RETHINKING INFORMATION LITERACY¹

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Over the past decade information literacy emerged as a central purpose for librarians, particularly academic librarians. This article critiques the model, beginning with the information-processing paradigm that provides its underlying assumptions. In particular, problems are identified with the assumed connection between information and knowledge, with inadequacies of the cognitive sciences approach—including the view of language as mere communication—and the inadequate consideration of the role of computers in human-computer interaction. The appropriateness of the "learning methodology" of the information literacy model is reviewed. Alternatives—including visual literacy, multiple literacies, and interactive literacies—are surveyed. The challenge of relating information literacy to workplace competencies is outlined. The article proposes that information literacy be refocused away from information toward learning, and beyond literacy in the direction of sociotechnical fluency.

Introduction

Information literacy stands today as a major focus and purpose of librarianship, an achievement that required a decade of work. Discussions at the corporate and public policy levels demonstrate broad concern on the issue [1, 2]. School librarians—and public librarians to a lesser degree—are active in the movement in the United States, signal-

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ing widespread recognition of the value of the information literacy program [3, 4]. The integration of information literacy into the curricula serves as a major strategic goal for the future success of academic libraries. Recent endorsement by major accrediting agencies as an essential purpose for the library assures that academic faculty and administrators will take up the banner and incorporate information literacy into the larger purposes and concerns of the American campus [5].

The progress of the information literacy initiative appears sufficiently institutionalized to allow, or rather command, a review of the assumptions of the model. Specifically, this article critiques the underlying information-processing paradigm, reviews the learning premises at its core, and explores the adequacy of the literacy being promulgated in light of both the challenge posed to the preeminence of print by the emerging visual ecology, and the need to segue beyond academic skills into workplace competencies.

The Information Literacy Initiative

Despite significant background work [6, 7], it was Patricia Breivik's presentation of a comprehensive model, and program, of information literacy in the late 1980s that marked the serious beginnings of the initiative in academe. In several articles and a coauthored book, Breivik presented the issue in terms of the learning process—specifically as an essential skill in lifelong learning rather than a matter of library instruction—making the topic a matter of general importance to the curriculum even while keeping it grounded in the library profession [8]. In a second book a decade later, Breivik redefined information literacy (IL) more broadly, encompassing such new trends as resource-based learning, undergraduate research, service learning, inquiry learning, and problem-based learning [9]. Again, Breivik successfully presented IL as a larger issue, central to the very learning process.

Certainly, this contribution was no solitary achievement. At least two edited volumes linked IL to the fundamentals of nurturing self-reliant learners [10, 11]. Studies of the needs and assumptions of teaching faculty regarding information literacy [12, 13], and explanations of actual learning practices of students [14–16] undoubtedly guided improvements in the practices and methods of a revitalized library instruction. Handbooks of actual practices facilitated improvements in the effective teaching of IL skills and knowledge [17, 18]. Researchers subjected IL objectives and outcomes to careful scrutiny [19], and elaborated the prevailing assumptions of IL, ranging from something grounded in information technology, to knowledge of sources, to re-
trial processes, to the use of tools to control and manage information to extend and create new knowledge [20, pp. 110–51].

Teresa Neely reports findings that exposure, experience, attitude, and student relationships with their instructors are major factors affecting IL outcomes [21]. Christine Bruce objects to the linear, objective, and presumably quantifiable practices of IL instruction and proposed a relational, phenomenological alternative method focusing on the conceptions of the learner [20]. Neely responds that the more objective approach allows for better outcomes assessment [21]. An international survey provides perspectives on how different cultures approach the issue [22]. Frequent reviews keep attentive professionals alerted to obstacles faced and progress achieved [23, 24, 25].

Any major initiative of this sort has its critics. Librarians did not rush to embrace the idea; professional acceptance of the label "information literacy" proved lukewarm at best [26]. Nevertheless, teaching faculty as well as librarians rallied in support of the IL movement. By the end of the 1990s, intensive annual Association of College and Research Libraries (ACRL) institutes drafted and trained scores of new recruits, advertisements for "information literacy" specialists rivaled searches for systems librarians in frequency, and numerous programs on the subject headlined regional and library system conferences. The extensive success of the information literacy initiative warrants a review of the generally accepted premises underlying the idea, the assumptions about the learning process that inform it, and the print-based and academic orientations of the effort in this era of multiple-media and perpetual workplace learning.

Is "Information Processing" the Appropriate Paradigm?

