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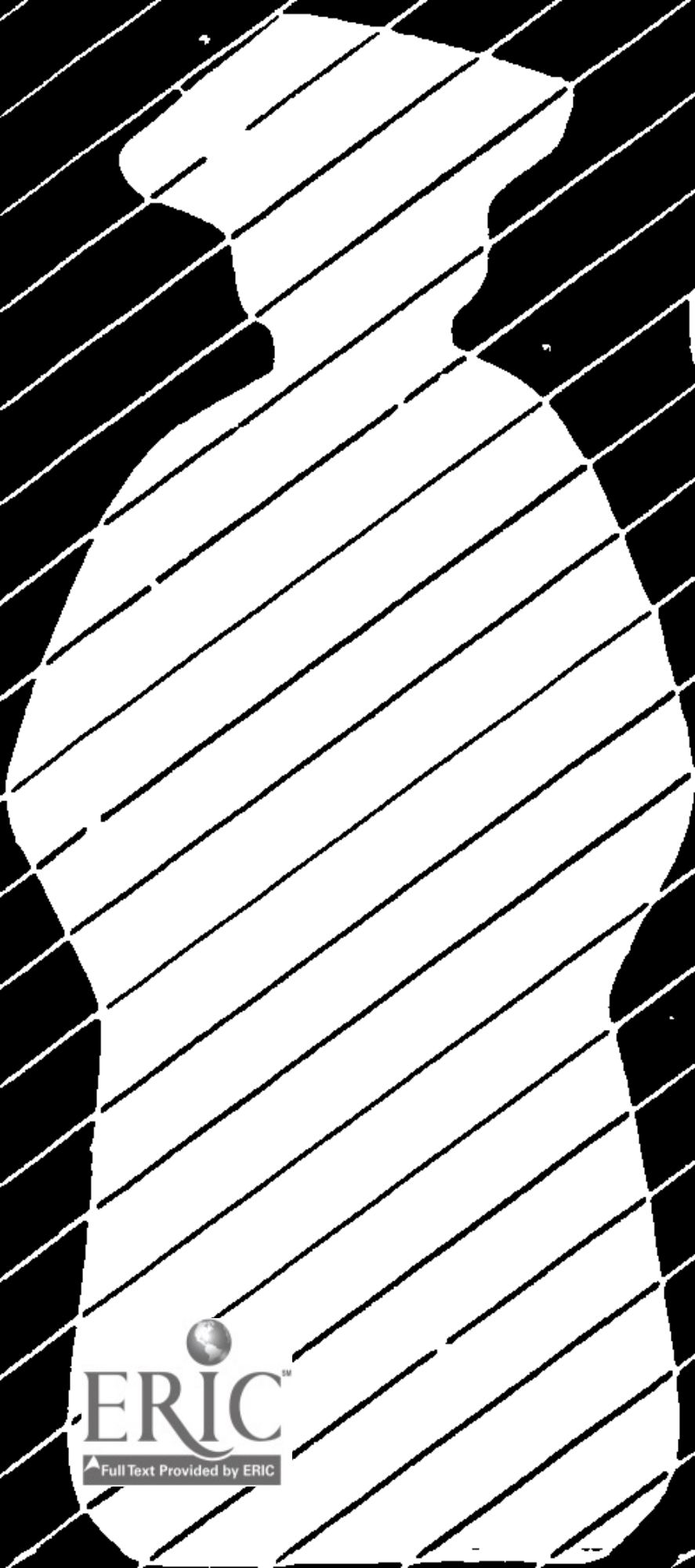
ABSTRACT

Intended to identify essential skills for academics and students as our society comes to depend increasingly on electronic text, and to decide how, when, and where these skills should be taught, this paper begins by discussing the tools of electronic information processing, i.e., telecommunications, computers, and software. A summary of the skills needed for the traditional printed-text environment, including the encoding and decoding of printed information, is followed by a discussion of the skills necessary for an electronic-text environment. These include finding, manipulating, and scanning electronic text, as well as word processing, touch typing, and use of outline processors or idea organizers. The ability of software to transform information into new forms and the skills required for collaborative writing, distribution of electronic text, utilization of specific programs, and programming are then considered. Issues for college administrators and faculty are also identified: (1) identification of essential information literacy skills; (2) teaching information-handling skills; (3) norms and ethics of shared or collaborative text; and (4) the cost of hardware, software, and training. The suggested research agenda that concludes this report calls for documentation of usage patterns, assessment of implementation, measurement of impact on academic products, and assessment of psychological and social consequences. (MES)



Electronic Information

Literacy Skills for a Computer Age

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Electronic Information

Literacy Skills for a Computer Age

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Contents

Introduction

Today the job of the academic in higher education is much the same as it was a hundred years ago—read and digest quantities of text, debate ideas, develop new syntheses and visions, express them in words (handwritten, typed, or printed), and instruct students in the essentials of the discipline through lecturing, discussion, tutoring, and feedback. The essential tasks for students have not changed much either—read texts, listen to lectures, respond to queries about mastery of content, engage in discussion and debate, and compose essays that demonstrate the ability to select, read, synthesize, and argue about a variety of topics.

