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Paul C. YATES
Department of Chemistry, Keele University

EVALUATION OF DIFFERENT STRATEGIES FOR THE EFFECTIVE USE OF THE WORLD WIDE WEB IN THE LEARNING AND TEACHING OF UNIVERSITY LEVEL CHEMISTRY

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ABSTRACT: The potential of the World Wide Web for the presentation of chemical information has been developed and extended to a considerable degree, yet not fully exploited for educational purposes. Some of the reasons for this are the uneven coverage of all degree level topics, the difficulty of finding relevant material and doubts about the quality of some material. Three distinct strategies have started to emerge for the effective use of the World Wide Web in the study of chemistry at university level. The assessment of the use of home written courses in terms of their educational value and cost effectiveness has been determined by means of a questionnaire distributed to the authors of a number of stand-alone chemistry courses. The effectiveness of the use of peer reviewed chemistry resources on the Web has been assessed through personal experience of setting up one such review site through the Web Reviews project. A number of web site "evaluation tools" have been developed, and one of these has been evaluated by applying it to several periodic table sites. [*Chem. Educ. Res. Pract. Eur.*: 2000, *1*, 129-133]

KEYWORDS: *World Wide Web; chemistry sites; teaching and learning; new technology*

INTRODUCTION

There are a number of reasons why one might wish to use World Wide Web (WWW) resources in chemistry education. There is potentially a lot of material available, printed and graphical material can be enhanced with animation and sound, and an instructor can produce collections of material from various sources ordered in an appropriate way for an individual course. Good WWW sites may be frequently updated, which is a considerable advantage over a discrete piece of software which may be updated only every few years.

In view of the apparent potential of the WWW to enhance the learning and teaching process (Brooks, 1997), it is not surprising that attempts have been made to classify different modes of use into various models. One such model (King, 1998) has been used to show how paper based materials may be converted for delivery by this new medium, for example. The model used in the present study, however, is developed from an instructor's viewpoint, and may be of use when considering the selection of material. This is important because, as will be readily

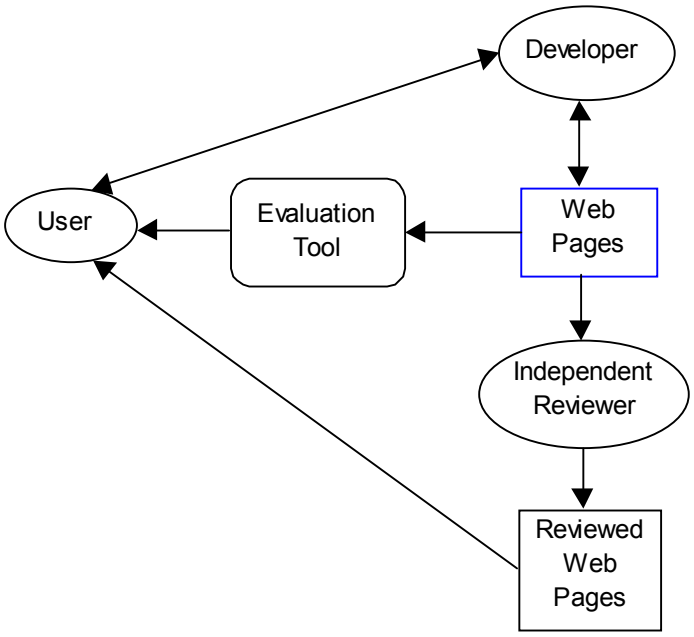

FIGURE 1. *Schematic representation of the relationship between the user and different types of web resource.*

appreciated, a vast amount of material exists, and the location of relevant material using standard search engines is a process which is less than an exact science (Lawrence & Giles, 1999).

The evaluation of such WWW based material is dependent upon where it appears within the model (Figure 1), and methods of evaluation for each will be discussed.

The Model

Three ways of selecting WWW based material for use in the chemistry educational process were identified:

If no suitable material can be located elsewhere, or if that available is unsuitable for various reasons, then a sensible strategy may be to develop it locally.

(b) An instructor may have confidence in a WWW site which has been subjected to rigorous peer review. Such libraries of resources are now in existence (Yates, 1998) and more are promised soon (Winter, 1999).

(c) If a suitable site can be located, but it has not been subjected to peer review, then the instructor will have to perform an evaluation of its suitability.

METHODOLOGY

The three approaches are quite different and require distinct forms of evaluation.

