

Use of library science students as search intermediaries for environmental science and engineering students*

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Abstract: A pilot project was begun in the Fall of 1988 that teamed first-year graduate students from the School of Information and Library Science with graduate students from the Department of Environmental Sciences and Engineering at the University of North Carolina School of Public Health. Library science students served as search intermediaries for students enrolled in an introductory environmental science course and provided online search services on research topics related to the completion of an environmental science class assignment. Environmental science students received basic information management instruction. Planning, development of instructional objectives, materials and methods, costs and evaluation of the project are described. Changes made in the program for 1989 and 1990, as well as future plans, are outlined.

1. Introduction

Environmental scientists are called upon by government, industry and an increasingly well-informed public to develop policies for the management of man-made risks to human health and safety. They develop and apply technology to protect and improve the quality of the air, water and other natural resources. Environmental scientists and engineers also develop methods to control and reduce pollution and protect workers from environmental hazards within the workplace.

Environmental scientists sometimes find themselves at odds with each other in their work, not only over matters of scientific judgement but also about scientific facts. An

* An abbreviated report of this project was presented at the National Online Information Meeting on 3rd May 1990 in New York.

example can be taken from a study of eleven scientists who were asked to assess the risks to public health from plutonium emissions discharged from the Rocky Flats facility in Colorado. Eleven different assessments of risk were made by these scientists, who were chosen for the study on the basis of their knowledge about and interest in risks to human health from exposure to plutonium. The study found that a crucial factor in this difference of opinion was that '... a nonretraceable process of organising information ... was being employed instead of an explicit principle derived from research findings' (Hammond *et al.* 1984).

Although there will be scientific disputes for as long as there are scientists, it is apparent that a haphazard and incomplete information management process can create serious problems when scientists must formulate and implement policies to protect the public health and the environment.

Organization, management and utilization of complex technical information derived from a multiplicity of sources are not skills that are quickly or easily acquired. Formal programs to teach information management are gaining acceptance in the curricula of schools of medicine, nursing, dentistry, law, social work and library science. A review appearing in the *Journal of the American Society for Information Science* describes graduate academic programs in the United States which incorporate information management into their curricula (Ball *et al.* 1989).

This paper describes an information management education program begun at the University of North Carolina that was designed for first-year graduate students enrolled in the Air, Radiation and Industrial Hygiene program in the Department of Environmental Science and Engineering, School of Public Health. This program provided the opportunity for developing information management skills through structured classroom instruction and teamwork with library science students to complete class assignments.

2. Background of the program

Satisfying the information needs of industrial hygiene professionals is a challenge, partly because of the many potentially hazardous chemicals and operations of the workplace (Corbett & Ifshin 1983) and partly because of the many disciplines that contribute new technology for evaluating and controlling the work environment (Bresnitz *et al.* 1985; Wood & Rubin 1986). The multi-disciplinary nature of the information they use and the complexities of searching it are well-documented (Pantry 1987; Wright 1981).

The idea for a project to train first-year industrial hygiene students to use specialized information services was originated by the Education Resource Center (ERC) librarian (Tucker 1988). In early 1988, she contacted the Head of Information Management Education Services (IME) at the Health Sciences Library at UNC to discuss the possibilities of such a project. The two decided that the direct involvement of academic faculty and students of the Department of Environmental Sciences and Engineering (ESE) in the UNC School of Public Health was necessary for acceptance and success. At the invitation of the Director of the ERC (an ESE faculty member), the ERC librarian and the Head of IME described the past library instruction efforts and information needs of ESE students at a departmental faculty meeting. They made a request for faculty volunteers who would jointly develop a pilot information management program for students.

Planning for the project began soon after the faculty meeting. The ERC librarian developed and distributed a one-page survey for the purpose of collecting faculty perceptions of student information needs (Appendix A). In a discussion session that followed, interested ESE faculty and students agreed to serve on a planning group that included the ERC librarian, the Head of IME and a faculty member of the School of Information and Library Science (SILS), who had expressed interest in joining the project. During the spring and summer of 1988, the group met several times to develop instructional objectives and activities.

2.1. Use of library science students as search intermediaries

The library science professor put forward the idea to use information specialists in training as search intermediaries for the environmental science students. Although a similar concept was the basis of a project for a science bibliography course in Australia (Wilson 1982), there are distinct differences between the two programs. The Australian project primarily stressed development of a bibliography based on manual search methods with an online search as a complement or supplement. In the UNC project, the manual searches were primarily used to help the library science students prepare for the online search. In addition, in the Australian project the clients for the bibliography were faculty researchers rather than students. Although the idea of students as clients was raised as an issue in the Australian project, it was not acted upon. Other programs in the academic setting have dealt with online searching, but have generally dealt with the use of online searching by end-users rather than library science students as search intermediaries (Horner & Thirlwall 1988; Ward & Osegueda 1984).