While the tasks for both academics and students have not changed, the tools available to accomplish these tasks are undergoing revolutionary change. The new tools are based on the computer and the peripheral storage devices that have led to the development of electronic text. Equipped with appropriate software, the computer provides a host of tools that make the task of information processing—storing, classification, retrieval, and production—not just faster and more efficient, but different in its very character. Faculty and students must become literate in the skills of electronic information processing, both to accomplish the tasks of education better and—for students—to prepare for the realities of today's world of work better. These skills are analogues to ones developed for efficient use of printed text. They include generic information-handling skills such as finding stored text, estimating its size, scanning for meaning, manipulating it for subsequent use, and printing the results. Also included are skills to use specific tools such as a word processor, electronic message system, or a database. The challenge of this paper is twofold: (1) to identify the essential skills needed to survive as our society comes to depend increasingly on electronic text, and (2) to decide how, when, and where these skills should be taught.

The Tools of Electronic Information Processing

There are two types of computer developments in higher education. One is in instructional computing, where new software is appearing that can assist in the teaching of subjects. The other is in the area of information handling where we see tools such as word and text processors, database managers, and communications software. This paper focuses on information handling.

The range and breadth of new tools are most easily described by personal anecdote. On a recent morning I began my work day at my office at home. With the aid of a telephone and modem, I connected my personal microcomputer to the university's central computer. The central computer handles hundreds of simultaneous users; more important, it maintains devices which allow for sharing of electronic text among all its users. I checked my electronic mailbox for messages from colleagues and students; although not all staff and students communicate in this way, a number of us who are physically distant from one another use it to make appointments and solve minor problems without playing telephone tag. In one message the dean asked if I had the citation for an article he needed. In another, a co-investigator on a proposal had just finished a new version of his part of the text; he told me the name of the electronic file in which I could find the text and asked that I review it, make any changes I deemed appropriate, and notify him by return message when I had finished.

While still connected to the central computer, I checked for recent activity on two computer conferences to which I belong. A conference is an electronic forum in which people interact on topics of mutual interest. Most of the interchange is public in the sense that all members of the conference see the input of others. Using a computer terminal, each conference member, at his own convenience, connects with the conference and reads what others have said recently about the topics being discussed. If members are motivated by the "discussion" of any topic, they type in comments which others will see when they next check in. One of my conferences is organized around a class I teach in electronic learning. Some of my students live in town, although not close to one another; others live 25 to 50 miles away. The class meets once a week for three hours. In the computer conference students extend the discussion of issues raised in class. Some topics are stimulated by my lectures; others are generated by students based on assigned readings or term projects. Today, I found some additional discussion on the topic, "Can a computer simulation be made self-instructional, or does it require mediation by a teacher to make it useful?" In another item a student indicated he was having trouble making his computer terminal operate correctly; another student—familiar with that equipment—suggested a switch setting that should be changed. By the end of the term students will have logged about 24 hours on the conference; about two-thirds of that time represents fruitful extensions of class time.

Next, I switched to a conference devoted to research issues on the topic of children and computers. A year ago, a group of 15 faculty, graduate students and school administrators formed a working group devoted to exploring this topic. We have been meeting every three weeks for face-to-face discussions. Between meetings business is carried on using this electronic conference. Today there was activity on three topics: identification of speakers for our forthcoming live conference, a report from one member on a relevant national meeting he had just attended, and a request from one of the subgroups for suggested additional readings.

As a third task I connected with the DIALOG computer in California to search the ERIC database of educational literature. I am writing a review paper on electronic learning and I wanted to search for references I might have missed in a review of my personal journals. I made an electronic copy of the abstracts of two articles that looked relevant, but that I had overlooked. I disconnected from DIALOG and linked to the local electronic version of my university library's card catalogue. I wanted to see if these references were in the holdings of our library and available for check out.

