

# Roles for New Technologies in Language Arts: Inquiry, Communication, Construction, and Expression

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## **Abstract**

New information and communications technologies such as computers and electronic networks are now being used in all facets of teaching the English language arts. These applications include word processors, tutoring programs, data bases, and new communications media. The wide-ranging uses of digital tools and media promise to transform language teaching. At the same time, there are concerns about the needs for teacher education, the time involved in learning new technologies, the monetary costs, the effects on students' learning, plagiarism, privacy, and a host of other issues. They all point to a general question: "What role should these technologies play in teaching and learning?" This chapter argues that a productive answer can develop out of Dewey's characterization of the interests of the learner. It discusses examples of applications grouped into four uses: (1) inquiry, (2) communication, (3) construction, and (4) expression.

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A decade ago, about the time work began on the precursor of this chapter (Bruce, 1991), televisions around the world displayed scenes of confrontation between students and soldiers in Tiananmen Square. Hundreds of people, perhaps thousands, died in the streets of Beijing that June. No one can forget the words of Ling Chai, then a student at Beijing Normal University, "We, the children, are ready to die. We, the children, are ready to use our lives to pursue the truth. We, the children, are willing to sacrifice ourselves." (Buruma, 1999). These words initiated the hunger strike that eventually led to the forcible entry of the army into Beijing and ultimately Tiananmen Square itself.

The events of that time were later seen to be much more complex than they first appeared. The students had conflicting strategies and goals, and many were more aligned with the central government than with the ordinary citizens who suffered most when the tanks rolled in (Long Bow Group, 1995; Schell, 1994). Nevertheless, the word "Tiananmen" has come to symbolize the struggle for freedom and the courage of young people to challenge powerful civil and military authority.

Today, Ling Chai lives in Cambridge, Massachusetts, and is CEO of Jenzabar, a company that develops web-based intranets for schools and colleges. According to the

web site <http://jenzabar.com/>, the company provides communication tools (e-mail, chat rooms, instant messaging, course bulletin board discussions, customized posting to a user group's front page, "personal profiles" to browse and customize), learning tools (custom course Web pages, a handout section for text, audio, video, or multimedia resources, syllabus posting with daily reminders for students), organizational tools (a calendar with course schedules and personal events, a resume builder and portfolio center), and fun tools (games, contests, and a social area, guides to build Web pages, Web shopping and travel centers with discounts and deals).

Few people can claim to have had a decade of changes as dramatic as Ling Chai's. But a decade is a long time for any of us, and for an area of study as well. Although the first author endeavored to write about issues, and not simply the latest technological devices, his chapter from a decade ago now seems quaint, rather than prescient. The tools offered by Ling Chai's company are now commonplace, and although early versions of each of these existed more than a decade ago, forecasts of their widespread adoption and incorporation into the World Wide Web cannot be seen in that earlier work. It is all too clear that its description of what is has become a record of what was. While this must be true of any area in the language arts, the use of new information and communication technologies unquestionably challenges our abilities to reflect in useful ways.

As we set out once again to consider the interactions between new technologies and the language arts, we wonder what massive changes may be lurking about, ready to apply a harsh time stamp to our words. Looking back, we see that many of the specific applications described in the previous version of this chapter are irrelevant, or have been superceded by technological developments. Still, some of the general conceptions of the computer's role stands up well.

### ***Is It Possible to Write This Chapter?***

Ten years ago, the first author wrote, "the time is near when computers, and other new information technologies, such as video, telecommunications, and speech synthesis, will play such important roles in English and language arts classrooms that it will not be possible to write a chapter like this one" (Bruce, 1991, p. 536). The point was that new information and communication technologies were beginning to show up in every one of the traditional topics, methods, and goals of teaching. Thus, research on the use of computers in teaching would become in effect research on every aspect of pedagogy. Moreover, one could not sensibly pull out computers as an object of study when they were becoming so thoroughly integrated with other media and approaches.

The process of digitization, of incorporating new information and communication technologies into our social practices, has not only continued, but accelerated, over the last decade. Thus, although we began with the idea of revising the earlier work, we find that few of the words there can remain untouched by the changes in the society in which our schools are situated. Nevertheless, the recommendation of that earlier work to consider critically the roles that new technologies can play in education still stands.

