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TECHNOLOGY AND LITERACIES: FROM PRINT LITERACY TO DIALOGIC LITERACY

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A web search on the phrase "technology and literacy" will locate thousands of documents, almost all of which deal with "technological literacy" or ways of integrating technology into literacy instruction. Except for vague and optimistic pronouncements, there is very little about what technology can contribute to literacy development and almost nothing about how technology should figure in an education system's literacy policy. The confusion between "technological literacy" and "technology for literacy" is especially unfortunate. The two are worlds apart and there is no reason to assume that people who speak learnedly about the first have knowledge relevant to the second. Educational policies need to be concerned with both, but the semantic overlap between the two is far from providing a reason to stretch one policy to cover them. What tends to get neglected in the confusion is "technology for literacy." This chapter endeavours to remedy that neglect.

First, however, we note a point made by many of the writers on technology and literacy: New technology has brought with it an expanded conception of literacy. The kinds of documents available on the web and circulated as e-mail attachments may include, in addition to written language, logos and typographical ornamentation, pictures, graphs, hypertext links, animations, video segments, sound bites, and Java applets. Each of these components has its technology, with which students must become proficient if they are to produce such documents themselves. Although this is a new expectation for schools to meet, its principal challenges are those of finances, scheduling, and professional development. Indeed, the common report is that if the technology is available and teachers are confident in letting students use it, the learning of new media skills takes care of itself.

Where research is relevant is in (1) harnessing technology to the solution of long-standing problems of literacy and (2) addressing the higher-level skills called for in a knowledge-based economy. On both of these counts, most of the technology currently in use in schools is disappointing. Although it makes limited contributions, it does not take advantage of available scientific knowledge,

International Handbook of Educational Policy, 749–761
Nina Bascia, Alister Cumming, Amanda Datnow, Kenneth Leithwood and David Livingstone (Eds.)

let alone push the envelope. This is unlikely to change unless educational decision-makers become more sophisticated in their demands.

The main contribution to policy-making that we hope to make in this article is to raise the expectations of decision makers in terms of what they could be demanding from technology providers. In the early days of information technology use in schools the emphasis was on comfort level, ease of integration into existing activities, and the "Wow!" factor. Vendors accommodated brilliantly to these demands, and continue to do so. But as teachers become more familiar with technology, they are more prepared to deal with software of some complexity, to experiment with new educational possibilities enabled by technology – and they are less easily "wowed." In short, they are ready for something more. Accordingly, we focus in the following sections on what "something more" could consist of as regards literacy development.

There are many paths that could be followed in exploring the potential of technology for literacy development. The path we follow here will seem familiar at the outset but will then shift to unfamiliar and uncharted territory. The path starts with reading and writing as commonly taught and practiced and moves from there toward what we will call "dialogic literacy." This is an ancient literacy, of which the Socratic dialogues have traditionally served as the model. Modern information technology not only provides a means by which such dialogues can overcome restrictions of time and space, it affords means by which dialogue can become more dynamic, democratic, and creative. Dialogue can be seen to underlie all the knowledge-creating disciplines and professions. Thus dialogic literacy, we shall argue, is the fundamental literacy for a "knowledge society," and educational policy needs to be shaped so as to make it a prime objective.

Technology and Print Literacy

Indicative of the changes wrought by technology in the landscape of literacy is the fact that we no longer have an entirely suitable term for literacy as traditionally conceived. We adopt the term "print literacy" here, while assuming that the term also embraces the diminishing species of handwritten documents and also documents that may be produced by dictation or use of speech-to-text technology. Although the means for encoding and decoding written text may change, there is little basis for the belief that print literacy, as broadly conceived, is becoming obsolete. If anything, the increasing complexity of knowledge in almost all fields is placing increasing demands on people's ability to compose and comprehend written text (OECD-OCDE, 2000).

