

EDUCATION AND LIBRARY AUTOMATION

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I shall try to develop in this paper a rationale for library education that will, I hope, have a direct bearing on certain major issues that have been of concern to the profession for perhaps half a century. These issues are reflected in questions such as:

How much of the work performed by librarians really requires professional education; are professional librarians used effectively?

Is it practical to expect library education to deal in depth with subject specialities?

If subject depth is acquired at the undergraduate level, let us say in chemistry, can the library profession hope to attract the better students, or is it more likely to attract those who have been unsuccessful in coping with their initially chosen specialty? That is, do not those who do well in chemistry usually become chemists?

What undergraduate specialty does indeed constitute the best preparation for graduate study in librarianship?

Is there a science underlying "library science"?

What does all this have to do with automation and data processing?

A great deal, we may say, in answer to the last, though perhaps somewhat indirectly. Mechanized data processing can be used to improve the efficiency of certain library procedures; and so can other forms of mechanization, including electric typewriters and pencil sharpeners. Whenever, wherever, and however opportunities present themselves to create any set of products or services at lower cost, this should be done—and possibly without making any great fuss about it so far as library education is concerned. Let the fuss begin when it is discovered that the end result has been to do more efficiently that which should never have been done in the first place, and that those whom one would hope to serve are ignoring libraries just as

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much as ever. This train of thought suggests two reasons why automation might be expected to have an important impact on librarianship:

(1) Questions on purposes and goals are raised that no one before thought of asking.

(2) An opportunity is presented to invent the library of the future as though nothing existed today.

It is this notion of inventing, or planning, future libraries in the light of a critical re-examination of their purposes that may be regarded as having far-reaching implications for library education.

At this point, with some justification, one might begin to suspect a swindle, for the foregoing ideas need not owe either their genesis or their importance to automation. This slight deception admitted, however, the fact remains that the threat of technological progress adds an element of urgency to the need for long-range planning. Furthermore, experience suggests that libraries have come to their present state of affairs through some combination of benign and malevolent accidents of evolution, rather than through long-range planning.

Some Assumptions about Future Libraries

Let us briefly consider some of the possible major changes that planning rather than accidents might bring about. The moving force behind such changes must lie in the inadequacies of present libraries, and so on this basis we prognosticate. To say that what should happen will happen is a dubious proposition at best, but at least with a goal in mind, things are more likely to muddle in the right general direction.

Today's collections, even the biggest, are inadequate for their own users, and so we must eventually take our goal to be the accessibility of all recorded information to all users, just as though all the libraries, and all the indexing and abstracting services of the world, were to function as a single system.

With this revelation, we could say simply that all else follows. However, there is some obligation to explain. To begin with, the case has been overstated. Certainly everything cannot be made available to everyone, and we shall have to settle for some kind of optimal relationship between widespread accessibility to most materials and the cost of providing it. Thus a notion of "optimal allocation of resources" is relevant. The implication is strong that even at very broad levels we might find useful a structured or formal, i.e., a mathematical, approach to problems.

Now, if users of library materials are in general scattered all over the earth, then it follows that we must either make copies of all recorded knowledge available everywhere, or we must provide adequate

communication lines so that desired information can be rapidly transmitted to those who have need of it. For example, suppose a few decades from now we were to decide that some 20,000,000 or so books and journals in the Library of Congress constitute the bulk of what a good university library should have. It is not unthinkable that future technology will permit us to create a photographically reduced image of the entire collection (at some enormous cost) and then run off contact prints by the thousands, box up a complete copy of the library into something the size of a large packing crate, and ship one off to every college library in the world at a cost of perhaps only a few hundred thousand dollars per library. (I shall not try to justify my cavalier disregard of copyright law at this point, and of course I am indulging in unrepressed speculation in the matter of cost, but there is a point to it all.) The major alternative to the packing and distributing of libraries is to make a single master library electronically accessible from remote points all over the world. One would then depend primarily on a vast communication network instead of techniques of microreduction as the primary technology for implementation of the future system. It is reasonably clear that the whole matter will really not reflect so simple a dichotomy, but rather, that we shall inevitably end with a mixture of technologies, hopefully glued together by a comprehensive systems plan. It should be clear that whoever is the architect of such a plan must understand fully the implications, with respect to both cost and capability, of microform technology and communications technology, involving, of course, all forms of terminal equipment, concepts of band width and channel capacity, noise, reliability, information capacity of graphic recording versus digital, and so on.