Now that my work with the outside world was finished, I disconnected from the telephone to do a number of local computer activities. I added the new references to my personal bibliographic file. This database stores all of my citations and notations for books and articles that I need for various research and writing activities. Whenever I need a current reading list or bibliography it can print one in any of a variety of conventional formats.

This paper was written using a microcomputer equipped with word processing software. This allows easy manipulations of text to reflect a different organization or a stylistic change that makes for more persuasive text. On my last reading of this essay I noted two sections that could be improved. For one, I felt that a more powerful opening paragraph would be helpful. Replacing the existing one required little more than "pointing" to it and typing a replacement. In another part of the paper I recognized the value of adding a paragraph from another paper I had written. I "opened" up the electronic file for the other paper, instructed the computer to make an electronic copy of the desired paragraph, re-opened the file for this paper, and instructed the computer where to insert it. Instantly the computer reformatted and repaginated the paper to accommodate the new text. The revised paper was ready for printing without requiring the skills of a secretary.

The budgets in my department are all done using a "spreadsheet" program. For a proposal I am writing I had to revise the budget; the total amount was higher than my sponsor would allow. I guessed that a reduction in the amount of time I committed to the proposed project might be sufficient to bring the total within the guidelines. An electronic "spreadsheet" program verified this hunch immediately. I inserted the lower fraction of time for myself, and the program recalculated all of the budget. When I saw that this change brought the total within sponsor guidelines, I printed out the revision. Again, I had saved a great deal of clerical time that used to be required to recalculate and then retype the budget.

The last task was a letter. The addresses of my frequent correspondents as well as the format I use for my letters are stored in the computer. The format is stored as a "shell" or "style sheet." It includes the letterhead, the formatted locations for the date, inside address, salutation, and the standard closing I use. I needed only to think about the letter's message. When I finished the text it was ready to be printed and sent out. Later, when I arrived at the office I addressed the envelope, but no one was needed to retype the letter (and perhaps add a typographical error in the process). Even my own "second thoughts" about the text can be quickly handled, so I don't need to debate whether a small change is worth a secretary's time to retype the letter.

In one hour I had processed a great deal of information. I had accomplished it without many of the delays associated with face-to-face communication and negotiation with support staff or colleagues The efficiency represented by accomplishing it with a friendly machine that did not need to be cajoled, trained, or persuaded to do the task ensured my returning to the computer tomorrow to continue this type of work.

The examples above are taken from the experience of a computer-literate faculty member. But students are rapidly gaining access to many of the same tools. Without requiring it, many students write their class papers on a word processor—using their own computer or one belonging to the school. At a campus like The University of Michigan, participation in a computer conference designed for the class is a common adjunct to more traditional requirements of attendance and participation in classroom activity.

In short, the tools of electronic text (databases, word processors, etc.) are attractive and even seductive for faculty and students alike. But beyond their novelty lies a challenge. Some of the cognitive skills to use these tools are fundamentally different from those associated with printed text.

Skills for a "Printed-Text" Environment

The traditional pattern of intellectual activity in college revolves around oral communication and written or printed text. This is true for both the generation and consumption of new information. Consider the exchange of printed text. A person wanting information on a topic consults a variety of printed sources, including books, journals, and magazines. The text itself might be original source material, a textbook or guide to textual material such as an index, or a collection of abstracts. To transmit information to others, the choices are to use pencil, pen, or typewriter to commit the ideas to paper. Printed text, then, is the dominant medium used for the exchange of information.

Developing the skills to decode and encode printed information is one of the major tasks of education. Students are taught to read and write. In elementary school this entails rudimentary decoding and encoding skills such as translation of words, sentences, and paragraphs. At intermediate and advanced levels decoding involves speed reading, reading for meaning, note taking, and research skills appropriate to the finding and decoding of reference material (locating references of various types in libraries and other collections, taking notes on index cards, and cross-classifying ideas).

Encoding has a similar set of graduated activities that includes the rules of sentence structure, vocabulary building, outlining and organizing ideas, and what might be called the etiquette or norms of writing. Over the years there have evolved norms for every form of written communication: business letter, personal letter, book review, essay, and research paper. These norms are based largely on audience considerations and add another layer of meaning to the words. In a business letter the inside address, salutation, closing, and even some parts of the text are stylized conventions. By using them, an author conveys a social message designed to elicit a desired response from the recipient. Similar expectations surround the use of conventions in other forms of writing. The research paper has a definite structure, including such parts as the introduction, a review of previous work on the topic, presentation of data, development of arguments using data, a closing summary, and a bibliography.