A pattern of thought that can best be described as the "information-processing paradigm" captures many of the implicit assumptions underlying current descriptions of this Age of Information (in addition to IL). In essence, the model describes information as proceeding through stages, progressing from noise (unorganized data) to perceived data, to (organized) information, to knowledge. Typically, the model developed incrementally, beginning with the "mathematical theory" of communication developed by Claude Shannon and Warren Weaver, which established the fundamentals of signals, bits, measurement of information, and the role of entropy in the information process [27]. Other subjects of inquiry included developing representation (exploring the kinds of symbols used both inside the computer and the human brain) [28], probabilities of measuring changes in knowl-
edge [29], and content analysis, the relationship of the symbols and intention in the message. One rendition of content analysis offered three models for considering meaning, an association model (statistical), a discourse model (linguistic), and a communication model considering patterns and interactivity [30]. Other scholars described levels of information integration, from low (categorical), medium (providing alternatives), and high integration (providing choices) as characterizing human information processing [31]. Sometimes models of information processing are used to guide research without being fully developed. Two comprehensive models provide exceptions that must suffice for this article.

Fred Dretske proposed an “information flow leading to knowledge” model. He begins with the “communications theory” of Shannon and Weaver (which he says is misnamed), which measures the amount and form of information signaled but does not manage content and meaning. Concern for meaning requires consideration of the intentionality and semantics of the sender, then—assuming all the information is transmitted—a “threshold of justification” sufficient to survive skepticism is required. The final step is the conversion of information to concept, which leads to belief and learning and knowledge [32]. In such manner Dretske explains the transformation from information to knowledge.

The field of psychology has produced a more elaborate and conscious development of the paradigm. From this perspective the information-processing (IP) paradigm is concerned with the manner in which information in the environment is processed and influences behavior; for some the model provides a general basis for the entire field of psychology [33]. For this line of inquiry there is less interest in information as signal, as used by Shannon and Weaver, and greater concern with information as representations of the environment as processed cognitively (using perception, memory, and selection) in stages to influence behavior. Thus, it is not psychology as a whole but cognitive psychology that provides the proper focus for this article. There are variations on the main theme, which can be summarized with the help of a review of the literature. Some scholars are investigating physical symbol systems, the symbolic architectures that make human information processing compatible with computer information processing. Others map the connectivity between input and output, denigrating the importance of stages. The dominance of the environment over the internal processing is the concern of the “ecological realist” school. Other domains of inquiry include visual perception, memory, and psychophysics. Generally these variations on the theme are not considered sufficiently at odds with the model to invalidate it; the psychological
rendering of the IP paradigm is extensive and still considered a valid working model or "metatheory" [34]. There is one exception. The ecological realist school cannot be easily reconciled with the assumptions of the IP paradigm.

James J. Gibson's [35] long-enduring ecological model of perception, information, and knowledge disputes the assumptions of the IP paradigm. He limits "information" to human communication, typically with words or images, allowing for secondhand experience but not firsthand experience. The environment does not signal the observers in this model. Information amounts to specifications (light, events, surfaces, "affordances") in the observers' environment, not in their sense receptors. That information is "picked up" in its richness as the observers move around, test the environment, and learn (continuously) to operate effectively in the environment with the help of their perceptual systems (not senses). Information is direct, constant, and requires no prior knowledge, either mediated or communicated. This model disallows the "input" of partial, ambiguous information requiring mental processing (matching against templates) as assumed by the IP model. Therefore the progression is not sensation to perception to knowledge as the cognitive scientists insist, with their speculative mental (cognitive) operations such as decoding, problem solving, and using past experience. Ecological perception, says Gibson, is holistic (not analytic), direct (ambulatory self-awareness of the total environment), and continually developing knowledge from experience by means of the perceptual system. Individuals do not receive signals from the environment but reciprocally participate in its creation [35, 36]. This model provides an alternative to information processing rather than causing an anomaly in the paradigm, a biological alternative to an overly mechanistic model, it should be noted.

In other fields of inquiry working definitions of the IP paradigm are not comprehensive but are nevertheless pervasive in current discourse. Expressed early by Mortimer Adler [37] and others, the progression from data to information to knowledge has become a truism for our time. Indeed, it has become even more powerful in recent years with the rise of the Internet and its user-friendly interface, the World Wide Web. Today a combination of forces, notably, ubiquitous computing, telecommunications-based interactivity, and the working assumptions of the cognitive sciences enable and promote the information-processing model.

Computing
The computer is the acknowledged symbol of the day. It is a modern phenomenon, with the term "information processing" first used, re-
portedly, in its modern sense in a conference at the University of Pennsylvania in 1946 [38, p. 153]. Some histories of computing dwell on hardware [39], while others stress the speed and accuracy of the information manipulation process [40]. With expense falling in relation to power (Grosch's Law), with computing power doubling every eighteen months (Moore's Law), and with the value of the system expanding exponentially with the growth of the network (Metcalf's Law), computing has become ubiquitous and an increasingly transparent base of the infrastructure of contemporary society [41].