Physical or electronic access to library materials is just one part of the problem, for we have yet to mention the question of intellectual access. Catalogs and indexes in the aggregate must be universal and comprehensive. That is, these tools must guide one to the location of any item of material in the universe of recorded knowledge. The concept seems easily enough stated, but its implications are staggering. We are speaking really of a greatly expanded National Union Catalog combined with some several thousand indexing services. This conglomerate is subject to the same technological dichotomy as are the primary library materials, namely a choice between remote electronic access and wide distribution of printed products. The forerunners of these two techniques are quite visible in today's system. Chemical Abstracts is published and distributed, while the National Union Catalog reposes in a single place which, in a manner of speaking, is electronically accessible to anyone willing to place a telephone call to the Library of Congress.

As users of future systems, we might hope to avoid having to decide which of several thousand sources to consult in order to find the

answer to a question, or to find a book. Presumably from a single point of interrogation we should be guided either to Chemical Abstracts, to the National Union Catalog, or to a small catalog of special materials one of which, with further dialogue, would yield the answer. At no point in this fantasy do we suppose that we must arbitrarily forego the clear advantages of small special-purpose collections and small special-purpose indexes and catalogs. The question of frequency of access as a function of the quantity of materials searched is at the core of what mathematicians have begun to call problems of file organization.

The form of storage is also important, economically, and is related to the problems of organization. As has already been suggested, or at least implied, looking something up in a printed index should be regarded as a possible competitor of interrogating machine-stored information. The difference becomes one of economics alone for those types of interrogation in which the capabilities of the two systems are equivalent.

What This Implies for Education

Now let us turn our attention to the question of just who is going to do this systems planning job. Certainly all that has been said so far suggests that it must be done by engineers, physicists, or mathematicians, but this suggestion is misleading. It seems likely that only those who have rummaged around enough in present indexes, catalogs, and other bibliographic tools are likely to have gained a real appreciation of the complex array of problems that will confront the designer of future systems, but this rummaging must be done with a keen sensitivity to alternatives. Most mathematicians who have such sensitivity are not in contact with library problems, and most librarians are not sufficiently sensitized to alternatives by an understanding either of technology or of the mathematics of file storage and organization. Who then shall plan the libraries of the future? This is the dilemma; the question for librarianship is whether to abdicate or respond.

It would seem that graduate library education can only in part respond to this dilemma. It is not possible to teach all we now teach about librarianship, and then add to it enough about computer programming and computer technology, microform technology, and applied mathematics in order to turn out those who one day will lead the profession into its dazzling future. The inference to be drawn from all of this is that we must begin library education with a very basic undergraduate program, but a program which is altogether unlike what is now regarded as librarianship. Undergraduate education

must be broad enough and have sufficient intellectual content first to attract the student and also to give him a later freedom of choice, for it cannot be supposed that his career decisions will be made and stabilized during the college years. That is, he needs the skills that are readily "transferable" to many professions. Can these seemingly contradictory demands be reconciled? I think they can, and to support this position I shall suggest some guidelines for an undergraduate program in "pre-librarianship." It is to be hoped, too, that this will turn out to be "pre-" other things as well, and if it does, this should be taken as a reflection of strength rather than weakness.

First, these guidelines should be treated rather loosely, for librarianship, like other professions, needs diversity. Yet such diversity should not be wholly without bounds, and adequate reasons exist to believe that there is a core of fundamental knowledge worth having for librarianship, and for other purposes.