Literacy with printed text, then, is associated with a variety of intellectual skills ranging from basic decoding of words and sentences to sophisticated understanding of the implications of form and genre for meaning.

Skills for an "Electronic-Text" Environment

Dealing with electronic and printed text has many similarities—words and sentences convey the same meaning whether they flicker on a screen or appear printed on paper. But there are important differences between electronic and printed text. These are associated with the identification, selection and retrieval of stored text; decoding of text that is longer than one "screen"; manipulating stored text for subsequent use; and expressing ideas in a medium that has an unusually wide array of output possibilities.

Finding Stored Text

As more and more archived text is maintained in an electronic form, readers must know how to find and retrieve it. Until recently, electronic information was of limited use to the academic professional or student. The number of journals and other sources of information for each field of study—each with an index at the end of the volume—was manageable by a serious scholar. There were also a few electronic databases available from DIALOG and other services, but the difficulty of accessing such data—through scarce and unfamiliar tools such as terminals and modems—provided little motivation to pursue the electronic avenue of information retrieval. A few bibliographic databases could be accessed electronically, but for the one or two times a year it was needed it was easy enough to ask a librarian or research assistant to do the task and deliver a printed copy of the results.

In recent years, the amount of information has proliferated in most fields. There are many more publications, ranging from journals and books to relevant technical reports. At the same time comprehensive databases have become available—DIALOG in Palo Alto, California, lists two hundred, including several each in areas as diverse as education, business news, biography, agriculture, engineering, law, and medicine. Couple this development with the proliferation on campuses of inexpensive hardware and software. The result is that many scholars and students are beginning to place a high value on getting their information electronically. As campuses become increasingly saturated with computing power, the forces exist to alter the norms for how information is obtained.

Consider the task of ascertaining whether the campus library contains a needed volume. It is easy to choose the electronic solution, given the choice of either spending time walking to the library to do the search manually or turning on a terminal and discovering the answer in a few minutes. Similarly, when a scholar can scan a bibliographic electronic database personally and immediately see the results of using certain key words for the search, the task is more efficient. This does not eliminate the need for a librarian to complete the search, but it does mean a scholar can give a librarian a more precise and useful set of specifications for a search.

As more academics create text electronically, their files become part of the information base that can be shared. When the technology is in place, it seems natural to suggest that a colleague provide reactions to an on-line work, instantly ready to the person who knows the necessary commands. This can also apply to students who create their class papers on the computer.

Manipulating Electronic Text

The skills to retrieve electronic text are of two types. One is the specific set of commands needed to carry out the activity described by the designers of a database. This includes the procedures used to "dial up" the data base, "log on" to the host system, and locate and retrieve the desired information. All hosts have a set of procedures—a protocol unique to their system. The skills are analogous to learning how to use a card catalog and various printed indices to the literature of a field of study.

In addition to knowing the procedures for using a database, a user needs a more general set of skills associated with efficient use of electronic text to facilitate subsequent use of the information. One of the great advantages of having information in an electronic form is the ability to search for key ideas or concepts, select them, and copy them to one's own electronic files or notepads. Microcomputers (both stand-alone and those serving as links to other computers) follow a variety of protocols, but they all enable the user to copy and move portions of text for subsequent local use. This is similar to photocopying printed text. It differs in that the copied text can be re-arranged easily and

incorporated instantly into another text. It is a great convenience to add newly found references to an existing bibliography of one's own, or to copy abstracts directly into a section where one is compiling new ideas on a particular topic. Each of these activities requires developing general file management skills (e.g., marking a portion of text [illegible]s of interest and copying it to an off-line d[illegible]ile). Such skills are generic to all computers, even though their use is tied to commands that are unique to a particular configuration of hardware and software.

Scanning Electronic Text: How Thick Is the "Book"?

There are other rudimentary skills associated with searching electronic text. As readers try to decode this text they unconsciously employ skills learned to manipulate print text. They estimate the paper's approximate length (and thus the time required to read it) by a calculus which includes knowledge of the subject matter, the size of the type face and the text block, and the number of pages—determined by feeling the thickness or actually counting the pages. The values for the variables in this calculus are readily obtained by scanning a single page to ascertain which of a number of standard parameters for text dimensions were used and then shuffling the pages to ascertain total length.

Electronic text is different. The text itself resides in electronic files that cannot be seen. The files have size parameters; the unit of measurement is bytes of disk space. (The paper you are reading occupies 45,000 bytes on a disk.) For these size parameters to help the reader, a different set of norms must be acquired. The other variables in the calculus require scanning the text for density indicators. Depending on the computer and monitor being used, a given amount of text occupies different amounts of visible space. On one machine a block of 200 words may fit on one screen; on another it may span two screens. A screen of text is not related to the size of a page of printed text. A user of electronic text must learn the conventions of each machine.