**Telecommunications**
The growing interconnectivity of communication media—the telephone, television, and the Internet—promise a new "communications revolution" in this new century [42]. The new, Internet technologies are distinctive for their openness, inclusiveness, asynchrony, and interactivity; this interactivity bridges the gaps both between speech and writing as well as the author-reader divide [43, pp. 1–8]. These phenomena complete a prophesied transformation of communication from a linear, broadcast, content-transferring phenomenon into a convergent process [44, pp. 1–22, 194–215]. Indeed, the growing overlap between information and communication creates an integrated process begging a new description, such as "cominformication," which can be defined as the convergence of signal, information, and understanding through an ongoing process of dialogue, sharing, and communication. Etymology and usage of the words suggest that neither information nor communication can adequately be understood without reference to the other [45, vol. 3, pp. 578–79; vol. 7, pp. 944–46]. Notably, the work of Shannon and Weaver seeking to measure precisely the informational content of a communication provides the starting place for the modern study of both phenomena [27]. Extensive considerations of the complex interrelationships of information and communication attest to the interdependence of the concepts [46]. A convergent and dynamic model, such as the concept of cominformication, warrants study, particularly since the networked technologies of groupware, teleconferencing, chats, and interactive video are transforming the working models of organizations and communities—into virtual organizations and networks [47]—as well as impacting entire generations [48]. Testing and developing the concept of cominformication could simplify various efforts to "construct" such a reality, such as the Robert Krauss and Susan Fussell description of shared communication environments [49].

The requirements of comprehending and performing professionally in this interactive environment will remain a challenge for some time.
Lest anyone think the Web a stabilized entity, consider such futuristic proposals as the "Semantic Web." This envisioned technology will use agents and encourage the development of dynamic, open-ended knowledge representation as well as logic-utilizing programs to work semantically, convey meaning, and advance human knowledge synergistically [50].

**Cognitive Science**

The third component of the information-processing paradigm is the view of human thought and behavior known as the cognitive sciences. Emerging in the 1970s to overthrow the long intellectual dominance of behaviorism, the cognitive sciences place the human mind in the center of the creation of the universe. Human perception, representations of the outside world, and information processing are considered fundamental, not incidental, to experience. The information-processing power of the computer provided much impetus as well as a governing metaphor for this approach, proceeding with the assumption of similarities in the way the human mind and the computer process information. Other working assumptions include a logical-rational bias and confidence that language amounts to communication through symbols [51].

The influence of the information-processing paradigm extends far beyond psychology and the information technology–oriented professions that spawned it. The "fact" of the natural progression from data to information to knowledge is assumed in various educational, managerial, and professional circles including sociology [52], politics [53], management [54], artificial intelligence [55], organizational development [56], economics [57], and even the emergent field of knowledge management [58]. In education the transfer of content remains a powerful central purpose. The accumulation of more information—documented through coursework and degrees—is assumed to produce knowledge. In human intelligence studies the focus remains on the amount of information acquired, put into memory, and available for retrieval [59].

But is the information-processing model the most appropriate theory available? There are many anomalies in the working IP paradigm; when anomalies become too obvious a paradigm becomes vulnerable to a new theory, one that is more powerful and explanatory than the original. Such difficulties exist with the IP paradigm, though only a few can be highlighted here, notably the underlying procedural and logical assumptions, the overworked hyperjump from information to knowledge, the role of language in cognition, and the nature of human-computer interaction.
Anomalies in the Paradigm

To begin, there is an evident—and sometimes noted—inconsistency in the progression of the process from data to information to knowledge. Two and two may make four in most instances, but a selection of incongruent specimens and concepts may not comprise four of anything that is useful as a set. Yet that is precisely the connection assumed in the shift from information to knowledge. First, it is assumed that more information is related to knowledge when it may relate more closely to confusion. Second, the troublesome information-knowledge transformation is assumed to occur in a black box, or problem space, that is occasionally noted but rarely explored definitively. The problem is a large one and can be considered from several perspectives even without comprehensive review.

From one perspective the problem is an error in logic. As R. Fillieule puts it [60], when cognitive psychologists move from one state of knowledge to another, without clear explanation, they confuse two types of rationality, that of inference and that of frame. Rationality of inference proceeds heuristically, by means of trial and error. From such an approach scholars sometimes make a jump from inference, which is subsidiary, to a more basic frame, which is exhaustive (considering all possibilities) wherein scientific discovery occurs. Filtering effects, used in inference, are confused with expansion effects, which are more comprehensive, and may comprise a complete form or frame. Thus, according to the author, do cognitive psychologists abuse their information-processing paradigm to explain far more (such as scientific discovery) than they should. So, for example, because human thought operates by manipulating symbols and ideas, and since the computer also manipulates symbols, the processes of the latter are used as models for human thought [60]. Thus, the author challenges a basic assumption of the cognitive sciences, the appropriateness of comparing mental and computer information processing. An anomaly arises that is difficult to resolve.

