

Teaching Literature Searching in the Context of the World Wide Web

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As part of the required curriculum for medical students, we devised a literature-searching practicum that has been used for two years. In both years, we stressed going beyond the skills needed for using a particular searching program, towards a more conceptual approach to information searching. In the first year, the practicum was taught in a traditional lecture/hands-on format. In the second year, the lecture was replaced by a World Wide Web-based tutorial (<http://www.welch.jhu.edu/Education/tutorials/practicum.html>). To our knowledge, this is the first Web-based resource intended to teach students about appropriate use of search technology.

Comparison of student evaluations showed no difference in attitude toward the two versions of the practicum, and observation of student performance suggested similar levels of proficiency. We conclude that placing these educational materials on the Web (1) makes us practice what we preach; (2) is as effective as traditional teaching methods; and (3) gives students a resource for reinforcement learning.

INTRODUCTION

The importance of teaching information management skills in the medical school curriculum increases as the available knowledge base expands and as emphasis on life-long rather than rote learning permeates many efforts at curriculum reform [1-3]. Perhaps most "traditional" among the spectrum of such skills is training in searching the biomedical literature, usually with MEDLINE as a starting point. For example, "medical schools should establish some organizational structure to promote the use of computers in medical education" and that more specifically, "schools should make a service for computer-based literature searches available at low or minimal cost and should train students how to use this resource [1]". The tremendous recent growth in resources available over the Internet — especially via the gopher and World Wide Web (WWW) systems — has redefined what it means to train students to manage information effectively.

Although students now arrive at medical school with computer hardware and software, they are not necessarily "information literate". A survey of our incoming class in 1994 revealed that fully 84% of

students had prior experience with literature searching, but only 36% said they had experience with MEDLINE, and fewer than 10% said they were familiar with WWW. Half of the students owned computers, but less than 25% owned modems.

There are several challenges to incorporating literature search training into the formal curriculum and to making it effective. Finding the time and an appropriate niche in an already overcrowded schedule is number one. Students and faculty members must also view these skills as important. There must be a mechanism for students to refresh and reinforce their training, since many students will be, at best, only occasional users of whatever systems are taught.

To be an effective part of the curriculum, training in information searching must be designed by educators and must be viewed by students as moving beyond the mere mechanics of a specific search system: for one reason, although specific systems are often easily mastered, the systems quickly become obsolete. Searching skills, however, outlive particular software. The short half-life of search software notwithstanding, we believe that the Internet will be an important source of information for physicians for the foreseeable future, and that searching the Internet is an important skill for life-long learning. Therefore, we have fused the educational objective of teaching literature searching with the goal of introducing students to the Internet as an information source. In order that our form fit our content, we put our entire curriculum on the WWW. This pedagogic tactic also allows students to reuse this material later in their learning to review material, to refresh their memory, and to provide help at times of specific need.

The goals of using WWW were (1) to make students more active learners, especially in exploring global information resources; (2) to provide an online tutorial that would permit more advanced students to place out of a required searching practicum by creating and submitting a bibliography on their own; and (3) to give some exposure to biomedical applications of WWW. We describe here our implementation and preliminary evaluation of a literature-searching practicum in a traditional format (1993/94) and in the context of the WWW (1994/95).

METHODS

Search Training for Medical Students at Hopkins

The goals of literature search training over the last few years at the Johns Hopkins University School of Medicine have been to teach students when it is appropriate to use these skills, how best to use them, and how to use the specific systems available to them here. But medical students have rarely taken the two-hour open enrollment MEDLINE classes offered regularly by the William H. Welch Medical Library for many years. Like others, we have designed curriculum-integrated instruction. Some recent efforts included:

- In 1989 and 1990, a two-hour module as part of the second-year Pharmacology course was given. This effort succumbed to pressure in 1991 for more time in the course curriculum for the expanding Pharmacology content.
- In 1992, students attended a Library orientation upon their arrival, which included a demonstration of available systems. Because the Library was in the process of implementing a new locally-mounted search system, search training sessions were not offered. The class entering in 1992 was also the first to experience an extensively revised overall curriculum.
- In 1993/94 and 1994/95, first-year students were given an expanded Library orientation which included distribution of Internet accounts, brief training in using email, gopher (and in 1994, WWW), and a demonstration of the new OVID MEDLINE search system. As a collaboration among faculty members in the Welch Library and in the Office of Medical Informatics Education, we designed a new literature search practicum for first year students.

Small Group Sessions

Using the tactic of small-group learning, we limited our practicum to a maximum of eight students per session. In a fully networked Macintosh classroom, each student worked at his or her own computer for one 2-hour session. The sessions were held on afternoons during time otherwise allotted for reading and study. Due to scheduling problems and classroom size, 19–20 sessions each year were offered to accommodate the entire class of 120 students. In 1993/94, faculty from the Library and OMIE were usually present at each session. In 1994/95, only one faculty member (KAB or HPL) ran the sessions.