2.2. Project goals and objectives

From a basis of ideas and perceptions on student information needs given by ESE faculty and students, the planning group developed a number of goals for the project. These were:

- (1) To provide a basis, through material located in a search of the scientific literature, for logical solution of an industrial hygiene problem.
- (2) To teach industrial hygienists in training the fundamental principles of searching science and technology literature.
- (3) To provide information specialists in training with an introduction to the literature of industrial hygiene and occupational health.
- (4) To give both ESE and SILS students an opportunity to learn skills useful in their professional careers.

Several specific instructional objectives were defined for the environmental science students, who were to be able to:

- (1) Prepare an outline of necessary steps for locating information in order to answer questions on an industrial hygiene problem.
- (2) Recognize, describe the content of and locate information in key industrial hygiene reference sources.
- (3) Describe information needs to an information professional, following guidelines for specificity, accuracy and completeness.

- (4) Search the online library catalogs of UNC, Duke University and North Carolina State University research libraries by author, title and subject.
- (5) Search *Chemical Abstracts* on STN, either by themselves or through a search intermediary, to locate relevant literature.
- (6) Search *Engineering Index* manually to locate relevant literature.
- (7) Search the NIOSHTIC CD-ROM database and retrieve relevant citations.
- (8) Search PERLINE and the serials microfiche to locate relevant journals on the UNC campus.
- (9) Prepare a bibliography using a standard style sheet.

2.3. Preparation of instructional materials and activities

The ESE and SILS faculty members, the ERC librarian and the Head of IME worked in close cooperation to design instructional activities and materials for students and to secure funding and facilities for the project.

The ESE professor developed an industrial hygiene case study assignment (Appendix B) that required literature research in the subject areas of applied chemistry and chemical engineering, materials science, industrial toxicology and industrial hygiene engineering control technology.

With the case study as a guide, the Head of IME and the ERC librarian developed curriculum materials for three hours of bibliographic instruction for the ESE students. These included use of *Chemical Abstracts* and *Engineering Index*, and a presentation on use of the UNC Online Catalog and the Health Sciences Library's PERLINE serials control system. Bibliographic instruction specific to the use of the *NIOSH Registry of Toxic Effects of Chemical Substances* and instruction on techniques for locating specialized sources of information in the occupational health and hygiene subject areas were also developed. Library pathfinders were compiled that listed titles, call numbers and campus locations for reference works, texts, journals, abstracting and indexing services, and current awareness services on the subjects of air pollution, industrial hygiene, industrial toxicology and occupational health.

After consultation with ESE faculty and a review of the case study assignment, the decision was made to use online *Chemical Abstracts* as a primary literature resource. The quality of industrial hygiene and toxicology content of *Chemical Abstracts* was an important factor in this decision. The American Chemical Society's International Scientific and Technical Information Network (STN) online system was chosen because of the substantial discount offered for teaching students to use the *Chemical Abstracts* files on STN. The SILS professor and the ERC librarian attended a two-day seminar to learn techniques for searching this system. The library science professor prepared instruction and assignments for the library science students.

A CD-ROM database system was also available for students to search at the ERC Library. This system contains the NIOSHTIC database and is an important access point for the literature of industrial hygiene and occupational health.

The Health Sciences Library provided classroom space and the use of online terminals. A UNC campus computer applications group provided \$1000 of funding for the project,

which covered the costs of instructor training and instructional materials for use of STN, as well as the online charges. Costs are detailed in Appendix C.

2.4. Instructional activities and student team searching

In mid-October, seventeen environmental science graduate students who were enrolled in ENVR 141 (a required course) received the case study assignment from the ESE professor. The Head of IME and the ERC librarian presented the three hours of bibliographic instruction that had been developed previously. Twenty library science students enrolled in the section of LIBS 158, Online Databases, that was taught by the library science professor were given instruction, assignments and practice in using the *Chemical Abstracts* databases on STN. Both student groups were given the pathfinders that had been developed for the project.

The library science student searchers were teamed with environmental science student clients. The ERC librarian served as client for the three library science students who did not have student clients. Playing the role of information intermediaries, each library science student interviewed their client to determine the information needs associated with that client's part of the case study. The student search intermediaries and clients developed strategies for searching *Chemical Abstracts* online. The SILS students used Health Sciences Library microcomputers and modems to connect via a telecommunications network to the STN system computer in Columbus, Ohio. Once connections were established, the SILS students performed the searches while the ESE students observed, provided commentary on the results and asked questions about the search process.