Information is not knowledge. There are many ways of developing this point. Examples can be found in which too much information hinders the development of knowledge [61, pp. 17–37], or requires more time for perception—such as reading a text or viewing a presentation—than its value warrants [62]. Gavriel Salomon stresses the distributed, contextual, and social nature of knowledge. Where information is clear, discrete, and can be communicated "as is," knowledge is connected, contextualized, and ambiguous [63]. "Information" is an overworked concept that is often confused with knowledge. Fritz Machlup inadequately distinguished the two in his otherwise masterful treatise
on the modern role of education, research, and communication media through the middle of the twentieth century [64, pp. 13–30, 159–204].

The term “information” is frequently overused, with meanings as basic as a tangible piece of datum or a document or as complex as knowledge structures. In addition to being an entity, or thing, information is used across a spectrum of processes that includes syntactic and algorithmic sign manipulation, cognition, assignment of social contexts, and the communication of meaning. An information system can consist of pragmatics (contexts, beliefs), semantics (meanings), syntax (rules for language and dialogue), and empirics (mechanics and statistics of communication). Søren Brier develops new concepts and techniques to manage all this. He critiques the IP paradigm and proposes cybersemiotics as a replacement theory. He stresses the mechanicistic nature of the IP model with its equation of computer processing and human thought. He illustrates the problem with examples of search results from a domain database (not to mention Web browsers). The search retrieves too many documents, or too few, and selecting the appropriate information requires substantial content analysis. In like manner he finds cognitive psychology and information studies too restricted, inadequate as practiced for dealing with the richness of human knowledge [65]. Brier further argues that the computer has seductively led to the practice of structuring questions as algorithms, with a resulting loss of richness and complexity. The IP paradigm proves inadequate for either the management of semantics or living systems, inspiring Brier’s effort to create a cybersemitic metatheory sufficient to meet those criteria [66]. The applied uses of information by various scholars overwhelm the accepted understandings of the term, contributing additional anomalies.

The working assumptions about language embedded in the cognitive sciences model present a particular difficulty. Jerry Fodor asserts that mental representations (ideas) amount to the manipulation of symbols, which computers can do as well. Thus is human thought reduced to something a machine can emulate [67]. But Peter Carruthers argues that this “communicative” view of language is far too narrow. He asserts that when a speaker speaks, the language constitutes the thought rather than simply encoding or signaling it. Communication (communication) is far more than signal; it is the creative and human understanding part of the equation as well [68]. Thus is the “process” transformed, and accumulating oversimplifications of cognitive science raise questions about the validity of the IP model.

In its tendency to treat all cognitions as comparable, cognitive science is simplistic, long ignoring emotion, for example, since such feelings overcomplicate matters beyond what the model can manage [69,
But an expanded research agenda looks beyond the limitations of sensory perception, memory, attention, motor systems, and language. Today the "new cognitive neurosciences" investigate mental imagery, emotion, stress, consciousness, and conceptual knowledge as brain research expands the breadth and depth of cognitive science [70, pp. 1037–1159]. An emerging and more comprehensive "knowledge processing" and "emotion managing" model will displace information processing and foster better understanding on this matter. A corresponding reconsideration is evident in the disciplines of "knowledge management" as well, where scholars and practitioners explore beyond the limits of information processing to consider a more constructivist perspective and such human dimensions as care [71] and emotion [72].

A related expression of the inadequacies of the information-processing model can be labeled "artifacts and activity." From this perspective the computer is a tool, an artifact—along with other artifacts such as language and organizations—which must be more adequately understood in relation to human work and activity. This school utilizes observation and the description of actual practices to investigate consciousness and behavior. For these scholars the cognitive approach to human-computer interaction is far too limited, since it does not encompass the social, cultural, and organizational contexts in which work goes on, technology is used, and learning occurs [73].

In short, the information-processing paradigm is a problematic foundation—at least outside the disciplines of psychology—on which to construct a compelling model of learning and information literacy. The logical processes of the model are faulty, its "uses" of "information" are overworked, the prevailing attitudes about the roles of logic, and language, and human-computer interaction—as well as the information-to-knowledge transformation—are too simplistic. Knowledge, not information, is the goal of the enterprise, and a new model, rather a new paradigm, is sorely needed.

Is "Learning" the Appropriate Methodology?

What is the goal of information literacy? The definition and standards for the process describe a changed state in the mind—as well as skills in lifelong learning—of the learner who has achieved IL competency [74]. However, since information literacy came from the library profession, generally, and bibliographic instruction in particular, it is grounded in content and the transfer of information. This characteristic is shared by many teaching faculty as well, but that tradition compro-
mises the ability of IL to embrace fully the requirements of contemporary learning theory.

Today learning theory operates well beyond a "representational" mind-set seeking to align minds with outside "reality." Currently, constructivism dominates the field, a view of learning as dynamic and emergent, resulting from interaction, dialogue, and context. Learning is not something that can be managed, predicted, and controlled [75]; it must be nurtured and allowed to emerge and develop naturally. Now scholars push the theory even further, looking at knowledge as enactivists, emerging from context and activity as work and learning proceed, blurring the distinctions between knower and learner; learning is something emergent, self-organizing, and self-renewing [76]. In this context what the learner brings to the scene is critical. Where learning theory long focused on the content and the method, today the emphasis is on context; that is, the background and traits of the specific learner are essential ingredients in the formula of successful learning by the individual [59].