(a) **Self written material**. There is clearly far too much material available on the WWW to allow a rigorous examination of the development of even a small random sample. The decision was taken to concentrate only on those resources which had been developed as stand alone courses, i.e. those which use the medium to replace the vast majority of student contact time. This represents an extreme use of the WWW in learning and teaching which places the highest demands on the quality of the developed materials. Standard search engines were used to locate 48 such sites. Each instructor was sent a questionnaire by e-mail, with the questions having been developed from issues raised on a recent CONFCHEM electronic conference (Tissue, 1999).

(b) **Libraries of peer reviewed resources**. The author was responsible for running the recent Web Reviews project to provide such reviews. Reflection on experiences gained while doing this were used to identify the issues related to such a process.

(c) **Evaluation of other resources**. This can be done using one of a number of evaluation tools. These have previously existed for computer assisted learning materials and prior to that for paper based materials (Steffin, 1983), but in recent years have been adapted to be used with WWW sites. The tool selected (Tweddle et al., 1998) had previously been used to evaluate sites which contained information about cancer, and it was hoped that this area was sufficiently scientific to indicate that it might be useful in the evaluation of chemistry sites. To assess the use of this tool, it was felt to be desirable to apply it to a number of sites which differed relatively little in their content. Use of standard search engines provided a list of 37 sites which gave an online version of the periodic table. The evaluation tool was applied to each of these in turn.

RESULTS AND DISCUSSION

Self written material

At the time of writing 16 replies to the questionnaire had been received, representing a response rate of 33%. A full analysis will be performed in due course, but in the meantime some interesting points are starting to emerge. The reasons for developing such courses are quite diverse. Respondents quoted the need to provide new material, to extend student learning options, to reach a wider audience and to avoid the conflicts some students have with work and family. There was a
far greater consensus on the demands placed on the student when taking such a course. All respondents to date have cited the need for good organisation and well developed study skills, while a small number have mentioned that students need to have developed their skills in information technology before embarking on such a course.

Libraries of peer reviewed resources

The Web Reviews project was funded from May 1998 to April 1999. In this time the infrastructure for submitting and disseminating reviews was put into place, and can now be used routinely. The greatest effort required in the project was in persuading academics to provide reviews of web sites. This has the potential to be a lengthy process and little reward exists for the

reviewer. The reviews received were invariably thorough and of very high quality, but the overall number remains small. Such a project probably needs to have a full time coordinator, and to offer incentives to reviewers, if a reasonably sized library of peer reviewed resources is to be built up. Given the small number of resources currently present, it is perhaps inevitable that the sites available have all received relatively positive reviews. This is due to the conscious or subconscious filtering which takes place when sites are being selected for evaluation.

Evaluation of other resources

Use of the web site evaluation tool became easier as experience was gained. In many cases it was not possible to provide a definitive response to every point being considered, but nevertheless merely a consideration of a particular point proved useful in evaluating a site. This exercise highlighted a number of interesting points related to the online periodic table, but it is likely that they may apply more widely to chemistry WWW sites and indeed elsewhere. One might expect a periodic table of the elements to have considerable potential for the exploitation of graphics, but in fact only 4 of the 37 sites reviewed did so, indicating something of a lost opportunity. In only 16 cases was the author named, and only in 5 of those were the author's credentials given or easily obtained from links to other pages. More seriously, only 9 sites gave the source of the data, even though most of them were data intensive. These facts suggest that considerable caution should be used when taking chemistry material on the WWW at face value.

CONCLUSIONS AND IMPLICATIONS FOR INSTRUCTION

In relation to the three ways of selecting WWW based chemistry material within this model, one can conclude that:

(a) Developing one's own material is a way of producing a highly relevant resource without having to worry about quality issues. Nevertheless this can be a time intensive process and care needs to be taken with delivery and selection of appropriate students.

(b) Peer reviewed materials might well be the resource of choice. However, certain issues need to be addressed before such reviews are available in sufficient numbers for this to be a viable option in even a significant minority of cases.

(c) A web site evaluation tool can be a useful device for selecting WWW materials in chemistry. However, experience is required in its use. The need to view sites critically before selection has been highlighted by the use of such a tool.

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ADDRESS FOR CORRESPONDENCE: *Paul C YATES, Department of Chemistry, Keele University, Keele, Staffordshire ST5 5BG, United Kingdom. Fax: +44 1782 712378,*
E-mail: p.c.yates@chem.keele.ac.uk.

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