"Intellectual Conditioning"

The planning of future systems would seem to demand a certain kind of intellectual conditioning, the ability to take a problem-oriented approach to a complex situation—i.e., the ability to discover the right problems. It is probably through problem solving that one learns the art of problem discovery, and so it would seem reasonable to include, in any undergraduate curriculum, courses that can be problem-oriented. In this sense, of course, computer science, mathematics, and the physical sciences offer unlimited opportunities. The alternative to problem solving too often is subject matter which places a high premium on the assimilation of facts. One cannot dismiss factual knowledge as unnecessary for the planning of future systems, but it does seem that higher values should be placed on the ability effectively to confront and deal with new situations.

Mathematics. If we begin with the premise that mathematics is not so much a specialty as it is an extension of our powers of communication, it is possible that serious thinking along this line would lead to the development of a good mathematics component for all specialties. It would seem that the humanist and the social scientist must have a certain minimal acquaintance with algebra and in particular with the concept of variables, systems of equations and inequalities, and graphic representation. In particular, they must have the ability to transform a physically meaningful situation into its mathematical representation. The latter point suggests that a certain amount of physics could serve similar ends.

Logic. An introduction to formal logic, and the language of mathematics associated therewith, would serve two ends. First of all, it would develop intellectual discipline, and provide a supremely structured approach to thinking about the world in terms of abstractions. Secondly, it would provide a basis for describing the principles and design of digital computers, and of operations associated with information retrieval. Both the power and the limitations of Boolean algebra, for example, can and should be understood in order to evaluate and appreciate a considerable body of literature on that subject alone.

Statistics. Statistics is in essence the science of dealing with uncertainty in data, and is indispensable to the critical interpretation of most research results. Failure to understand its laws invites the deepest of misconceptions and has led, in library science as elsewhere, to countless dubious conclusions based on ill-conceived experiments. It would seem that some appreciation of statistics should be acquired by any truly educated person, but how much is enough is not easy to decide; a veneer from a course or two probably does not suffice.

Behavioral Science, Social Science, and the Humanities. Since it is, after all, the interaction of a library with its users that is crucial, a good case can be made for the very great importance of the study of human behavior and human institutions as a part of the foundation of library science. Important contributions to studies of the use and users of information have been made by psychologists and social scientists, among others. Theories of indexing and classification have been worked on by mathematicians, scientists, and humanists; their intellectual roots are diverse, but in principle, at least, mathematics, linguistics, and psychology must be among such roots. This area is broad, and it is difficult to generalize excessively as to its applicability to library science; perhaps it is essentially a matter of judging the value of individual courses.

Computer Science and Information Science. The principles of computer organization, design, and programming clearly deserve to be regarded as much more than just a specialty, for they can be taught from a sufficiently fundamental viewpoint to justify their presence in any undergraduate curriculum. Like the study of logic itself, the programming of a computer demands an uncompromisingly rational approach to the formulation and solving of problems, and can be said to represent almost a way of thinking. No other single academic area comes as close to the essential nature of systems planning and analysis at all levels. More specifically, problems of file organization, maintenance, and access can best be approached from a knowledge of computer applications and associated considerations of random and serial access, and memory organization.

The foregoing guidelines to "pre-librarianship" are, admittedly, ambitious, perhaps even excessive, in scope. At least, though, they strongly imply that certain alternatives and commonly held views lack equally strong justification. For example, to suppose that the specific undergraduate curriculum does not much matter seems indefensible. But more than that, I think it is wrong to argue that if one wants to become, for example, a biology librarian, one should major in biology. Biology obviously has its own attractions, and those who find the study of it rewarding should probably not change to librarianship, nor should they decide too early in their careers to specialize so narrowly. Furthermore, such an approach, though it might well work in individual cases, seems to suggest that librarianship has no intellectual substance of its own that would justify planning a library career in the first few years of college. The major thesis here has been that it does have substance and that it does have foundations. This seems especially clear if one accepts the premise that the "planning of future libraries," in contrast to "working in today's libraries," is an acceptable aim of graduate education in librarianship. It is from the fact that it forces one's attention to the planning function that automation may ultimately have its greatest influence on library education.