Certainly information literacy today satisfies most of the requirements of contemporary learning theory. Even a quick reading of the ACRL "standards" for information literacy outcomes affirms the centrality of the student to the process; IL is emphatically student centered. The process is "active," requiring extensive involvement and interactivity on the part of the learner. That is clearly the trend and intent of advocates of information literacy. Assumptions of student engagement are plainly evident in the details of the IL standards, allowing room for personal interest, building on competence, and assuming a longitudinal progression of understanding—based on "constructions" in the mind of the student rather than an isolated event. Exercises, collaboration, news groups, resource assessment, and numerous other techniques testify that the IL movement has abandoned the instruction of passive learners who are assumed to be ignorant [77]. There is allowance for group interactivity and peer mentoring, an acknowledgment of the social, situated character of the learning process [78, and see 79]. Information literacy theory has surmounted the assumptions of a print-based perspective; interpreting visual information, using the Internet, and utilizing media for presentations of student research are considered appropriate skills and required competencies [18].

The information literacy model long acknowledged the purpose of improving the learning process. In 1989 Breivik set out the premise in her book with Gordon Gee, and she expanded the idea in her later volume on student learning, which touted various methodologies such as resource-based learning, service learning, inquiry learning, and problem-based learning [8, 9]. Champions of the innovation also
stepped beyond the limitations of academia, stressing the importance of IL for success in the workplace in the future [80] and raising the goal of an information-literate society [81].

The reservations raised here are not about the goal of learning but, rather, about the educational practices still prevailing today; insufficient attention is paid to the social, situated, sociotechnological, and practical dimensions of learning that are now available from several scholarly perspectives.

For too long learning theory focused on the content being communicated and the process whereby it was transferred and verified. Too little acknowledgment is afforded to the context brought to the process by the learner. This factor is sometimes noted, but often inadequately taken into account. The failing is not unique to information literacy but is widespread in academia and the schools generally. The goal of change in learners, in the transformation of their thinking, is recognized [82] but insufficiently measured and tracked.

How much change, and what kind has occurred? Pretesting—as well as continuous assessment and posttesting—must become a fundamental component in the learning process if assessment is to be valid and learning verified. Current practice gives insufficient attention to pretesting [83]. The extensive debate over intelligence could be restructured and managed by testing the change that occurs in the assumptions, beliefs, knowledge, and mental models of the learner [59]. It may well prove easier to test and verify change than to measure intelligence, facilitating the assessment demanded today by the political and cultural establishment.

Successful learning—not information—leads to knowledge, which encompasses cognition (awareness) and understanding (context and experience), and should be accessible, in memory. Knowledge is not certainty but is a set of beliefs about causal relationships between phenomena [84, pp. 4–8]. Ultimately, learning must encompass the practical as well as the intellectual. Thirty years ago Machlup pointed out that there are several types of knowledge in addition to the intellectual, including practical knowledge (encompassing professional, business, workmen's, social, and household expertise), spiritual knowledge, small-talk and pastime, and unwanted knowledge [64]. For all its dominance of the domains of knowledge, the university's emphasis on abstract ideas, great thinkers, and a common intellectual heritage never fully triumphed over American traditions of democracy, pragmatism, and equity [85]. A persistent theme in that tradition is to learn by doing. Not learning simply for its own sake, but learning for personal change, to improve one's "know-what," "know-how," or "know-why," has been the proper purpose in both intellectual and applied schools
of thought ([86] and [37, pp. 110-13]). Academic librarians must acknowledge and take fully into account the validity of learning beyond the intellectual realm.

The social context in which learning occurs requires greater consideration in educational practice. Cognition is generally treated as an individual matter, but this perspective ignores too much of the process. The situated cognition perspective demonstrates the process by which the learner becomes a member of an ongoing community of practice [87] and studies the social roles of language, discourse, and the repair of miscommunication (cominformicparation) in the creation of shared knowledge [88]. Coincidentally, the perspectives of social informatics stress that information and computer technologies are not peripheral to the process but are deeply integrated sociotechnical interaction networks that facilitate situated, active learning [89; and 78]. The link to situated cognition and activity theory is made once again. The focus on learning methods remains central and appropriate.

Is "Information" the Appropriate Literacy?

The term "literacy" refers to "letters." For a long time writing provided the only medium for preserving and transferring information beyond the face-to-face, oral tradition. To know letters meant to be literate, learned. In common usage literacy primarily still means the ability to read and write. This meaning might be described as a level one meaning of literacy. A second level of literacy means a new capacity to communicate using another language, code, or technology. The new tool can be another vernacular tongue or a mathematical code, such as the calculus. Andrea diSessa offers a precise definition of literacy at this level: a socially widespread patterned development of skills and capabilities in context of material support to achieve valued intellectual ends [90, p. 19].