The SILS students were also assigned to try to find relevant citations using manual searches before performing online searches. As a part of the assignment, they were to complete a critique of their manual and online searches.

2.5. Evaluation of the project

Library science students provided written and oral critiques of the project and the search results were analysed by the library science professor. Comments were obtained from both the ESE students and their faculty.

2.6. Analysis of library science student search results

In order to have a measure of the success of student searches, an analysis was made of the number of relevant references located by manual and automated methods. Data are summarized in Table 1.

Half of the library science students reported that they preferred the online searches over the manual searches. These students recorded a lower psychological cost for the online search than the manual search. Six students reported the psychological cost of the online search to be higher than the manual search. Two students reported high psychological costs for both the manual and online searches.

Thirteen (65%) of the SILS students reported difficulties, frustrations or nervousness because of their lack of knowledge of the subject, the database, the printed *Chemical*

Table 1: Relevant citations retrieved by student searchers (n = 20).

	Online	Manual
Range	2-22	0-12
Mean	10.85	6.15
Median	12.50	6.50
Mode	15.00	8.00

Abstracts or other sources, or lack of experience with the Health Sciences Library terminals, or some combination of these factors.

Some students mentioned that they wished they had been able to use a source that was more appropriate to the information needed by their ESE clients. Other types of databases that they mentioned included medical, environmental, industrial hygiene and engineering. Six (30%) of the SILS students would have preferred to conduct this project later in the semester when they would have had more experience searching online systems.

Six SILS students reported that they had problems contacting their ESE students for client interviews. Several students said the ESE students seemed uninterested, or lacked incentive regarding the searches, or did not understand what the searchers were supposed to be trying to do for them. Other clients reflected more positive experiences with their introduction to the literature searching process.

Three SILS students suggested that it might have been beneficial if the two groups had met jointly at the beginning of the project in order to learn more about each others' needs. Five SILS students indicated that they found it helpful to have the clients present during the online searches. However, several SILS students noted that the experience showed them the disadvantages, as well as the advantages, of having the client present during the search. This suggests how important it is to explain to such clients the ways that they can benefit from being present at their searches and demonstrates the educational role of the librarian/intermediary.

One student who had failed to capture her search to computer disk and had to repeat it later in the absence of her client said the search was '100% easier to do without him . . . because of my nervousness.' One of the searchers reported that her client, who had at first seemed uninterested in the online search, was afterwards eager to perform an online search himself. Another client declared that this (online) was the only way she was going to do research from then on.

Both searchers and clients were surprised at the high cost of the online searches. On the STN system the full cost is displayed on the screen, although the amount billed was much smaller, with an academic discount of 90% on search charges. Having students see the actual costs was a valuable, if intimidating, lesson.

Despite the sometimes uncooperative clients, psychological discomfort and other problems, SILS student evaluations on the experience as a whole included such comments as 'It was a great exercise' and 'I found the experience to be fun, once I got over my initial nervousness.'

2. 7. ESE student and faculty evaluations of the project

When the environmental science students made classroom presentations for the case study assignment, they were asked for their perceptions and reactions to the bibliographic instruction and their work with the library science students. Additional comments were made on formal course evaluations received at the end of the semester.

Their comments indicated an active interest in learning about the search process; there were requests for instruction in the use of Boolean logic for searching, an interest in learning to use *Chemical Abstracts* and other science and technology abstracting and indexing services, and the desire to know more about the information sources and concepts that were introduced in the bibliographic instruction sessions.

ESE students had positive comments about working with the library science student searchers, stating that the library science students had helped them locate useful information and that they would have liked to spend more time in the searcher/client interview sessions. One student wanted to retain the services of the library science student who had performed his literature search during the project and another would have liked to have another search performed using a different strategy, if time and expense had permitted.

The course instructor was interviewed at the end of the semester and offered comments, observations and suggestions regarding the project. A fellow ESE faculty member who normally taught part of the course (but was on sabbatical leave at the beginning of the semester) had assisted in grading students' work and also provided critical comments and suggestions.

The ESE professors felt that their students had benefited from the bibliographic instruction and searching sessions. They observed that students' papers seemed better organized than they had been in the past. Also, they noted that students had cited primary source documents rather than secondary references in papers produced for the class assignment.

