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ABSTRACT

Several current projects aim to improve the use of scientific and technical information by increasing research on the education of users, by upgrading instructional materials which teach the use of such information, and by increasing user motivation. Some projects attempt to increase motivation by incorporating literature searches into the structure of regular college course work. Others hope that by imparting information search skills to college faculty, the skills will ultimately be transmitted to large numbers of students. The Division of Science Information of the National Science Foundation recently conducted two projects to acquaint college faculty with on-line data base searching and to develop instructional designs which incorporate those skills. A short course was also developed on the use of computer-based information resources. (EMH)

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THE EDUCATION OF USERS OF SCIENTIFIC AND TECHNICAL INFORMATION*

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The scientific and technical information community continues to regard education of users as a critical research need that should be high on the list of research priorities held by the National Science Foundation's Division of Science Information. Present scientific and technical information (STI) services, it is assumed, are used effectively only by a small proportion of potential users. Usually cited as reasons for under-utilization are lack of familiarity with available resources and absence of sufficient instruction in accessing and using services. In the belief that familiarity and instruction has been limited by a scarcity of educational materials and programs, the Division of Science Information (DSI) is currently sponsoring research with two kinds of goals. One set of research projects will result in innovative tools to improve awareness by scientists and engineers and other users of the availability of the STI resources.

Another set of projects aims to improve currently existing instructional materials for teaching effective use of information systems, by developing innovative, often computer-assisted, instructional aids.

A third area less often cited as an objective of user-education is overcoming lack of motivation on the part of users. Motivation is usually assumed to be automatically provided by the user's information demands in his work environment. Although it is admitted that a certain level of motivation is essential to efficient learning, few cases exist, it is argued, where the user does not possess this minimum requirement. Motivational factors therefore don't deserve special treatment in information training programs. But an opposing point of view at least deserves investigation. Users are not going to devote time and effort to acquainting themselves

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with either information resources or with means to effectively using them, no matter how available, without the appreciation that their time will be saved or that new possibilities to solve their problems will be realized. Merely increasing the awareness of resources or improving skills won't alter user behavior. Without the educational resources to excite users by convincing them of the value of information, investment in training will lack an essential ingredient for success.

Motivating the user must be considered in user education

Several DSI projects currently in progress experiment with the principle that user education efforts must include a motivational element. For example, teaching methods and materials for science or engineering courses are currently being developed in which newer information resources and tools supplement or replace traditional literature searches, problem-solving exercises, classroom exemples, or other course requirements. The general approach is to introduce college faculty to methods of accessing and retrieving computer-based resources, and to provide them with applications of computer information retrieval in college science teaching. Each participant is then required to develop a project involving computer retrieved information. Ultimately this sort of program should introduce the value and techniques of information retrieval to a very substantial number of students. Furthermore, information retrieval will be introduced as prt of the problem-solving or learning process, rather than as an end in itself. That is, such materials are aimed at providing students with an introduction to the value of STI services in terms of improved response to course requirements, and increases in the

productivity of their own learning. In addition, faculty response to changes towards more flexible science and engineering curricula and the introduction of new courses and majors on broad, interdisciplinary subjects, is also improved. The hypothesis is that faculty performance in such courses is often inhibited by lack of easily accessible, appropriate materials with which to teach. Using newer information resources to help faculty solve their problems, and demonstrating their improved performance could go a long way towards encouraging increased use of information resources.

Other aspects of the design of these projects are also generalizable.

A basic concept exemplified by these projects is that college faculty, subject specialists, provide the audience for the education effort. In this way, they function as intermediaries between the information supplier or resource and the ultimate intended beneficiary of the training --the student. One advantage of using this approach is that an audience is provided for the training which already has empathy with end-users, in this case students and credibility in their eyes. This puts them in a good position to excite interest by convincing the user of the value of information. The credability of the teacher as a channel and a source of information has already been established. Audiences for user education efforts, other than library staff or information specialists, offer the best potential of effectiveness when the objective of user training is to improve general awareness of the value of information and a general introduction to identification of appropriate information sources.

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Another advantage of this approach is that it offers the potential of providing instruction to large numbers of users at low cost. Scarce resources of information services dedicated to user education can be stretched if the audience for the training is in an effective position to train others. The use of faculty or other such audiences offers a multiplier effect to "spread the word." Care must be taken here to choose audiences not only with the potential but also with the ability to pass the content absorbed on to others.

In addition, the design makes use of already existing channels/ institutions for dissemination of materials and methods developed during the training sessions. Educators are presumably rewarded for and are knowledgeable about channels of dissemination for improved methods and techniques of teaching. In designing efforts which view improved use of information as a means to innovative teaching, and in providing materials to support these efforts, educators will use their own resources and those of their institutions and professional associations to disseminate these products.