Research makes it clear that reading and writing comprise a number of separable skills (Stanovich & Cunningham, 1991). Technology has demonstrated just how separable these skills are. There are separate pieces of software that can translate text into speech and speech into text, check and correct spelling, spot grammatical errors, evaluate style, and even produce summaries of documents. On the other hand, technology is not yet up to the level of integrated competence that enables a person to read a handwritten note on a refrigerator

door and alter meal plans accordingly. Not surprisingly, therefore, learning technology has tended to focus on subskills rather than on a wholistic approach to print literacy. One of the more legitimate complaints against subskill approaches to literacy is that many of the identified subskills are tangential ones unrelated to the actual cognitive needs of learners. Traditional workbooks are full of exercises in sequencing and classification, word-picture matching, sound-picture matching, and questions about paragraph content that are not based on any theory or evidence but are closely aligned with the kinds of items that appear on reading achievement tests. Unfortunately, much learning technology simply transfers these dubious exercises to an electronic medium, with some enhancement of their entertainment value but no significant change in pedagogy.

Phonemic Awareness Training

Phonemic awareness is awareness of identifiable parts (for instance, a set of 40 or so speech sounds) that in various combinations make up the spoken words of a language. Its importance in learning to read an alphabetical language is now well established (Adams, 1990; Treiman, 2000). Available computer software can handle parts of the training that call on the learner to recognize speech sounds – for instance, by making same-different judgments or counting syllables – but the technology of speech recognition is not yet up to the level of accuracy required for software to handle the complementary part of the training that calls on the learner to produce the sounds – for instance, by producing a word that rhymes with a presented word or replacing one vowel sound with another in a spoken word. Because phonemic awareness is a personal acquisition, much influenced by prior language experience, software that could individualize training would do much to enhance early literacy teaching.

Decoding Instruction

Phonics instruction has two components, called "analytic" and "synthetic." The analytic component, commonly carried out through workbook exercises and word analysis, may be thought of as an extension of phonemic awareness training, extending it to the relations between word sounds and spellings. The synthetic component involves what is popularly called "sounding-out" as a means of decoding unfamiliar written words. In recent decades, beginning reading instruction in English-speaking countries – in both "traditional" and "whole language" classrooms – has been largely confined to the analytic component, whereas research strongly supports an emphasis on the synthetic (National Reading Panel, 2000). Computer-based instruction and exercises can easily handle the analytic component, and that is what most of the available software does. The synthetic component, however, requires speech recognition at a level beyond existing technology. Thus an unfortunate result of the introduction of computers into primary grade classrooms has been to encourage an increased

emphasis on the analytic component, which already tends to be over-emphasized, and to encourage further neglect of the synthetic.

Assisted Oral Reading

The decoding of print, whether by "sounding out" or by visual recall, can impede reading comprehension if it is slow and laborious, as it tends to be in the early years and as it tends to remain with poor readers. A tested means of building up fluency is oral reading, with a teacher or aide helping out in the recognition of difficult words, so as to allow fluent reading to proceed. In practice, this has meant either round-robin oral reading or individual tutoring. Recently developed applications, however – specifically, Soliloquy's Reading Assistant (http://www.reading-assistant.com/) and Project LISTEN's Reading Tutor (Mostow, Aist, Burkhead, et al. (2003) – have proven capable of performing the helper role in oral reading, a boon to teachers who do not have aides capable of doing that work. This helper role requires speech recognition, but computer recognition of words-in-context is much more successful than recognition of isolated words or word sounds, which makes computer-assisted oral reading feasible even when computer-assisted synthetic phonics is not.

Comprehension Strategy Instruction

Much of what is called "teaching comprehension" consists merely of the teacher asking comprehension questions. This activity is easily carried out by computer, and there is an almost unlimited supply of software for this purpose; but its value, except as rehearsal for test-taking, is questionable. Reading research has demonstrated more potential gain from teaching students to be strategic in their approach to reading. Comprehension strategies are mental actions carried out during the course of reading for the purpose of solving comprehension problems, making connections, or otherwise getting more out of the reading than is gained by a more passive approach. There is ample evidence that such strategies distinguish good from poor readers, that younger readers make relatively little use of them, that they are teachable, and that teaching them yields gains in comprehension (National Reading Panel, 2000). However, it is also the case that few teachers teach them and that enabling students to incorporate comprehension strategies into their normal practice requires much more intensive teaching than is usually devoted to it. It is much easier to teach procedures that are carried out after reading or during interruptions of it than to teach processes that must go on covertly during reading. Again, the role of technology seems to be to increase the emphasis on what is easiest to implement. What makes the teaching of comprehension strategies inherently difficult is that it must intervene in an ongoing and typically over-learned process. It is within the realm of possibility that a computer could provide strategy coaching on an ask-for-help basis. This has proved successful in other contexts (e.g., Davis & Linn, 2000). The student who experiences a comprehension difficulty could hit a key and the