Literacy: Expanding Definitions

Today there is a third level of literacy that is complex and many-faceted. New media appeared in the last half of the twentieth century that challenged the role of print in communication. First, broadcast media, especially television, made communication much more visual (leveraging the role of film in the process). Then, in the last decade of the century the Web-interfaced Internet made communication interactive and more technological. To communicate fully today requires new, computer-related competencies. Reading and writing—even in more than one language—no longer suffice; constructing a Web page, navigating
the Web, and participating in an online chat group are among the required basic skills. Finally, it must be noted that a literacy is a social matter. Mark Warschauer stresses that a literacy is not context neutral but is rather a process valued by a given society. Computer-mediated communication characterizes society today, with its interactivity and many-to-many communication. Hyperlinks transform the author-reader relationship; readers become active in the process [43, pp. 1–16, 155–67]. There are calls as well for the need to understand math and science, the larger culture, historical method, emotional and sexual literacy, and other subjects, but that must be argued elsewhere. The agenda of basic literacy is challenging enough.

Kathleen Tyner provides a compelling overview of the current situation. She points out that current conditions demand something beyond any monolithic literacy. What is required are multiple literacies, which she categorizes as tool literacies (computer, network, and technology literacies) and literacies of representation (information, media, and visual literacies), each with specific characteristics and social purposes. She also broadens the definition of literacy to include “technologies of the intellect” to assure creative access and use of the information, and techniques of communication and dialogue, including metalanguages [91]. Before the vast heritage of the literacies of the past are abandoned, however, some further discussion is required.

The Persistence of Print
Our education systems, and libraries, remain print oriented. The information resources that are cataloged, indexed, and readily available for access and study remain print sources in the main. Accordingly, the descriptions and standards for information literacy carry heavy assumptions weighted toward print. Librarians have been criticized for limiting themselves overmuch to published materials [23].

Concurrently, words are taking on a new life. Teachers of freshman composition argue that words are not static but dynamic, making connections and linking writers with readers across time and space. In this view writing is not about words but about connections and about the social, cultural, and political roles of writers [92]. Words still serve today to communicate and to express and develop the self. But the product of this age of cyberspace appears to be different from the rational, centered self of the modern world. The postmodern self may, indeed, be characterized in terms sharply opposed to the modern persona [93]. Sherry Turkle describes the deconstruction of the autonomous “self” in the cyberspace of the Internet [94]. Clearly, literacies are cultural values, deeply rooted in specific times and contexts, but reading and
writing remain fundamental skills even if they are no longer sufficient unto themselves.

**Visual Literacy**

While it still dominates the preservation of information, print no longer dominates the transfer of information. Sometime in the last half of the twentieth century the mass, broadcast media forged into a major role in that process. For some years it has been obvious that the prevalence and widespread use of the image requires better understanding of how visuals are created and utilized. The preeminence of the image in representation and communication, the vulnerability of the image to manipulation, and the aesthetics of the image are matters requiring knowledge and competence of anyone who would maintain independence of mind and thought in the increasingly visual environment of modern communication. The progression beyond graphic arts and photography to film and television simply adds new dimensions to the requirement [95].

Many advocates claim that visual literacy must be the required new competency. A new cognitive awareness and expanded aesthetic appreciation are the keys to comprehending the visual environment. Considerable attention is being paid to the most effective ways to teach visual literacy in the schools; new critical skills and mental habits are needed to ascertain the construction, values, and purposes of the media product or resource [96, pp. 19–20]. There is greater cognizance of the active role of the mind in "creating" the universe we perceive (visualize) [97]. Visual literacy quickly wanders into the realm of politics and ideology out of concern that commercial ownership of the newly dominant means of communication threatens manipulation of "reality" for corporate benefit [98, 99]. Others caution that the symbols and representations used by various media are not coextensive but are different and draw on different mental capabilities [100, 101].

Why is visual information so powerful? According to Kathryn Henderson it is because the visual is "meta-indexical," meaning a holding ground where codified knowledge (language or mathematical, for instance) and uncodified knowledge (such as tacit, visual, kinesthetic, and experiential knowledge) can meet. This link between the visual, the codified, and the tacit is why many groups rely on sketches when they are brainstorming and communicating ideas. Computer graphics tools, such as computer assisted design, are unmatched in manipulating codified knowledge, but before the knowledge is codified it is tacit, and hand-drawn sketches are the preferred tools by many for visual communication [102].
The relationship of print and the visual is complex, but one proposal for combining them warrants mention. Robert Horn proposes "visual language" as a single device for communication, combining words, images, and shapes into an amalgam that reinforces the power of one medium with the capabilities of another [108]. One key to visual learning is separating thought from looking. The way to do this process is to cultivate visual manipulation skills among students—and all learners. When one has personally manipulated and edited ("morphed") an image, it is easier to detect uses of the technique with an image one is viewing (for example, computer programs like Photoshop facilitate inserting an image that "could not be there," such as John Wayne's image). A basic skill level is required beyond critical thinking skills per se [104]. Images have impact, and yet most students do not understand how visual communication really functions. Visual intelligence integrates verbal and visual reasoning; its enhancement is vital in a society where virtual "reality" is competing with the "real" for attention [105]. For example, can society be confident that a generation that watches such movies as Jurassic Park and Dinosaurs at an impressionable age can be logically persuaded that such creatures do not exist somewhere today?