Finally, use of audiences such as educators to train end-users has more chance of success if there is some opportunity for their trying out and being successful in their attempts to transfer information use behavior. User studies have shown some groups to be more recalcitrant than others. Researchers in on the job situations, for example, are seldom prepared to devote time to studying information handling techniques. Some have argued that a start should be made long before the university level, and that the secondary school is the appropriate place to begin teaching information use. In any case, with college science students, at least the potential exists to encourage good information behavior, that is,

while information seeking habits are still being formed.

Two current DSI projects

A 5-day seminar /workshop, Information Tools for Engineering Education and Research, was conducted at the University of Illinois, in July, 1975. The workshop was co-sponsored by the National Science Foundation and the Commission on Engineering Information of the Engineers Joint Council. The attendees--engineering faculty from 12 universities in the United States and Canada--gained their awareness and appreciation of data base searching through a series of lectures, demonstrations, and hands-on use of terminals for on-line searching. Engineering faculty participants were grouped into afternoon discussion sessions for three workshop days. Problems and topics discussed included the following:

-How can data base search services be effectively brought into engineering education?

-At what level should it and can it be introduced?

-For what type courses will data base searching be effective -- theoretical courses, applications type courses, individual study programs, etc.?

-What type of engineering problems are most dependent on information resources for their solution?

-Is it necessary that basic engineering courses be taught from textbooks only?

-Can new courses be designed to take advantage of the data base resources that are now available?

-What type of engineering information and data sources would be used by engineers via computer searching if they were available?

-What are current barriers to using computer-readable information?

-What applications areas can best advantage of data base searching?

-If data base searching is desirable for use in engineering courses, how should the service be funded?

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-How can the engineering faculty member involve his department head or administration in obtaining funds for information retrieval?

Workshop output did not include course preparation and designs for course-assignments involving on-line searching. It did reach the consensus that much broader uses of on-line searching exist than merely in constructing bibliographies for dissertations; than in chemical literatures courses; or even in how-to-use the library courses.

Recommendations indicated there is a wide range of appropriate courses and course levels in which to introduce information use. Engineering design courses, interdisciplinary courses, and courses in rapidly changing or new fields of interest such as bioengineering ranked high. One semester project suggested for a senior design course was to design changes necessary to convert a 1965 Model 1100 MG gasoline powered automobile to operation from electrical energy. Solving the food shortage, recycling by-products, utilizing peanuts, evaluation of transit systems, and alternatives to the postal service were interdisciplinary courses suggested as particularly good laboratories for experimentation with access to on-line services. No advantages were seen in encouraging additional information use among students to solve textbook type problems.

A final report from the project is expected in July, 1976.

Also being planned as a follow-up to the workshop, is an informal "consortium" of the participating engineering departments to experiment with recommended changes in the engineering classroom, exchange materials developed, jointly develop instruments to measure student response and deal

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with institutional barriers. More exact determination of resources required to establish effective use of information in engineering education is also expected.

Results from the workshop indicate that progress is going to require commitment both on the part of faculty and information specialists, and that part of initial efforts must come from information specialists who are generally more aware of and interested in solving these problems. In this research, an attempt was made to identify institutions where information specialists and faculty could get together to develop the new approach. Only with additional experiences of this sort will we be able to measure the appropriate contributions of faculty and the information support team. Finally, efforts such as workshops which last only a few days need to be supplemented with mechanisms through which the initial group can keep in touch, discuss ongoing problems and exchange successes.

Another DSI project currently in progress develops a short-course, Use of Computer-Based Information Resources in Science Teaching, offered during 1975-76 on the NSF-AAAS Chautauqua Short Course Circuit for college teachers. Advantages of this short-course circuit include the use of already existing access to college teachers with positive attitudes towards educational innovation and support from their institutions for changes in teaching methods. The primary objective of the program is to make available to college teachers of science as quickly as possible new knowledge about topics of current interest in such a way that materials will be directly useful in current educational programs. Clearly, these objectives are in line with any information industry supported effort to

impact on science education. The format of the program is also appropriate for teaching use of information services. The term "short course" is a misnomer; since the work extends over a period of approximately three months. Each class meets for a two day session in the Fall. In additional to the instructional materials provided, plans are made for participants to work on projects related to the course during the next three months. In the Spring, each class meets for a second two-day session when additional instructional materials are provided, and the results of the interim projects are exchanged and discussed. In addition, use of an existing circuit allows use of the publicity and selection mechanisms of participants.