computer, instead of supplying an explanation of the difficult text passage, could suggest an appropriate strategy for dealing with the difficulty. Much more challenging, but foreseeable as a possibility in artificial intelligence, is for the computer to detect comprehension difficulties by analyzing the oral reading speech stream, eye fixations, and other clues, and prompt strategy use even when the student is unaware of a difficulty. In summary, computer-assisted teaching of comprehension strategies lies in the future; it would be a mistake to assume that existing software claimed to "teach comprehension" actually does so.

Summarization

Straddling reading and writing is the production of summaries. Summarization during reading is a strategy used by good readers (Pressley & Afflerbach, 1995); summarization after reading is a well-recognized study skill. The accuracy of a summary is an indicator of level of comprehension. And the ability to produce a cogent summary is a useful composition skill. For both practical and ideological reasons, however, summarization has not played a large role in literacy teaching. New technology may change that. Latent Semantic Analysis is a technology that can both evaluate how closely a summary maps on to the content of a text and detect important missed or distorted points. Summary Street, an instructional tool based on this technology, enables students to test their own comprehension and to revise their summaries in pursuit of a higher score (Kintsch, Steinhart, Stahl, & LSA Research Group, 2000).

Vocabulary Instruction

Limited vocabulary is a serious handicap in both reading and writing. Various direct and indirect approaches to vocabulary development have been tested, with generally positive results. The consensus seems to be that vocabulary needs to be approached in a variety of ways – that students need to encounter and use a word often and in varied contexts in order for it to become part of their active vocabulary. An analysis of vocabulary development software by Wood (2001) indicates that there is considerable variety in the kinds of experience different software applications provide, suggesting that an assortment of such resources could contribute to overall growth of vocabulary.

Teaching Writing Mechanics and Conventions

Users of the leading word processor will already be familiar with the strengths and limitations of computer intervention in writing mechanics and style. From an educational standpoint an important issue is whether this kind of software supports the learning of spelling, grammar, and style conventions or whether it merely compensates for the lack of such learning. There appears to be marvellously little concern about this issue, compared to concerns about the parallel issue of pocket calculators and arithmetic. Instead, curriculum standards often

treat word processor use (along with spell checkers and the like) as a composition skill in its own right. Reviewing research at the post-secondary level, Goldfine (2001) found that the effects of word processor use were largely negative, resulting in the development of more careless and mindless writing habits. Rather than advocating the avoidance of word processors, however, Goldfine suggested, for instance, turning off the spelling and grammar checkers until after students have done their own proofreading, then turning them on so that students could compare the errors they detected to the errors detected by the machine.

Teaching and Supporting Composing Strategies

Essentially the same story can be told here as with reading comprehension strategies. There are identifiable strategies that distinguish expert from less expert writers; these strategies are teachable; teaching them improves writing. But teaching them is difficult because, again, it means intervening in an ongoing process. However, if the student is composing on a computer the possibilities for context-sensitive intervention in the form of cues or suggestions are much greater than with reading. We are not aware of any software in which coaching is based on analysis of the actual text being produced by the student, but several applications interact with the student on the basis of the student's indicated goals and plans. Two that have produced positive results are the Writing Partner (Zellermayer, Salomon, Globerson, & Givon, 1991) and MAESTRO (Rowley & Meyer, 2003).

In summary, technology has so far made limited contributions to the teaching of print literacy, but these contributions are offset by a tendency to emphasize the aspects of literacy instruction that are easiest to implement on a computer. In this way, instructional software provides unbalanced instruction and reinforces a bias toward low-level cognitive processes (even when it is touted as teaching thinking skills). None of this is likely to change unless educational decision-makers become more sophisticated in their demands. The past quarter-century has seen an amazing growth in understanding of print literacy, and this understanding is readily available to software developers; but until there is pressure from customers, they have no incentive to upgrade.