They expressed interest in a similar project for the next offering of the course (Fall semester 1989) and offered some suggestions for modification. Two of these were (1) an increased emphasis on literature searching strategy in lecture sessions and (2) assignments that would require their students to use such sources as the OSH-ROM CD-ROM system, *Chemical Abstracts*, *Engineering Index*, specialized libraries such as the ERC Library, and libraries at nearby facilities of the US Environmental Protection Agency and the National Institute for Environmental Health Sciences.

The ESE instructors found the pathfinders that had been prepared for students to be useful and wanted a guide for students that listed area libraries. Their perception of the results of the cross-disciplinary cooperation with the School of Information and Library Science was favorable, although they felt that advanced students from both disciplines might find the exercise more beneficial. They also suggested that a team approach be employed in the future, with library science students functioning as members of a research team with environmental science students.

2. 8. Changes for 1989

Based on student and faculty evaluations, several changes were made when the project continued in the Fall of 1989. Because of limitations experienced when using only *Chemical Abstracts* for online searches and to permit experience using a broader range of refer-

ence tools, arrangements were made for library science students to search a wide variety of online, CD-ROM and print sources. These included over twenty online databases on the DIALOG and STN systems and several CD-ROM services, including OSH-ROM, NTIS, MEDLINE, AGRICOLA, *Applied Science and Technology Index* and *Science Citation Index*. Students conducted the online searches in the SILS computer laboratory instead of the Health Sciences Library. The Triangle Research Libraries Network online public access catalog was used for searching library holdings at Duke University, North Carolina State University and the University of North Carolina at Chapel Hill.

Manual searching took place in the libraries at the University of North Carolina at Chapel Hill and North Carolina State University, and in the Library of the US Environmental Protection Agency in the Research Triangle Park. The latter facility serves as a library science field research site for SILS students. Manual searching resulted in the use of over a dozen different abstracting and indexing tools including *Chemical Abstracts*, *Engineering Index*, *Excerpta Medica* and *Science Citation Index*. Costs were much lower for the 1989 program, partly because CD-ROM databases were utilized but also because no new documentation had to be purchased. The total costs for 1989 were \$260.00.

In order to give the environmental science students a broader range of subject topics than was available with a single case study, the ERC librarian and the ESE professors compiled a list of thirty topics from which the ESE students could choose to perform a brief literature review. The review was to include five to ten annotated citations from the recent scientific and technical literature. The thirty topics were evenly divided among air pollution, industrial hygiene and biohazard science, a new subject component of the course.

The bibliographic instruction was also altered somewhat in 1989. In addition to the engineering and chemistry content, local access to federal public documents was covered in greater depth at the request of one of the instructors. Updated pathfinders were prepared and distributed to both ESE and SILS students. A brief guide to area libraries was prepared and distributed. Instruction in the use of the PERLINE system was dropped. The bibliographic instruction sessions and the compilation of the literature review were spread out over the semester in order to give the students more time to become familiar with the various print and online search tools.

The 1989 project used second-year SILS students in the LIBS 222 Science Information course. These students had basic information searching skills and were more comfortable in their roles as search intermediaries. Because the students had prior experience with online searching and were performing searches in familiar physical surroundings, they did not experience the emotional stress that the student searchers had felt in the previous year.

In 1989 there were more ESE students than SILS students. The SILS professor assigned students to work with two clients in order to give them more experience in conducting client interviews and performing searches. The ERC librarian served as client for the library science students who only had one student client.

2. 9. Changes for 1990-1991

Due to changes in faculty and staff as well as class scheduling, the cooperative program was not implemented in the academic year 1990-1991. ESE students received bibliographic instruction in two courses, ENVR 141 and ENVR 242 (Industrial Hygiene Practice). The

biblio-graphic instruction covered basics of literature searching strategy and an introduction to the literature of industrial hygiene and toxicology, and included a session on US Government publications. In the ENVR 242 course they also received an assignment that required the use of the OSH-ROM CD-ROM system to search and retrieve citations.

There are tentative plans to resume the cooperative program for the Fall of 1991.

3. Conclusion

As was noted earlier, the authors were satisfied that the project had 'real life' aspects which provided a valuable learning experience for both groups of students. The environmental science faculty concurred, as did both groups of students.

Many of the environmental science students had not previously been aware of the information resources that they learned to use. Instruction in literature searching techniques was also new to most of them. The bibliographic instruction introduced them to information sources that they must use in their professional work. Several became familiar with automated literature searching through use of the CD-ROM database in their specialty, and they expressed an interest in learning to perform online searches. They also had an opportunity to work with information specialists.