Search Practicum: 1993/94

In 1993/94, the full MEDLINE database was available for the first time as a local installation (called MED2000+) based on the powerful UNIX OVID search software from OVID Technologies. Together with the first-year curriculum faculty committee and students, we designed an exercise that would

accomplish our search training goals and tie into an appropriate place in the curriculum. Regular Friday afternoon Clinical Correlation (CC) lectures gave students the opportunity to relate clinical experiences to that week's basic science lectures. Students were assigned to Monday afternoon practicum sessions at which they selected an appropriate question from the CC as a search topic. They created bibliographies that would serve as a start in answering the selected question. Students were required to submit the bibliographies as individuals and as a group for evaluation purposes. CC faculty provided expert review of the bibliographies. To fulfill their course requirements, all first-year students had to show mastery of literature searching through submission of a bibliography and successful completion of a quiz. Students not completing the requirement were given an incomplete grade.

The structure of the two-hour practicum was as follows: (1) Discussion of unanswered questions from CC and listing possible search topics (10 min); (2) Didactic lecture on the search process, question formulation, the publication cycle, database types and characteristics, MEDLINE basics, searching techniques, and Medical Subject Headings (MeSH) (30 min); (3) Tutorial in searching MED2000+ using a standard search topic (30 min); (4) Discussion and selection of a question from the list for group members to search (10 min); (5) Performance of individual searches, saving results to disk and discussion of results (30 min); (6) Selection of group bibliography, submission of searches, and completion of evaluation (10 min).

Students received a packet containing lecture notes and supplementary materials. Evaluation of these sessions, including written feedback from students immediately following each session (see Results) and upon conclusion of the practicum (not included) led us in part to make several changes to the practicum the following year.

Use of WWW: 1994/95

After evaluating the 1993/94 sessions, we made the following changes: the practicum was uncoupled from CC, so students could select topics from any part of their curriculum; the group bibliography was eliminated; review of the bibliographies was done by practice instructors; and a ten-question multiple choice quiz was added at the end of the session. The practicum requirement could be satisfied by placing out (choosing a topic from a list of several from the previous year, submitting an adequate bibliography on that topic, and completing a quiz) or by attending an assigned session to do same.

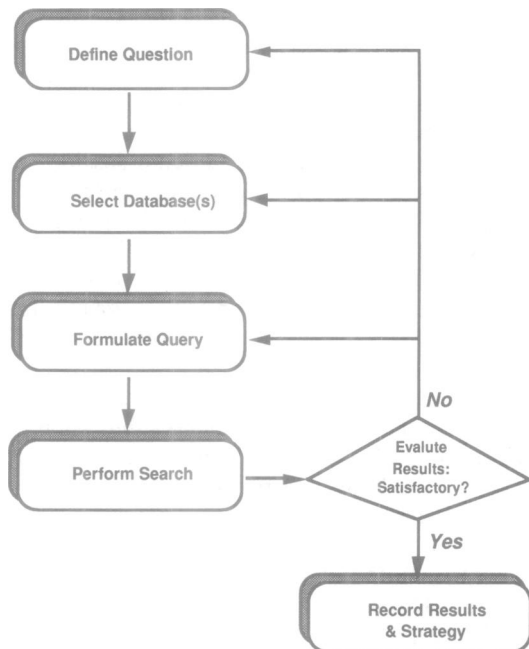


Figure. The Search Process clickable image map.

In addition, the structure of the practicum was modified as follows: (1) Guided traversal through the WWW tutorial (40 min); (2) Discussion of proposed search questions (15 min); (3) Selection of question and search in by all students (30 min); (4) Discussion of results and suggestions made as to alternative strategies or databases, that were then were acted upon if time allowed. (15 min); (4) Saving final strategies and results to disk, filling out a class evaluation form, and completing the quiz (20 min).

The small group instruction began at the practicum home page located at the URL: <http://www.welch.jhu.edu/Education/tutorials/practicum.html>

A clickable, image-mapped "search process" diagram (see Figure) was the starting point and focus of the session. The blocks for each step in this process were linked to other pages through which students were guided. Define question explains the importance of clearly formulating the search question and breaking it up into appropriate concepts. Select databases refers to a page explaining the factors that go into deciding where to search among different types of databases, for example: full-text (Online Mendelian Inheritance in Man [OMIM]), bibliographic (AIDSLINE), protein sequence (SWISS-PROT), 3D structure (Protein Data Bank). Explanations of important database characteristics are also given, focusing on MEDLINE. From here, students view another clickable image map of the "publication cycle", which yields explanations and specific examples of in-progress, prepublication, primary, secondary, and tertiary literature sources

from around the world [4]. Under formulate query, instructions on free text vs. controlled vocabulary approaches are stored, as well as information about MeSH. Perform search provides detailed guidance on using our MED2000+ system, and is where we open a telnet session to MED2000+ for system-specific instruction. Evaluate search gives information on how to judge search results and to recover from unsuccessful searches. Record results and strategy explains how to download information to disk. The diagram stresses the iterative nature of the search process and the need to evaluate results iteratively.