Technological Literacy
In its early days information literacy had to labor to distinguish itself from computer literacy, which focused on such skills such as knowing how to operate a computer, keyboarding, or using a word-processing program to perform work. Now IL has shifted too far and often pays too little heed to technological factors. Certainly icons and Windows-based programs make computers much more user-friendly and have reduced the need for basic instruction, but many computer users flounder upon encountering any of the glitches and problems that pervade the process. Renewed attention to the technological component is needed, specifically the complex set of socially and culturally situated values, practices, and skills required to read, write, and communicate effectively in the context of today's electronic environment [106]. These factors complicate the teaching-learning enterprise dramatically [107], a consideration that receives insufficient attention in current IL practice.

Advanced Literacies
Networked computers and the Web provide myriad complexities; computer-mediated communication is interactive, linking the many to the many. This interactivity breaches the divide between author and
reader; the reader becomes a participant in the process. The system also gives any author a potential global audience. At present, most of this interpersonal communication is textual, but that is changing. Web pages and user-friendly graphics programs simplify the inclusion of information in visual, audible, and other formats [43 and 98].

Interactive literacy can be considered on many levels. French philosopher and critic Gilles Deleuze envisions a fundamental interactivity in nature and society, a comprehensive design, called rhizome, which expresses the emerging realities of multiplicity, complexity, and connectivity among all the points of the entity [108]. Librarians perceive that influence already emerging in literature for young people, foreshadowing new multiauthored and participatory genres and new electronic spaces that foster communitarian sense making [109]. The reading component of the “three R’s” is changing noticeably.

Two more proposals for the requirements of advanced literacy warrant mention. Andrea diSessa proposes computational literacy for the realms of mathematics and scientific inquiry. In this endeavor he develops three “pillars” for a literacy, which he also describes as a “material intelligence.” The three components are the material (signs and representations), the mental/cognitive (what happens in the mind in presence of symbols), and the social, when the community decides on the importance and value of a set of skills, such as freshman calculus for science majors [90, pp. 1–28]. For diSessa, computers and communication portend vastly expanded levels of learning power.

“Knowledge media” literacy offers another model for consideration, engaging the convergence of computing, telecommunications, and cognitive sciences. This convergence provides for a much richer and more rapid interaction between the members of a learning community, and this reportedly amounts to a fundamental change in the relationship of people and knowledge. In this venue knowledge becomes more transient, dynamic, and open-ended; knowledge becomes more public than private, and broader at the expense of depth; and knowledge displaces linear reasoning and the linear model of history [110].

What, then, can be concluded regarding the appropriate literacy? Clearly, no single skill will suffice. What remains are poor choices. One approach is simply to extend the meaning of the term “literacy” far beyond its popular, accepted definition to embrace multiple media [111, pp. 208–14]. A second choice is to adopt Tyner’s “multiple literacies” model. A third option is to move beyond consideration of “literacies” to develop new models better able to capture the complexity of the mental and technical skills required for functional competency in today’s world.
Literacy, Competency, Fluency, or Expertise?

Literacies are tools. To this point in the discussion the tools are being used primarily for academic purposes. The burden of information literacy, however, is not to bring scholars up to speed, but to assure that the graduates produced by the academic enterprise are fit to function in the Information Age workplace. This need requires that learners become lifelong learners to assure continuing currency and competencies amid rapid change [106, pp. 3–24]. Not everyone will be a knowledge worker, but nearly everyone will have to engage in increasing levels of knowledge work, which can be described as using information to make judgments regarding work processes and activities.

Literacy in the workplace is not a simple matter. It encompasses skills, practices, and reflection regarding the work process. Workplace literacy is both personal and social; it requires problem solving amid changing contexts [112, pp. 1–12]. Workplace literacy is not school-based reading and writing but, rather, technological, functional, and social engagement grounded in specific, work contexts [113, pp. 3–25]. Competence involves experience in practice. Many of the skills IL emphasizes will have a short "shelf life" and will not prove long lasting in practice [114]. In short, in the workplace it is competency that is required, not just literacy.

Several distinctive but apparently compatible and overlapping proposals suggest rich possibilities for the future. For purposes of simplicity these will be labeled information technology (IT) competence, fluency, and expertise.