Most of the library science students felt that this project aided in their development as searchers and gave them confidence in working with clients. They found it rewarding when they were able to support the work of their student clients. The library science students also expressed enthusiasm in learning about environmental information sources and how science and technology information can be applied by scientists in their work.

The success of this project is due to the spirit of interdisciplinary cooperation that all of the participants worked to achieve. In a time when financial constraints place limits on academic programs, creative collaboration and resource sharing are vital in providing innovations to curriculum content and a useful practicum for professional students.

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Appendix A: Faculty survey

Technical information management skills for environmental sciences and engineering students
Survey and questionnaire

- (1) What are the information management needs of students in your program area? (Specific examples would be helpful)
- (2) How do you feel that these needs might be more adequately met by currently available library services on the UNC-CH campus?
- (3) What are your ideas on ways to integrate information management education into the ESE curriculum?
- (4) Would you be interested in working on a task force, in cooperation with the Health Sciences Library faculty, to develop a program of specialized instruction in information management for ESE students? If you would, please write your name and telephone number at the top of this form.
- (5) Do you have additional comments?

Appendix B: Industrial hygiene case study

Information management for industrial hygiene students

Background information

A 45-year-old man, who worked as an automobile mechanic, has developed paralysis of the lower limbs and is confined to a wheelchair. Medical tests have determined that the paralysis is due to nerve demyelination.

This man worked for five years in a large garage and several times each week dipped metal parts into a vat containing a solvent in order to remove grease and dirt. Workers in the garage used several different trade names for the solvent. Some of these trade names were benzene, skellysolve and stoddard solvent.

The man is suing for worker's compensation benefits.

Assignment

Find references on the toxicology of light petroleum solvents.

Find references on the manufacture and usage of light petroleum solvents, including manufacturing processes, means of exposure, degradation and disposal, and substitutions.

Find references on the maximum exposure limit for various hydrocarbon solvents during an eight-hour working day.

Find references on standard methods of air sampling and analysis and biological monitoring for light petroleum solvents.

Find references on methods of controlling workplace exposure to solvents and solvent vapors, including personal protection, engineering controls, legislation controlling worker exposure to these chemicals and standards regarding notification of hazards associated with these chemicals.

Appendix C: Costs for 1988

Costs for the project were: \$40.00 (user manual plus service initiation), \$154.55 (online charges plus STN and *Chemical Abstracts* documentation) and \$346.04 (online charges) for a total of \$540.59. Additional costs of \$250.00 were for the ERC librarian and the library science professor attending the STN CA File Basic Workshop and the Registry File Dictionary Searching Workshop. This brought the total amount paid to STN in conjunction with this project to \$790.59. No attempt was made to calculate other costs such as monthly telephone line charges, searching equipment and maintenance of the equipment.

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A comparison of archives held by three host computers: DIALOG, ESA-IRS and DATA-STAR

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Abstract: This paper describes the availability of databases held on DIALOG, ESA-IRS and DATA-STAR. In Section 2 particular attention will be paid to database overlap between hosts. Section 3 will consider the differences between prices and will analyse the relation between prices and database contents. Section 4 analyses the fixed costs of local investments and the variable added costs of online transmission.

1. Introduction

In this paper we will describe the availability of databases held on DIALOG, ESA-IRS and DATA-STAR. The first question we will answer is: 'Does one need to access three hosts?' The second question is: 'How is it possible to choose the right one for the actual search?' The first question involves an overview of the distributed databases to find out the peculiarities of each host. The second question involves a comparison of the different database contents and prices as a guideline for the appropriate selection.

In Section 2 particular attention will be paid to database overlap between hosts. Section 3 will consider the differences in price and will analyse the relation between prices and database contents. Section 4 analyses the fixed costs of local investments and the variable added costs of online transmission.

We first give a short review of the hosts involved in this analysis using the documentation distributed by DIALOG, ESA-IRS and DATA-STAR.

'The DIALOG Information Retrieval Service, from Dialog Information Services, Inc., has been serving users since 1972. With nearly 400 databases from a broad scope of disciplines available on the system, the DIALOG Service offers unequalled subject balance and variety. The coverage, combined with the DIALOG searching capabilities, make it the most powerful online system of its type. The databases on the DIALOG system contain in excess of 329 million records . . . ' (Dialog 1992).

'DATA-STAR is a service of Radio-Schweiz AG, based in Berne (Switzerland). Radio-Schweiz is a company with a long tradition in telecommunications going back to the time of Morse telegraph' (Data-Star 1991).