Page-access statistics were kept on the server for all practicum pages.

RESULTS

In each year, 120 students were enrolled. One student received an incomplete in each year. Eight students placed out in 1994/95.

The end-of-session evaluations were filled out by 67 students in 1993/94 (56%) and by 87 students in 1994/95 (73%). See Table 1. Students did not differ from one year to the next in their prior experience with literature searching. There was no difference in their evaluations of different parts of the session, of the overall session, or of the length of the class. Although there is a statistically significant difference in whether the classes met overall expectations ($P=0.217$ by Kruskal-Wallis), the mean scores are close (2.54 for 1993/94 and 2.80 for 1994/95). The students' responses to the two practicum formats was very similar.

In 1993/94 (prior to the Web-based tutorial), students were asked if they thought they had learned more in the small group session than they would have had they tried to learn the material at a computer by themselves; the response was mean scores (\pm sd) of 1.48 (1.19), where 1 = Definitely and 2 = Perhaps, and 5 = Definitely Not; thus students felt there was great benefit in coming to a session. In 1994/95, students were asked were they to do it over again, would they choose to place out of the small-group session with the help of the Web-based tutorial. The scores had a mean (\pm sd) of 3.24 (1.18), meaning that despite the availability of the tutorial, they were still reluctant to rely on a machine. Thus, even in the era of WWW, there is still a preference on the part of many students for face to face teaching.

Examination of page-access statistics allows us to see the relationship between what we told students to do and what they, in fact, did. The statistics show, for instance, that the home page for the practicum was accessed from the teaching lab 202 times. The page

Table. Student end-of-session evaluations.

Question (anchors*)	1993/1994†	1994/1995†
Number of respondents	67	87
Prior experience (very much/none)	2.89(1.00)	3.03 (0.98)
Session better than machine (definitely/definitely not)	1.48 (1.19)	N/A
Would place out(definitely/definitely not)	N/A	3.24 (1.18)
Amount of material covered (too much/much too little)	2.94 (0.52)	2.97 (0.52)
Length of session (too long/much too short)	2.40 (0.67)	2.44 (0.66)
Met expectations(far exceeded/fell far below)	2.54(0.69)	2.80 (0.68)¶
Practicum components (definitely or excellent/definitely not or poor)		
Answerable questions	1.42(0.55)	1.51 (0.53)
Biomedical overview	1.26 (0.45)	1.22 (0.44)
MED2000+ Tutorial	1.53 (0.75)	1.77 (0.75)
Quality of instruction	1.42(0.64)	1.53 (0.63)
Bibliography creation	2.09(0.84)	2.15 (0.82)

*Anchor for response-score 1/anchor for response-score 5

¶P=0.022

†Means and standard deviations are presented, but statistical tests are nonparametric.

about the search process was accessed 181 times, the page about the publication cycle, 159 times, and the page on database characteristics, 97 times. These numbers all support the assumption that students followed directions, although as instructors, we cannot know how often or when they did so.

Search Examples

We discussed all topics suggested by students regarding their appropriateness for MEDLINE and other resources worldwide. We looked for good fits with the MED2000+ MEDLINE database, so that searches would illustrate key search concepts, including use of MeSH, subheadings, and appropriate limits. When time allowed, appropriate resources linked to the WWW tutorial were consulted — for example, OMIM was searched for questions involving genetic disorders. Below are examples of topics selected by the students:

- With what drugs/therapy do we treat polycystic kidney disease?
- What autoimmune diseases affect the dorsal root ganglion?
- What are the advantages of using Goretex versus pericardium in open-heart repair?
- What is the post-operative morbidity after shunt repair of tetralogy of Fallot?
- What is the role of genetics in the inheritance and progression of Amyotrophic Lateral Sclerosis (ALS)?

DISCUSSION

Literature-Search Training and WWW

Search training at other medical schools has been recently reviewed [5]. Others have found as we have that such instruction must be tied into the curriculum in order to be seen as relevant, to be attended

regularly, and to be effective. The point of integration has included clinical clerkships, special content courses, elective courses, and seminars. While much traditional teaching of literature searching has been tied to specific implementations at a given institution, efforts within problem-based learning curricula most resemble our practicum in that they seek to emphasize early in students' careers that literature-searching is an important problem solving skill, rather than a series of technical maneuvers in a specific system.