*Information Technology Competence*

Information technology competence is composed of skills, personality traits, and knowledge, both tacit and explicit. A study of business managers indicates that competence must not be confused with performance, which is affected by motivation and environment. But there is a skills component, determined by the "fit" between the individual and the task. The knowledge factors include both explicit knowledge (of applications, systems, and management) and tacit knowledge (experience and cognition) [115]. Another study reports links between an organization's investment in education and learning—along with less hierarchy and leadership-enhanced change competence—and its profitability and effectiveness [116]. Even chief executive officers must become competent with IT if they are to be effective in today's dizzying marketplace [117].

One available model for the competencies required today proposes the use of design as pedagogy for multiple literacies. The expectations
of the new work life include competitiveness, constant learning, collaboration, and comfort with diversity. Available designs include languages and other semiotic systems such as photography and film. The design and the redesign processes, or presentation and recontextualization efforts, require a metalanguage to support the transfer of meaning between media and genres. That is why, in this view, the rise of iconographic interfaces is significant; the icons serve to make access and critical engagement available to many more people. Any mind is embodied, situated in a social setting, and contextualized in knowledge domains and practices. A metalanguage enables conversation among a wider range of people about language, images, text, and meaning-making interactions; icons and visual language serve that need [118].

Information Technology Fluency
One important U. S. policy initiative enjoying the support of several federal agencies is the information technology fluency proposal produced by the National Research Council. Produced with input from computer scientists and engineers, employers, educators, and librarians, this proposal uses fluency to describe a higher level of competency. FIT (fluent in information technology) individuals can express themselves creatively, synthesize information, and reformulate knowledge effectively. This competence requires a certain level of skills, basic concepts, and intellectual capabilities to allow the successful application of IT to complex situations [119, 120]. This initiative tweaks IT competency and allows for a degree of concentration that makes IT fluency a serious contender for a redesigned information literacy-competency standard. The profession should give strong consideration to partnering with this initiative to better achieve the goals compatible to both.

Expertise
In the workplace the premium goes to expertise. How is expertise defined? From a cognitive perspective expertise requires more and better knowledge, better-organized knowledge, problem-solving capabilities, and superior analytic, creative, and practical abilities [121]. Beyond the cognitive dimensions there remain the matters of tacit knowledge, social understanding within the field of expertise, expert agents and expert systems, and the dynamic problem of situated or contextual knowledge [122]. Stretching information literacy to cover the complexities of expertise will not prove successful. At some point it is functional competency, not literacy, that serves as the standard to be realized. Such competency—or fluency—can only be achieved, however, on the job, relieving academics of responsibility in this regard, yet demanding considerable collaborative work to manage the transition from aca-
demic literacies to workplace competencies. Partners for this work must be recruited from schools, the workplace, and other entities beyond the library and the campus to plan and implement the required policies and practices to assure appropriate literacies and competencies.

Conclusion

What conclusions can be drawn from this discussion? One implicit message is that information literacy reaches too far. As developed to date, IL sets too broad a target and must clarify realistic objectives. When service learning, inquiry learning, and problem-based learning are added to active learning and collaboration, the finished product has no focus or character. How can IL be distinguished from a comprehensive learning process? As practiced today, information literacy can require competency with tools, resources, the research process, emerging technologies, critical thinking, and an understanding of the publishing industry and social structures that produce information products. The stated goals imply turning every information seeker into a librarian and a pedagogical practitioner on top of his or her disciplinary, professional, or avocational knowledge. Librarians, by the way, are not alone in their concerns. The information sciences profession has expressed serious interest in developing IL as a full-blown discipline in its own right [123]. Altogether, information literacy reaches too far, attempting more than can be realistically developed within existing realities, at least without a major coalition of professionals and public entities dedicated to that purpose.

On the other hand, information literacy as practiced is too limited, too grounded in text, and overly concerned with conveying basic skills to fully encompass the visual, the interactive, and the cultural domains required by the current situation. A new model should adhere to the following guidelines: (1) librarians and their partners must focus their energies and attention on those aspects of learning inadequately addressed in current practice, namely, putting greater emphasis on the visual and technological components, as well as the social determinants of learning effectiveness, and (2) librarians must ratchet up their standards and expectations from literacy to sociotechnical fluency.

In addition to the ongoing tasks of "reconceptualizing IL" [20, 123] and stressing the social and psychological dimensions of the work [21], a word is in order about organizational requirements. Meeting the challenges outlined here demands that libraries go beyond "business as usual." For example, models stressing the integration of academic li-
library functions into the heart of the learning enterprise are needed. Interestingly, two recent articles suggest new possibilities, that of the "learning library" [124] and the library as a "discovery system" [125]. Many professionals are working in similar directions even if they are running on different tracks.

The convenience and growing acceptance of "information literacy" will render most librarians loath to abandon the concept. Information literacy will be with us for many years to come. But it is learning rather than information, and sociotechnical fluency rather than literacy, that comprise the agenda for tomorrow. This challenge requires a broader vision in addition to greater awareness of the limitations of the existing model.

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