Scanning Electronic Text for Meaning

Good readers do not decode text in a strictly linear fashion. They visually scan prior and subsequent material and physically "flip through" the pages as part of mentally building a sense of the whole text. They may be looking for a topic heading, or figuring out where an idea fits in the overall flow of an argument. Children learn the scanning skills for printed text in the elementary school years.

Electronic text scans differently: there are no pages to flip, and there are fewer visual markers to help locate or fix points in human memory. One must learn how to scroll through the text—the equivalent of "thumbing through" printed text—finding cues such as section headings, key words, and text length to facilitate this type of decoding. This entails a combination of learning the commands required to move the text forward and backward on the screen, and using them frequently enough to acquire a "feel" for text that has fluid borders.

On many machines this involves issuing a lengthy instruction or issuing a series of commands. To simplify the process and make it as simple as thumbing through printed text, many machines support "macros" which permit a user to cluster commands and invoke them using a user-defined shorthand. The skills to create macros are among the rudimentary information-handling skills.

Word Processing and Touch Typing

The most commonly used electronic enhancement of communication is computer-based word processing. Word processing software allows an author to generate text that is truly fluid, in the sense that it can be easily corrected or re-arranged to suit the author's needs. At any time the most current version of the text can be printed, removing the clutter of crossed-out words and circuitous arrows designed to lead the reader through the convoluted path of reorganized thoughts. Correcting so-called "typos" is the least of its attractions. Of greater interest is the capacity to relocate text easily within the body of the composition in response to a new way of thinking about a topic. While it is not known whether this capacity improves the quality of the finished product, it is sufficiently attractive to lead experienced authors to value highly their word-processing software. And for the present at least, word processing is being adopted increasingly by those who write. As with electronic text retrieval, this is the mode of text handling being adopted widely throughout business and industry—the destination for most college graduates.

What skills are needed to become efficient at word processing? As with other electronic enhancements, basic training is needed in the specific commands associated with the word processing software selected by the user. This can range from extensive training for some of the sophisticated word and text processing packages

(e.g., WordStar) to very little training for the "what-you-see-is-what-you-get" word processors, such as MacWrite, the standard word processing software for the Macintosh. Undoubtedly, the ease of operation associated with programs such as MacWrite will become commonplace with most processors within a few years and extensive training will not be necessary.

The most important skill required for using all word processors is touch typing. Currently, there are no shortcuts for getting ideas from the brain to the computer. Authors must learn how to type fast if the entry process is not going to stand in the way of rapid expression of ideas. Educational institutions should consider how this skill can be efficiently taught. Courses in this subject can be offered, but there exist excellent tutorial software whereby a motivated individual can learn without attending a formal class.

Outline Processors

A variation on word processing is a class of software variously referred to as outline processors or idea organizers. This software allows an author to enter thoughts and ideas either randomly or with some preliminary organization, and then rearrange the ideas into a logical format. The outline is started by entering main ideas as headings. New ideas can be placed as subheadings under these main ideas or made into their own main headings. The software remembers the level of outlining given to the idea.

At any point an idea can be expanded as inspiration strikes or needed information is found. Some outline processors, such as ThinkTank, allow the elaborations to be displayed or hidden, depending on whether one wants to look at details or stand back and get the big picture of the essay being written. Ultimately, one is trying to build an ordered hierarchy of ideas that represents a coherent whole. The outline processor helps the author construct this whole by providing a flexible scaffolding. The use of this software does not require any new skills beyond those needed for word processing. Their value as a cognitive tool, however, needs to be assessed. Such tools have yet to prove their worth, but—in published reviews—experienced authors have expressed their satisfaction.

A variation on outline processing will probably emerge for college writing. As mentioned earlier, there are standard formats associated with different types of writing (essays, research papers, and business letters). If an outline processor contained the "shell" for some of these formats, it could provide a helpful standard of organization for students. The Quill authoring system is used at the elementary school level; its equivalent at the college level could prove equally useful. Departments could develop shells appropriate to their needs. Chemistry might have one for lab reports, psychology for social science research reports, and communications for newspaper stories. If students had in front of them on the screen the proper organization for an assignment, they might invest their time more profitably in the task of analysis and synthesis.