Contexts for Development of Print Literacy

A criticism that may be brought against all the approaches discussed in the preceding section is that the skills they teach are decontextualized. Computers have played an ambiguous role with regard to contexts for literate activity. On one hand, desktop publishing, web publishing, and e-mail have made it possible for students to write for real and extended audiences. According to numerous reports, this is a great motivator and encourages students to take greater care with their writing. (The most serious attention to style and mechanics we have

seen occurred when third-graders were producing work that would be read by students in a higher grade.) On the other hand, instructional software, as discussed in the preceding section, has contributed to decontextualization rather than creation of a meaningful context.

The principal response to the problem of contextualization has been *project-based learning*. (Much of the activity is reflected in web sites that provide project descriptions and resources and ways to connecting with other projects. As of July, 2003, a web search on "project-based learning" locates more than 50,000 documents, and restricting the search to any particular country's domain name will reveal that project-based learning has truly taken hold world-wide). As promoted in countless workshops and professional development courses, project-based learning involves students working in small groups to gather information on a topic or issue of interest and use it to produce a report, usually a multimedia document or slide presentation. Projects can be carried out using standard Web browsers, word processors, and presentation tools, but software specifically designed to facilitate school projects is also available.

There are wide variations in what project-based learning actually amounts to. At one extreme, it is merely a dressed-up version of the traditional school "project" or research report. It is still essentially a cut-and-paste operation, except that the cutting and pasting are now done with software tools. Both the meaningfulness of the context and its relevance to literacy development are questionable. More highly developed and researched approaches to project-based learning, however, put the main emphasis on content rather than presentation (e.g., Bell, Davis, & Linn, 1995; Marx, Blumenfeld, Krajcik, & Soloway, 1997). Generally, considerable pains are taken to ensure that the projects are engaging ones that are relevant to important ideas or issues in a field of study. Accordingly, they are normally considered as approaches to science education or education in some other content field rather than as literacy education. In contrast, the traditional "projects" or "research reports" are often treated as a part of language arts education, with recipes for producing them appearing in language arts textbooks.

From a literacy perspective, the issue in considering project-based learning is what kind of environmental press it creates for literacy. To what extent do project activities create a need for more careful reading, deeper comprehension, clearer exposition, more convincing argumentation and the like? Evidence is lacking to answer this question, but it does seem fair to say that project activities are not usually designed with such objectives in mind.

Dialogic Literacy

In recent years a number of different strands of thought and research have produced a heightened recognition of the role that discourse plays in the advance-

ment of scientific knowledge and understanding (Gross, 1990; Simons, 1990). This is a development that deserves equal attention in other subject fields, although its contrast to earlier views is not so easily apparent. Ever since the curriculum reforms of the 1950s, the received wisdom has been that hands-on experimentation is the heart of science. The new view does not deny the importance of experimentation, but it holds that knowledge advances by bringing experimental findings into a sustained discourse the purpose of which is to advance the state of knowledge and understanding. The same can be said about empirical research in history or any other field. This so-called "rhetorical turn" in the philosophy of knowledge clearly places a heightened emphasis on literacy. Moreover, it places emphasis on a level of literacy considerably higher than the levels that normally figure in curriculum guidelines, standards, and tests.

Functional literacy may be defined as the ability to comprehend and use communication media to serve the purposes of everyday life. We will define "dialogic literacy" as *the ability to engage productively in discourse whose purpose is to generate new knowledge and understanding*. This definition is not tied to any particular representational medium, so long as the medium is one through which people can interact in a knowledge-building way. In chemistry, for instance, dialogic literacy may require the ability to comprehend and express ideas using the conventions of chemical diagrams (Schank & Kozma, 2002).

The term "dialogic literacy" is not original with us but appears in some of the literature on college writing instruction (e.g., Coogan, 1999; Cooper, 1994). There, however, dialogic is contrasted to monologic literacy, mainly in political terms: Dialogue is seen as democratic, whereas monologue is seen as authoritarian. From this standpoint, dialogic literacy is treated as a practice to be instituted rather than as a competence to be acquired. The closest we have seen to treating dialogic literacy as an attainment is in some discussions of problems in sustaining high-quality discourse in e-mail or threaded discussions (e.g., Shamoon, 2001). In the present discussion we explicitly treat "dialogic literacy" as an attainable competence. To speak of dialogic literacy in this sense is to imply that people may possess it in varying degrees and that it is continuously improvable.

