Giles, 1999). After three months online, the ECIFM site had been indexed by one major search engine. It has now been indexed by many popular search engines, (i.e. Exite, Lycos, Google, AltaVista and Yahoo). A specific search for ECIFM usually brings it up at the top of the list. Other general search terms such as "Farm management", "Agr-environment", "Agricultural history", bring it up.
on the first two pages of search results. More specific queries such as "Hedgerow", "Land pollution" generally highlights the package within the first five pages depending on the search term used.

The authors were also proactive in increasing awareness of the site. The site was positively reviewed by the Learning and Teaching Support Network for the Biosciences (see ftp://bio.ltsn.ac.uk/Bio7250/ECIFM.pdf) and received good coverage in the editorial of the Farm Management Journal (Warren 2001), giving vital links to both the wider academic and industrial communities.

Feedback and reflection

The site is intended for use by both the farming community and students, but we have had most experience and feedback from use of the site by undergraduate students. Whilst the authors are most aware of its use by students, it is expected that improvements in the site that promote student learning about agri-environmental issues in farm management will also reflect on the utility of the site for the wider farming community.

Feedback from students has resulted in several improvements to the website. The original navigation of the site was commented upon as being confusing. These factors were addressed with the addition of a site search engine and changes to the navigation process (Fig. 1, Table 2). The speed of access and page changing was increased with the removal of the dynamic HTML (animation) effects. This was considered to be especially important for some of the student and farm-based audience who might possess older hardware.

Some comments from students have been negative, for example, "Internet learning is a modern method of saving money that
compromises the level of interaction between those teaching and those being taught. There is no substitute for face to face interaction in seminar situations for education and inspiration. Other common complaints from students related to the expense of paper and time to download and print web-based information, and the availability of computers. This suggests inappropriate use of the website, as the authors did not envisage the use the site as a substitute for lecture notes. On the positive side, students appreciated the easily accessible information for reference and for revision purposes. (During the Easter 2001 holiday period, the number of monthly 'hits' on ECIFM doubled, most probably due to revision for undergraduate examinations.) It is worth emphasising that the use of Internet learning is hardly a money-saving exercise. Considerable amounts of staff time are required to prepare internet learning material, which is not often offset by reduced hours spent teaching in the classroom. Thus, as currently used at Reading, the ECIFM package aims to improve the learning experience of students but has not reduced the investment of time by teachers.

Compared to initial efforts, our current experiences with ECIFM and Internet learning in general indicate a much greater satisfaction with its use among students. There are probably a number of contributing reasons for this:
- the methods listed by Horton (2000) to improve WAL have been incorporated over time
- students have been encouraged to use the website and a tour of the website has been given in class
- the aspects of the site that will be of particular value have been emphasised in lecture and tutorials
- the site has been integrated into module curricula
- where the site is an essential part of the student learning experience, exam questions can be based on its content, or a percentage on website participation
- if students ask a direct question regarding a subject that is available on the site, they are directed to pursue it there
- the quality of both the content and presentation of information has improved over time
- students are much more accepting of IT and its role in education
- IT hardware provision for students and staff has improved considerably in the last five years.

Updating and future plans

The initial concept of the ECIFM website and subsequent design and construction began in July 2000. The intention at this time was to update the website once a month, however, limited funds and staff time constraints have not permitted this. Several updates were carried out over the two years since first publication, mainly focusing on design and technical factors. The first major overhaul, in September 2002, addressed mainly the content, but included some technical issues. There is a need for all sites to meet web-publishing standards (see http://www.w3.org/) and more recently to meet accessibility criteria (see http://www.techdis.ac.uk/) and we are working toward these. The LTSN review suggested improvement of access to the glossary and references, that is, hyperlinks from the text to the relevant reference or explanation. It has also been suggested that the site be arranged as an electronic book with an index page/site map allowing accessibility to all subjects from one page. Further suggestions made by staff from within the University and from student feedback were reviewed and a cost-effective strategy was put in place. This involved delegation of various areas for updating to staff members. At this update, general scientific information such as graphs and charts were revised using the latest data available from various UK government, private sector and NGO sources. The interactive section of the site (subject 8) required a more in-depth update, owing to revision of agricultural prices and the changes within the Countryside Stewardship Scheme. The decision was made to utilise external hyperlinks more than previously, especially concerning key issues.

If resources permit, future upgrades will include conversion to a frame-based web to reduce headers and navigation bars as well as the inclusion of ‘latest news’ and ‘student’ pages’ and possibly feedback forms for the answering of ‘pause for thoughts’. Although more an information resource than a strictly educational site, the possibility of including specific exercises with electronic submission capabilities (suggested by the LTSN) has been discussed.

Concluding comments

The construction of this site has been a valuable and challenging experience for the individuals
involved. The initial time commitment initially was considerable and will need to be on going if the site is to remain up to date in terms of both content and design. The need to find time to update the site is a continuous problem and one that should not be overlooked at site inception. On the positive side, updating helps to ensure that the authors themselves are fully conversant with changes taking place on the agriculture-environment boundary. From our experience of the design and publishing of ECIFM, we suggest the following recommendations regarding the construction of educational webpages by beginners:

- Be clear about the objectives and likely users of the website
- Review materials already available on the WWW, there is no point in reinventing the wheel!
- Adopt a careful choice of subject matter and judicious selection of relevant and topical outside links
- Use various types of design and questions to maintain interest and maximise learning potential
- All information should be as objective as possible, be scientifically accurate, and must be correctly credited and referenced.
- Choose user-friendly and compatible software, and name all pages and files as you proceed
- Intersperse blocks of text with photographs, charts, questions and interesting quotes
- Minimise animation effects and number of 'weblinks' for minimum downloading time and quick retrieval of information
- It is easy to underestimate the time required. To minimise research time, source information on software-compatible files from departmental colleagues, if possible
- Think about how the website is to be "disseminated"
- In the university teaching situation, the web site should be integrated within the degree curriculum
- Do not attempt to use the site simply as a substitute for good teaching and learning.

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