Transformation of Information

A feature of several software programs is an ability to transform information into new forms. Consider these examples. Numerical information is entered into a spreadsheet program. The program can manipulate the numbers providing various kinds of summary statistics. But also, with a single command, the program can display the statistics pictorially as a chart or graph. Several database programs allow the direct input of pictorial information as well as text or numbers. With a program called The Learning Tool, a user enters text (or pictures) into a series of electronic notecards. The user can then graphically connect these cards with lines and arrows to represent interrelationships among the bits of information. The user can also create icons that summarize the information. These capabilities gain more significance in light of the fact that some of today's word processors have the capability to handle both normal text and transformed information—pictures, graphs and icons. This capability will be commonly available in a few years. What does this imply for the way colleges teach composition and the presentation of ideas? The transformed information used to be the province of specialists in a field; they will rapidly become common ways of expressing ideas. Should we teach critical thinking around the pictorial representation of information in the same way we currently teach critical expression of ideas with words and phrases?

Collaborative Writing

Sharing text is an important aspect of developing finished ideas. This is especially true for faculty co-authoring a scholarly paper or providing critical comment on a student's text. With printed text, sharing is done by one author putting words on paper, and another reading the text and writing reactions in the margins or on a separate sheet of paper. As more text is made electronic, an analogous electronic capacity is needed. This is emerging with software that permits multiple documents to be worked on simultaneously. A monitor's screen is split into two or more "windows" or separate work areas. In one window the original text appears; in a companion window on the same computer screen is a place to enter comments on the original text. The presence of comments is noted by a special mark on the original text, and the original author can call for the comments with a simple command. When this capacity to share is fully realized, it will present intriguing possibilities for collaboration. Co-authors or dyads of student and teacher could convey critical comments expeditiously by swapping discs. With computer networking and hard disks, this could even be done without ever physically exchanging disks. The most important skills for collaboration are the same for both printed and electronic text—the skills of critical textual analysis and sensitive feedback of constructive value to a colleague or student. The novel skill is manipulating information in multiple windows.

The Distribution of Electronic Text

Computers have opened up a bewildering array of options for communicating with others. Both print and electronic exchange have been affected. Consider print first. The phrase "desktop publishing" captures the challenge of producing print. In a printed-text environment authors generate handwritten or typed output following one of a small number of conventions regarding margins, paragraph indentation, and spacing between lines and headings. This streamlined set of design conventions simplifies the technical aspects of manuscript preparation for an author. If there is a reason to make the text appear more similar to printed text it is submitted to a printer where an editor or book designer with expertise in layout and composition literally designs the book.

Today's word processors offer a wide array of book design features including running headers, floating footnotes, and a selection of font sizes and styles that can be changed any place in the text. In other words, the author has available many of the same options available to the book designer, but not the knowledge or skill to exercise these options in aesthetically pleasing ways. To be efficient, a writer must now acquire the knowledge to make aesthetically pleasing choices without wasting time that might otherwise be invested in crafting ideas. It may be that authors could be helped by being given standard format guidelines to prevent unnecessary effort being invested in appearances. Microsoft Word word processing software has the option of style sheets in which most of the features are preset. So there is a technical solution to the problem but no agreement that it ought to be used.

There is considerable interest today in bypassing print entirely through the electronic exchange of correspondence. Electronic mail is a way of leaving messages that can be retrieved at the recipient's convenience. It is a potential timesaver, because, unlike a telephone call, the two parties do not need to be available at the same point in time. So-called computer conferencing is electronic mail that can be viewed and commented on by a group of people. It is a way of carrying on group discussions without face-to-face meetings. To engage in either of these types of exchange requires the usual knowledge of commands unique to the particular software. The conference systems EIES and CONFER have different command sets, but they use generic skills.

Conferencing represents a new form of correspondence. Letters and face-to-face meetings have their etiquette, or standard forms, based on conventions about how to address people according to their status and what messages are appropriate to the context. The conventions are taught repeatedly in school and reinforced at home. Computer conferencing is a hybrid medium of exchange. It is a mix of oral discussion and written notes. In oral discussion the participants are conscious of the strands of the argument by its very freshness. If the content becomes too complex for the participants to process mentally, information is deleted and the discussion streamlined. In a computer conference the "discussion" transpires in a series of typed notes left in an electronic file. The discussion of an item might extend for pages and span several weeks. Without the immediacy of a live exchange it can be difficult to remember the strands of the discussion. Reviewing earlier parts of an exchange becomes necessary to remember the strands of the conversation. To become efficient communicators, participants must learn how much information can be inserted in any one discussion item or response to an item. They must also learn how to find earlier exchanges (other than the most recent one that appears on the screen) so they can remember the thread of the argument. They must also learn how to hold in short-term memory a wide array of ongoing points from the conference. The generic skills, then, are the same ones required to retrieve and manipulate archived text.