Dialogic literacy, like other literacies, involves many skills and attributes and is context-dependent. That is, the ability to contribute through conversation to knowledge creation in one context does not ensure that the same will suffice in another context. The defining skills of dialogic literacy are those without which one's ability to contribute to knowledge advancement will be limited in any conversational context. What might those indispensable skills be? Lists of dialogue skills that address this "necessary but not sufficient" criterion have a certain obviousness about them. They are the kinds of things anyone would think of when asked, "What do you need in order to be a good participant in a dialogue?" For instance: Dialogue is a conversational practice. Like sports, exercising, or other practices, you build skills as you work at it. Some important dialogue skills to practice are:

- Allowing others to finish their thoughts;
- Respecting others' thoughts, feelings, views, and realities, even when they differ from your own; or

- Listening deeply without needing to fix, counter, argue, or resist (Conway, 2001).

Research on conversation or dialogue skills is not very helpful in extending the skills list beyond the obvious. Most of this research deals with young children, second-language learners, pathological cases, or artificial intelligence programs. In all these cases mastering the obvious skills represents a sufficient challenge.

The Dialogue Project at MIT, founded by physicist David Bohm and carried forward through the influential work of Peter Senge (1990), has helped pin down the concept of dialogue by contrasting it with discussion: Discussion is aimed at settling differences, whereas dialogue is aimed at advancing beyond the participants' initial states of knowledge and belief. Dialogue is purposeful, but it does not have a fixed goal. The goal *evolves* or *emerges* as the dialogue proceeds. Ability to sustain this open-ended yet goal-directed character would seem to be a hallmark of dialogic literacy.

Technological Supports for Knowledge Building Dialogue

Related to the distinction between discussion and dialogue is a distinction we have proposed in the treatment of ideas between "belief mode" and "design mode" (Bereiter & Scardamalia, 2003). In belief mode, the concern is with truth, evidence, and coherence. Rational argument is the preferred form of discourse in belief mode. In design mode, the concern is with the usefulness and improvability of ideas. Collaborative, problem-solving dialogue is the preferred form of discourse. Design mode is clearly the most relevant to Knowledge Age occupations. It is central to the work of research groups, design teams, and innovators in knowledge-based organizations. Schooling, however, has traditionally been carried out almost exclusively in belief mode and accordingly has put the emphasis on argumentative as opposed to problem-solving or knowledge building discourse. This emphasis persists, even in areas like science education where one might suppose that problem-solving dialogue would prevail (e.g., Kuhn, 1993). Correspondingly, technology to support or teach dialogue skills has, with one notable exception, focused on argumentation.

It should be noted, however, that most of the software used in education is not conducive to either type of dialogue. We have in mind the ubiquitous chat rooms, bulletin boards, listserves, and discussion forums that accompany course management systems and other learning ware. All of these favor brief question-answer or opinion-reaction exchanges. Extended discussion that goes deeply into an issue or problem is a rarity (Guzdial, 1997; Hewitt & Teplovs, 1999). Although a dedicated instructor can sometimes guide discussion to deeper levels, the technology itself wars against this by the hierarchical structure of message threads, the inability to link across threads, the typically chronological ordering of contributions, and above all the lack of any means of introducing a higher-

order organization of content – the synthesis or subsuming idea that is the emergent result of the most successful dialogues. Technology that overcomes these limitations is technically possible and is in fact available (Scardamalia, 2002; Scardamalia, 2003).

Whereas the communication software in common use represents technical variations on e-mail, technology designed to foster dialogue generally has some theoretical basis. For instance, several applications to support argumentation are based on Toulmin's (1958) model of argument. The elements of logical argument identified by Toulmin are used to structure and label dialogue contributions and are the basis of hints to the users (Cho & Jonassen, 2002). The principal software to support knowledge building discourse, Knowledge Forum®, is based on theoretical ideas of knowledge processes, such as the distinction between knowledge-telling and knowledge-transforming strategies in writing (Scardamalia & Bereiter, 1987), and a conception of expertise as progressive problem-solving (Bereiter & Scardamalia, 1993).

