A Working Academic Librarian's Perspective on Information Technology Literacy

By Joseph Jones 1

In a democratic society, where no opportunity should be precluded at birth, the education system should provide the abilities that will allow its citizens to continue to learn. The need for learning throughout life ranges from the immediately practical, to competence and credentialing, to enjoyment of life, to curiosity, and to the theoretical.

In our present stage of technological transition, information is distributed across a range of media and formats. There is a clear trend of migration to electronic forms for reasons of distribution, manipulation, quantity, economics, and convenience. Perhaps the greatest limiting factors at this point are technology itself (the quality, durability, and portability of display screens) and social convention (copyright, which covers mode of expression far more than information itself).

Literacy is a word that embodies a bias toward the verbal rather than the numerical, and this is matched by the balance in what is taught and what most people need and do and use most of the time. However, it must be recalled that western educational tradition rests on the verbal and the mathematical, a basic distinction reflected in many forms -- from the trivium (grammar, dialectic, and rhetoric) and quadrivium (arithmetic, geometry, astronomy, and music) of late antiquity, to the division of the Scholastic Aptitude Test of the late twentieth century, to mention only two. As reflected in information technology today, these two forms of knowledge find their primary material expressions in the networked computer and the handheld calculator.

Recent historical experience with a profoundly transformative technology, the automobile, suggests a range of required competence. First comes acquaintance with the machine itself -- its controls, parts, operation, configuration, and model differences. Next is a set of physical skills and coordination related to the human body. Finally, and most difficult, is an understanding of laws, conventions, social context, geography and navigation. As an analogy with the computer, this begins to break down in considering interaction, the relationship between consumption and production, and the knowledge component inherent in the activity itself. Since accidental misuse of information technology ordinarily does not lead to serious consequences (damage to property, threat to life, legal liability), its employment is much less constrained by physical, mental, and emotional maturity.

Three broad areas of information technology can be defined, and distinctions made within each. Primary is the physical equipment itself, the hardware. This includes the processor and associated memory, input devices (keyboard, mouse, cd rom, diskette, scanner, microphone), output devices (monitor, printer, speaker), and network communications links. Without some command of the hardware, nothing can be achieved. It is reasonable to expect that basic ability in this area can be acquired in the first years of schooling if not before.

The second area is software, which consists of one or more operating systems and associated applications that deal with symbolic systems (language, numbers) and the senses of sight and hearing (images, sound). As developed thus far, basic applications include word processing, calculation and spreadsheets, databases, and paint and draw programs together with image editing. Our educational system privileges linguistic and mathematical skills -- very much in that order -- and training in image and sound (art and music) are rather peripheral. For relating these to interaction with information technology, at least at present, motor skills are a significant determinant. Touch screen, mouse, and keyboard constitute a hierarchy of difficulty and complexity, and potentially set an a priori limit on what can be taught at a particular stage. For example, size of hand has dictated that keyboarding not be taught before the middle grades. The more limited keypad of a

calculator could be introduced earlier. It can be assumed that current educational practice has arrived through long evolution at an understanding of what can/should be taught at particular age levels. This should be associated with appropriate information technology at all levels, provided that physical development and motor skills are not a barrier. To cite one instance, screen reading skills seem likely to be well in advance of corresponding keyboard writing skills.

The third area, to which the first two ultimately are ancillary, is data, which becomes information through its organization. All information can be viewed from the perspective of its structure -- that is, in terms of the units of which it is composed. Linguistic information tends to be embodied in files, records, fields, and associated indexes. Mathematical information lends itself more to tables, databases, equations, and functions. Most people throughout their lives directly use and depend on language far more than they use or depend on mathematics, and this is reflected in education. Consequently, this discussion of information production (creation, presentation, writing) and consumption (searching, access, reading) will focus on the linguistic.

In library science, there are a small number of key notions that account for much of what happens in structuring and retrieving information. On the one hand, these are simple; on the other they are so abstract and interrelated as to be quite difficult to grasp at more than an intuitive level. The present context allows only for pointing at or naming some of them -- not for developing any discussion of them. There are only two fundamental means of organizing information: one - semantic and usually hierarchical ordering of knowledge through classification, and two - entirely arbitrary ordering by the fixed familiar sequence of the alphabet. These two may intermingle, most notably in a subject thesaurus with cross references. Related to these primary considerations of meaning and form is the distinction of a concept from its linguistic representation, which leads into matters such as synonymy and class inclusion. As information approaches the status of natural language, in part because of the scale and economics of full-text resources, the user is called upon to provide structure and control in the search itself.

Here the distinction between pre-coordinate and post-coordinate indexing becomes manifest, as well as the inverse relationship of relevance to recall. These basic perspectives relate to inherent structures that enable information retrieval. Included are citation indexing (the mapping of genetic connections among individual texts) and Bradford's law of scatter (a quantification of the sociology of communication). In these circumstances, iterated searching can compensate for the absence of an explicit thesaurus, and tools for meta reference may function at multiple levels of abstraction from the sources pointed to. Something like the relativity of physics operates among the disciplines represented by specific subject thesauri, and the use of general subject languages is fraught with the distortion of particular perspective.