Program-Specific Skills

The above skills are called generic in that they apply regardless of the particular hardware and software being used. Scrolling text and searching for key words is generic, but it is done differently within MacWrite on a Macintosh, Finalword on an IBM PC, or DIALOG on the Lockheed system. Can one learn generic skills without imbedding them within skill building for a specific piece of software? Probably not. A campus may have dominant use of a few different pieces of software: for example, two word processors, two spreadsheets, and one campus-wide electronic message system and conferencing system. But efficient use of any of these tools requires learning not only the prescribed commands in the manual, but some generic information handling skills as well. While it is important that this be done, much current instruction (e.g., a workshop in the use of a particular word processor) does not emphasize the underlying generic skills. If it does need to be formally taught, should it be in technical workshops or become a part of regular instruction in English, biology, and other subjects? Alternatively, could it be made part of practice-sharing group sessions set up for faculty and students alike?

Special Computer Tools

At present there are a limited number of software tools available for the computer. In addition to word processors and outline processors there are databases and spreadsheets. These have some specific and some general utility for instructors and students. The database is an excellent device for storing bibliographic material. Spreadsheets have less obvious general applicability except for those disciplines—such as business—that are the primary users of the tool. It is less obvious that students need to acquire facility with these tools as a necessary part of becoming literate in the arena of electronic information. But their widespread use in business raises the question of whether students should be trained to use them just as they are taught to read, write, and use libraries.

Programming

Another class of computer-based information skills is that of programming. Should students be required to learn a computer language as part of their undergraduate education? Let's distinguish between providing advanced courses in programming for the few students who want to specialize in computer science, and requiring that all students attain some rudimentary skills in programming. By and large, the trend has been away from having individuals create their own programs to handle information. A handful of expert programmers have been creating increasingly powerful and easy-to-use software packages that allow the

ordinary user to avoid the painstaking job of developing personal software tools. The trend will continue, limiting the need for general programming skills. Programming might be included in the college curriculum for a number of reasons, but attaining general literacy in the handling of electronic information should not be one of these.

Special languages, however, have curriculum-specific relevance. Should all graduate students in psychology and education learn LISP because of the overwhelming influence of artificial intelligence on these fields? Should all engineers learn Pascal? Perhaps they should since the very metaphors of the discipline are coming to be expressed in the vocabulary and syntax of these programming languages.

An Agenda of Issues

The increasing use of electronic text raises a number of issues for college administrators and faculty.

Identification of the Essential Skills

This paper identifies a variety of information literacy skills. It is not a definitive list, nor could it be, given the rapid changes in the technology. Faculty members on each campus should deliberate about which skills should be considered essential. And faculty members in each discipline should consider whether there are skills specific to the discipline that need to be developed. At present, of course, the list is likely to include skills identified by campus innovators; certainly many of mine arise from the experience of my colleagues and I, who have been early adopters of the technology. As more faculty gain experience with electronic text, and as hardware and software evolve, it is likely that the list will change.

Teaching Information-Handling Skills

Today, few campuses offer classes in the use of the tools of printed text—handwriting, use of the library, and typing. It is commonly assumed that facility with these tools is a part of pre-college education. There are two exceptions to this. Libraries offer orientation sessions for students, and study-skills centers provide some training in writing and study habits for those in special need. By and large, however, it is assumed that these tools were acquired in previous schooling to a level sufficient to equip students to perform the usual academic tasks.

The electronic tools are too new to make this assumption. Special training needs to be provided on campuses for some years. Should it be done through regular classes in the disciplines or provided separately through campus-wide workshops? The latter would seem most appropriate since few faculty members are qualified to teach these skills. Furthermore, most probably feel it is inappropriate for them to provide this training; after all, the skills in question are designed to enhance, not supplant, the normal academic activities. It is clear, though, that faculty members will need to acquire facility with these tools if they are to integrate them into academic and instructional work.

Norms and Ethics

An ingredient in campus debate should be the norms regarding shared or collaborative text. The highest values of scholarship are associated with individual performance in scholarly activity. Electronic text invites both borrowing the ideas of others and borrowing from one's own electronic text. In the past, the difficulty of combining the text of various authors was an inhibitor to sharing and borrowing. Electronic text changes this, and indeed may change the way many people write. Composition may become much more an act of assembling pieces of existing text than creating entirely new ideas. How does the academic community feel about this? What norms (or rules) shall be promulgated to students?