Recent conferences include several examples of the use of WWW in medical and library education [6-7]. Tutorials and course materials have been created in many areas. Advantages include: easy delivery of material to remote learners; use of a popular tool that is already familiar or very important for students to learn about for many other reasons (e.g., many library and campus-wide information systems are being built on WWW); students can be active explorers of material, creating their own paths through the content; material is always available for later reference; and content can be updated for all students with little effort. However, we lack studies comparing the effectiveness of Web-based instruction and more traditional methodologies, and so the disadvantages of Web-based tutorials are uncertain. Of course, students need to be comfortable with this new medium. Apart from a brief introduction at orientation, for most of our students this was their first exposure to WWW.

Conclusions

The scope of our practicum was ambitious, with or without the use of WWW. Paradoxically, many students felt the sessions were too long, even though the material could barely be covered in two hours. Furthermore, the students must struggle with the need

to learn this skill at a time in their curriculum when they may fail to see its relevance.

Our sense, as instructors, is that Web-based teaching is as effective as traditional didactic teaching. We feel that the sessions were more efficient and engaging after incorporating WWW, since students could themselves call up examples of topics under discussion. Instead of passively watching slides, they were in control. This approach makes students more active learners, although the server statistics suggest that students are not always exploring the desired links. Students "wandered" even during class when they were guided; it is hard to compare this with similar behavior during a traditional lecture. Whether our students will return to the material at a later time of need remains to be seen. However, it is encouraging to note that the practicum URL was announced on several listserv discussion lists and has subsequently been accessed externally over 1000 times by users in 26 countries.

Web-based teaching does not obviate the need for hands-on classes. Some students wrote that they could have "placed out easily" but that they preferred to get direct teaching. Most significant is that, despite the comments on length, a majority of students said that they would come to the session if they had to do it over again. While only 8 students out of 120 decided to place out, we expect this percentage to increase in future years as a greater proportion of incoming students arrive already familiar with WWW. We plan enhancements that will make self-directed use of the tutorial easier: more guidance, better organization, and increased interactivity. There will be more workstations on campus and new students who own computers and modems will soon be able to use graphical browsers from their residences. We expect that these factors may increase practicum place-outs and lead to even more widespread use of WWW-based course materials in general.

Literature search instruction is one part of our evolving medical informatics curriculum, the goals of which are to give students a broad range of tools and skills needed for their careers as physicians, and to enable them to be life-long learners. The objectives of this curriculum span management of patient, education, practice, policy, and research information. Modules related to literature searching yet to be implemented are use of bibliography management software and a module on Internet searching. Comments from students suggest that it will be critical to reinforce the skills learned during the first year practicum some time later, perhaps during preparation for the clinical years. Previous reports also confirm

that these skills must be practiced throughout the curriculum if they are to be maintained [8-9]. We expect that such reinforcement will be made easier and scheduling problems lessened through the greater availability of Web-based course materials and tutorials.

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References

1. Swanson AG, Anderson MB. Educating medical students. Assessing change in medical education — the road to implementation. *Acad Med.* 1993; 68(6 Suppl):S1-46.
2. Matheson NW, Cooper JA. Academic information in the academic health sciences center. Roles for the library in information management. *J Med Educ.* 1982; 57(10 Pt 2):1-93.
3. Anonymous. Physicians for the twenty-first century. Report of the Project Panel on the General Professional Education of the Physician and College Preparation for Medicine. *J Med Educ.* 1984; 59(11 Pt 2):1-208.
4. Subramanyam K. Scientific literature. In: Kent A, Lancour H, Daily JE, Nasri WZ., eds. *Encyclopedia of Library and Information Science*, v 26, Marcel Dekker, Inc., NY, 1979, p. 394.
5. Minchow RL, Pudlock K, Lucas, B. Breaking new ground in curriculum integrated instruction. *Med Ref Serv Q.* 1993; 12:1-18.
6. Second International WWW Conference Fall '94: MOSAIC AND THE WEB, October 17-20, 1994. URL: http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings/WWW2_Proceedings.html
7. Third International World-Wide Web Conference: Technology, Tools, and Applications, April 10-14, 1995, Darmstadt, Germany. URL: <http://www.igd.fhg.de/www95.html>
8. Shelstad KR, Clevenger FW. On-line search strategies of third year medical students: perception vs fact. *J Surg Res.* 1994; 56(4):338-44.
9. Pao ML, Grefsheim SF, Barclay ML, Woolliscroft JO, Shipman BL, McQuillan M. Effect of search experience on sustained MEDLINE usage by students. *Acad Med.* 1994; 69(11):914-20.