Knowledge Forum is characterized, not as a writing or discourse tool, but as a *collaborative knowledge building environment*. This implies that the knowledge work of the group is centrally carried out in Knowledge Forum. Other knowledge-related activities such as experimentation and model-building produce results that are brought into the environment, where they become additional objects of inquiry and discussion. Rather than being based on a message-passing model, like conventional online environments, Knowledge Forum is based on a knowledge evolution model. Instead of producing a string of messages, participants produce an evolving mutlimedia hypertext that objectifies the knowledge that is being built. Mentors, visiting experts, or classes in different schools are brought into the process, not through message exchanges, but through entering the environment and joining in the work going on there (Scardamalia, 2003).

Dialogue presupposes a shared goal that is valued by the participants. The mere airing of opinions (no matter how passionately held) or, alternatively, the holding of mock debates and the solving of artificial problems do not provide contexts conducive to the development of dialogic literacy – regardless of the technological supports that may be provided. Accordingly, it seems essential that fostering dialogic literacy be part of a more general movement toward engaging students with big ideas and deep principles. This implies that the main work of developing dialogic literacy should go on in subject-matter courses rather than in language arts or media courses. Most of the innovative work on dialogue is, in fact, being carried out in science education, history education, and other knowledge-rich fields, rather than being treated as an objective in itself.

Regardless of context, a further issue is the structuring of dialogue. Harking back to the distinction between dialogue and discussion, a fair generalization about classroom activity structures is that they support discussion rather than dialogue. When there is dialogue – a deliberate attempt to advance the state of knowledge – the teacher typically plays the leading role, as is specifically the case with Socratic dialogue (Collins & Stevens, 1982). The result, however, is that dialogue skills are mainly exercised by the teacher, leaving the students in

a reactive role. A vital role for technology is to change that structure, so that students are taking the initiative for moving dialogue ahead toward its emergent goal. This requires that the technology be more than a discussion environment, that it have the properties of a knowledge-building environment (Scardamalia, 2003).

Policy Implications: Making Dialogic Literacy a Priority

The need to prepare students for work in knowledge-based organizations is widely recognized. Curriculum guidelines and standards already include, under headings such as "21st Century Skills," objectives thought to be in line with emerging post-industrial needs. As regards literacies, these objectives frequently take a technical, media-centered approach: Students are expected to become proficient in the use of word processors, computer-based image-processing and presentational software, to learn how to perform web searches, handle e-mail, participate in web forums, and so on. Although there is no denying that these are useful skills, it is important to recognize that they are the digital-age equivalents of learning to hold a pencil, use a card catalog, and format a business letter. In other words, they are low-level skills that are nowhere near sufficient to prepare students for "knowledge work."

Higher-order Knowledge Age skills are also recognized. These generally have to do with collaboration, initiative, communication, and creativity. The almost universally endorsed way of folding these, along with the technical skills, into a learning package is by means of collaborative "projects" (Moursund, 1999). It is here, however, that "knowledge work" tends to degenerate into traditional "school work." Projects are typically run off according to a formula that, except for a greater emphasis on collaboration and electronic media, has undergone no significant change in the past century: Choose a topic, narrow the topic, collect material, organize it, produce a draft, edit the draft. The criticisms that have been levelled for generations against this ritualized practice apply to many school projects: It is basically an exercise, the product has no authentic purpose, and it is not preparation for anything other than more school work of the same kind.

Conclusion

In this chapter we have argued for "dialogic literacy" as an over-arching objective. In every kind of knowledge-based, progressive organization, new knowledge and new directions are forged through dialogue. Post-industrial management style calls for broadening the base of those who participate in the dialogue. The dialogue in Knowledge Age organizations is not principally concerned with narrative, exposition, argument, and persuasion (the stand-bys of traditional rhetoric) but with solving problems and developing new ideas. So, to be effective participants, people have to be able to marshal their communication skills in the joint pursuit of problem solutions and conceptual advances.

Bringing Knowledge Age dialogue into the classroom will require a change much more profound than the adoption of new activity structures or a shift from an instructivist to a constructivist philosophy (Bereiter, 2002). It will require repurposing education so that innovation and the pushing forward of knowledge frontiers are authentic purposes. Only through such a systemic transformation can we reasonably expect that education will provide an environment for the cultivation of new Knowledge Age literacies.

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