Who Pays?

There are many costs associated with the type of information literacy discussed here. There is the cost of purchasing and maintaining hardware—microcomputers, data-handling telephone links, mainframe computers, and computer connect time. There is the cost of software—word processing, terminal emulation, and various other programs that facilitate the exchange of electronic information. There is the cost of providing training in the use of these tools, and the administrative coordination of these many activities. These costs cannot be hidden; their size poses a challenge to fund raisers trying to meet the increasing costs of items of long-standing priority, such as faculty salaries.

Ultimately, if the skills of electronic information literacy are widely adopted by colleges, it will have implications for precollege instruction. Colleges must maintain open dialogue with secondary institutions during these times of transition.

A Research Agenda

The campus debate can be more informed to the extent that systematic research is conducted on the relevant issues. Four kinds of research are called for: documentation of usage patterns, assessment of implementation, measurement of the impact on academic products, and assessment of the psychological and social consequences.

Of great value is simply monitoring who uses what machines for what purposes. On any campus (or in any organization for that matter) it is important to document the kinds of uses being made of machines, and the importance they have in the conduct of daily work. This information can illuminate decisions about university purchases or decisions to encourage students to purchase their own. It can also inform the decision on providing systematic training in literacy skills. On most campuses the growth of computer use has not been the result of a campus-wide policy, but policies emerge when activities become sufficiently widespread to require policy. The policy should be based on thorough and accurate information.

Another focus for research is the process of implementation. As with any new system introduced into an organization, it is important to identify potential problems with the implementation. What kinds of technical problems arise as students and faculty use computers? What are the limitations in the software being employed? Are there technical problems with the sharing of electronic text? Will the technical problems get in the way of accomplishing the desired academic tasks? How will non-using faculty react to the introduction?

To understand the impact of the technology on scholarship and instruction, systematic experiments must be conducted. For example, is teaching English composition enhanced by word processing? This question is best answered by randomly assigning students to two different sections of a course, one in which students use computers as they compose, and another in which they do not. Systematic observation of students and their products will provide the evidence. Based on similar experiments done in elementary schools, there are some intriguing hypotheses: Those using word processing will spend more time working on their compositions, write longer paragraphs, do more revisions, and review each other's work more often. Many of these outcomes would be valued in the college community, but they are only hypothesized; only research can ascertain if they are real outcomes.

In addition to the impact on the products created by students and faculty, there are a number of social and psychological issues that bear investigation. The university is a community of faculty and students. A sense of community is built and maintained by interpersonal, face-to-face communication. As more communication is done electronically, instead of face-to-face with voice and non-verbal modes of interaction, the nature and strength of the communication values may be affected.

Another set of issues surrounds the speed of information exchange in electronic text communication. Academic exchange has a certain pace to it, set in part by compartmentalized activities—for example, a certain number of classes per week meeting at preset times. There are also expectations about the amount of time required to read, write, and listen to new ideas exchanged in print or oral fashion. Electronic tools may alter this in unknown ways. For some, the computer might seem a demanding master, requiring ever-faster responses. Does it create tensions in those who use computers extensively? As the computer is used more extensively, new role demands will be created. For example, a departmental secretary's role might change substantially. Where formerly a high premium was placed on routine typing and telephone skills, the secretary might be expected to correct faculty papers using a word processor. And a faculty member may use more than one type of word processor, requiring the secretary to master several systems. These changed expectations could alter office relations and job satisfaction.

These research questions are offered as illustrations. They represent important issues, the answers to which can influence the way in which a campus community views these innovations in communication.

To maintain the inquiring spirit during a time of transition it is probably wise to remind students and faculty that, in a technology-rich environment, speedily obtained information and slick-appearing text is not equivalent to good scholarship or persuasive argument. The machines can be captivating and delude their users into thinking that the mere mastery of their functions should be rewarded, because the product looks so appealing to the eye.

Literacy in electronic information handling must stand the test of scholarship and instruction. At present early adopters suggest that these tools can contribute in a positive way to reasoned thinking and writing—the central concern of the university. But this very assumption must be open to assessment and reassessment.

Notes

An earlier version of this paper was presented at the annual meeting of AAHE (American Association for Higher Education), Washington, DC, March, 1986. The present paper profited from the comments of various readers, including Ron Pedone, Bob Kozma, Bob Bangert-Drowns, and Mary Joscelyn.