Before turning to the implications of these basic principles for pedagogy and the infrastructure required to support it, a brief look at the environment (computers and networks) seems called for. There is really little that is new in the basic possibilities for presenting or searching for information. What is new is a tremendous increase in magnitudes of space and time. Geographic location, physical quantity, and the time required to cope with these are placing much less technical constraint on what can be done. The issue becomes electronic geography and how to travel through it. At the physical level is the matter of communication, the mechanics of connection and interconnection, and the basic protocols employed (especially smtp, http, telnet, and ftp). An issue that has become prominent in the last five years is the need to introduce users to (or shelter them from) multiple interfaces for the same data. In part, this arises from a migration from telnet to http. At the symbolic level is the need to represent and conceptualize, through a screen, what is taking place in navigation through, interaction with, and manipulation of what can be discovered. In particular, navigation requires the skill of recognizing and adapting to a variety of interfaces and processes. For example, ftp

looks very different as a command-line program, a windows form, and a succession of screens on the web. Although use of information technology can be far more dynamic than note-taking from a printed page, it is not apparent that the human sensorium will immediately benefit from this new capability.

What seems most clear is that anything a student learns about using information technology should be associated with need, and preferably with desire. In a postsecondary academic context, such instruction is better integrated with learning particular subjects and completing particular assignments. This means that traditional library "bibliographic instruction", an abstract session on how to do research (electronic and otherwise), is often not very productive. While integration with an assignment helps, the most useful circumstance is for information technology to enter naturally into a search for information that is not predetermined by medium or mode of access. Formal bibliographic exercises (use *Social Sciences Citation Index*), cooked assignments (use one article, one book, and one electronic resource), and treasure hunts (find an electronic resource that shows how Poe uses the word "moony") are frustrating for student and librarian alike, and counter to the spirit of research. Open-ended topics (Chile's relation to NAFTA in the past year) should lead to the most appropriate resources (Lexis-Nexis online).

Although the ideal is individual assistance with particular searches at the point of need, which in turn leads to self-sufficiency, there is a set of prerequisite skills that for practical reasons cannot be transmitted on a one-to-one basis. Group instruction in equipment, interfaces, choice of resources, and system geography is inevitable, despite its shortcomings. Longer term, there is a question whether this remains a voluntary activity or is made a requirement of some kind. As in so many other areas of life, the pragmatic individual tends to seek just what is needed just when it is needed. The weaknesses, gaps, and imbalances that arise in this situation are partly compensated for by the native abilities of postsecondary students. After all, information technology calls forth only one of a range of coping skills demanded by our system of higher education.

There are professors who add competence in information technology and associated resources to the content of their disciplines. In most instances, however, a librarian in their subject area is likely to know more than the professors about information resources, alternatives, the local environment, and their changing configuration. Teaching could benefit from increased communication between librarians and professors, less fear by either librarian or professor of what may not be known, and mutual design of assignments that are likely to lead in electronic directions. To approach proper exploitation of what is already available may require the passing of a generation, particularly in traditional humanities subjects.

Even at a postsecondary educational level, the use of information technology for research tends to be ad hoc, pragmatic, and intuitive, with little clear grasp of what constitutes good searching and why. It seems reasonable to assume that the level of abstraction required for self-critical evaluation of methodology and results usually will not be mastered by those in the early years of high school. Search engines, given the sometimes deliberate opacity of their algorithms and data harvesting strategies, coupled with the volatility of their development and availability, do not seem likely to reward in-depth attempts to understand their varying characteristics. But then, they represent the weaker arbitrary approach of the alphabet, whose only strength comes from the implicit semantic component contributed by the searcher. The apparent simplicity, directness, and low producer overhead of keyword searching ensures that it will be used, and much misused. One of the more effective approaches, which should be introduced very early, is trying to guess a web site's address (or one of its aliases).

The alternative, a classified approach to information, offers something more teachable, especially at lower levels. The interconnections of the web itself constitute a geography. Without much capacity for abstraction or criticism of results, students can be shown

selected sites whose authority and active maintenance make them useful for particular tasks. The teaching of this could be informed by an understanding of facets as developed in classification theory. Some of the sites may be accessible only because of subscription by the educational institution.

As the networked personal computer becomes more widespread as a home appliance, children will gain some basic skills outside of formal education, particularly through games. In the school setting, not all of the burden need fall on the teacher, since some peer support can be assumed. The question of infrastructure is a difficult one, given the economic and administrative costs of maintenance and obsolescence. The solution may lie in components owned, cared for, and taken home by the student, with other requirements like network connection provided by the school.

Recent developments in processing power and data storage capacity, together with a significant decline in cost, suggest the advent of an era where equipment itself may be less of a constraint. In a local urban working-class high school, for instance, word processing outside the classroom is already a norm. Even in the absence of network connection, many of the fundamental aspects of computer-based information systems can be reproduced or simulated for instructional purposes. By far the most difficult task on the horizon may be developing among educators themselves a conceptual, critical, self-conscious understanding of information provided through electronic technology. Perhaps the technology itself will force this as intuitive approaches developed through centuries of print culture become untenable.

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