Sixty-five faculty participated in the course at the four "Central Circuit" locations: Madison, Wisconsin; Kansas City, Missouri; Baton Rouge, Louisiana; and Oxford, Ohio. The course and participant reaction to it, as well as the impacts of their interim projects, was monitored and evaluated by an independent consultant. Both results from the project, and its evaluation will be available in a technical report expected in July 1976. In addition, a series of teaching and student aids will also be produced. Response to the course by participants and the AAAS was enthusiastic and the course, revised on the basis of this initial experience, will be offered during 1976-77 on the "Western Circuit" including Oregon Graduate Center for Study and Research; Stanford University; Harvey Mudd College; and the University of Texas at Austin.

As part of the preparation for teaching the course, a search was made of individuals able to provide case histories of the use of computer searchable files in college science courses. Here again, as in the Illinois exploratory effort, a wide range of uses for information resources, mechanisms for delivery, sizes of institutions, and information sources

used was indicated. Suggestions ranged widely from low-level to advanced courses; course-substance ranged from the use of searches to locate chemical compounds which are specific examples of given bonding geometries to use of files to locate source material for writing research questions. Some included library use as well as use of computer files. Several depended heavily on information specialist-subject discipline cooperation. Others used data-bases created at the institution as opposed to commercially supplied ones. Institutions varied in size; while resources were limited at smaller institutions, the motivation to develop innovative use of files seemed more impressive.

One result seems clear. The cost of commercial retrieval services is not an insurmountable barrier. Several participants in the Chautauqua Circuit have already placed the purchase of retrieval services in their college budgets for next year. Suppliers have also indicated interest in providing educational discounts to participants to encourage use. What seems clear is that in order to approach administrators, a good cost estimate of the funds necessary to design or adjust science or engineering courses to take advantage of data base searching is required. Funding of approximately $300/student/semester has been suggested as a first approximation -- basically the same amount as is currently available for students to utilize computers for calculation purposes during a semester-course at large state universities.

These initial efforts, then, indicate that gaining the support and interest of the subject specialist, in the university, and probably in industry, is a good approach to improving and encouraging information use. Improving understanding of how information resources advances science/engineering training and management will contribute to

efforts to educate users of scientific and technical information.

More research is required.

Assuming this strategy is a viable one for motivating users and that some of the principles explained earlier are effective, some of the research required is the following:

-the information needs of different disciplines; levels of study; styles of management.

-the motivation necessary to make user education effective. This requires knowledge of preferences for types of information storage and retrieval and the best techniques for involving the user in information searching and use.

-the extent to which existing resources can be used and new ones established to advance user education efforts, as well as the possibilities of cooperative efforts.

-the ways in which education in librarianship should be adapted to play a role in science education and management.

-the utilization of new techniques in instruction and the understanding of the impact of new directions in science education.

the effects of the attitudes of teachers and managers to the value of information on the attitudes of students and researchers.

-the required sequences of training from primary education through on-the-job training.

-the role of libraries and information centers in the education of the user.

Some activities which could be undertaken immediately include:

-pilot cooperative ventures between information specialists and faculty.

-promotion by libraries in universities and in industry of outreach services which encourage links with faculty and research managers.

-the publication of examples of successful examples of how to use information services to improve science education and research.

-the creation of a formal or informal group interested in this area, best based on an existing association or combination of associations.

-conduct of a travelling workshop similar to the Chautauqua in a specific discipline.

Finally, some caution in expecting quick or easy success is in order. First, institutional change rather than reorientation of individual users' beliefs and attitudes must be the objective of user education efforts. These efforts require a new sort of justification for support and appreciation of investment in information resources. The contribution of the information resource must be viewed as a part of the resources allocated to learning or teaching. "Support for the library" must be replaced by some quantified costs for resources related to teaching specific disciplines or even courses. If this approach is to be successful and beneficial to the information community, some of the currently existing competitive claims for funds submitted in isolation by teaching departments and information services within institutions must be resolved.

Secondly, the expected outcome of investment in user education by suppliers, libraries and information centers must be viewed realistically. Changes in attitudes, values, skills, are necessary to increased use of, and investment in services, but in most cases not sufficient, at least in the short-run. Evaluating the success of user education efforts with marketing criteria such as "increased sales" encourages false expectations and underestimation of the realization of the goals of the training program.

Lastly, and most important, user education must involve realistic feedback mechanisms as well as committment on the part of the information community to respond to user requirements. User education initiatives, on the part of NSF, as well as others, are going, if successful, to create expectations that services will solve users' problems, meet their needs, improve their productivity, reduce their investments of time and effort. Unless services exist or

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can be developed that are effective in meeting the upgraded demands of trained, knowledgeable users, the credability of the information community, the willingness of users to pay for services, and the development of new institutional arrangements able to utilize currently existing information resources, will decline.