A narrow conception of the computer's use within English language arts teaching would see the computer as a device with some well-defined function, such as drill on basic skills. Under this conception, it would make sense to examine critically the research that has been done specifically on computer use, with the aim of identifying the programs that are most effective and the populations of students who could be most helped. One would look for evidence of the effectiveness of this technique across curricular goals in comparison to other technologies. Thus, one might compare a multimedia presentation to a lecture, or the use of film strips to learn about famous authors; or one might compare playing word games on the computer versus a board game as a way to build

vocabulary.

We can learn from studies such as these, but it is important to be cautious in interpreting the results. Some might be tempted to dismiss the new technologies, to resist their use because results are conflicting or yield too little benefit for the costs involved. Others are tempted to embrace the very same technologies, and see them as the secret to educational reform, based on studies that all too often confound the effects of new tools with issues of pedagogical approach or teacher enthusiasm. Both of these interpretations suffer from inadequacies in the research base about the use of new technologies. But more importantly, they both miss what may be more profound changes, for better or worse, in the whole educational enterprise.

Stepping back, we can see a need to reconceive technologies for language arts, and perhaps, to reconceive language arts. Such a reconception would envision the emergence of a set of flexible media, which can be employed in such diverse ways that the basic question shifts from "How effective are these new technologies in teaching the language arts?" to "How are they being used to accomplish pedagogical goals?" The latter question in turn leads us to consider what it is that is actually happening to the ways that people find out new things, communicate with one another, and make meaning. Thus, rather than looking at technologies per se as a new method to be assessed in toto, we must understand more about both the societal changes in literacy practices and the implications for education.

### ***Roles for New Technologies in Language Arts***

New technologies such as computers and networks are now being used in classrooms for instruction in composition, literature, decoding, reading comprehension, spelling, vocabulary, grammar, usage, punctuation, capitalization, brainstorming, planning, reasoning, outlining, reference use, study skills, rhetoric, handwriting, drama, in short, for every area of language arts. There are also programs specifically designed for learners in preschool, primary, upper elementary, middle school, high school, and college grades, as well as those in adult, English as a second language, foreign language, bilingual, special needs classes, home schools, and organizations such as libraries and museums.

These wide-ranging applications of technology raise the question, "What role should the computer, the Web, and other new communication and information technologies play in language arts teaching and learning?" The research in this area overlaps considerably with that of other research on technology in education. It has been a process of discovery, and at times, of contention between rival camps. There are divergent conceptions regarding whether, why, and how these new media are to be used for instruction.

This is not surprising given that there is no clearly identifiable thing to be evaluated. Turkle (1984) has suggested that the computer acts like a Rorschach ink blot test in the way it evokes diverse responses from people. She argues that these responses tell more about people than about the computer. Similarly, the ways that computers are used in schools reveals more about conceptions of learning than they do about what computers can or cannot do.

This poses a challenge for even initiating a discussion on the topic of the use of new technologies in language arts. We need to analyze three complex, diverse, and evolving arenas. First, we need to consider how new communication and information technologies are developing and to examine their various features. Second, we need a way to characterize the diverse and rapidly evolving integration of these new technologies into daily life and literacy practices. Third, we need a way to conceptualize

the diverse goals of language arts instruction so that we may productively consider how the new media are being used to address those goals.

How then can we simultaneously make sense of three such dynamic enterprises? A promising approach comes, not from looking ahead to a science fiction world, but rather from looking backward, to some of Dewey's (1956) writings on curriculum. Dewey saw that any curriculum could be specified only in part by cultural resources and societal needs. In addition, the enacted curriculum must derive in large part from the interests, or impulses, of the child. Although these interests themselves cannot be conceived independent of their sociohistorical circumstances, it is nevertheless the case that they constitute an alternative framework for shaping the curriculum.

Dewey saw that the greatest educational resource were these "natural impulses": to inquire or find out things; to use language and thereby to enter into the social world; to build or make things; and to express one's feelings and ideas. These were the foundation for the curriculum; the pedagogical challenge is to nurture them for lifelong learning. Dewey's four categories, developed long before the electronic age, turn out to be quite useful for analyzing applications of educational technology (see Bruce & Levin, 1997, for its application to learning technologies for science and mathematics). Rather than building a taxonomy on formal instructional models, or on hardware and software features, one can begin with these "impulses" to learn and grow.

If we apply this four-part taxonomy to the use of new media in language arts, we see a broad array of applications:

- Media for communication. New media establish social realms that permit new forms of meaningful communication and reconfigure the relationships among students and teachers, and between the school and the world outside the school. They provide automatic translations between language and hyperlinked definitions of new words.
- Media for expression. New media make possible new modes of self representation. Hypermedia allows the intermixing of photos, drawings, sounds, video, tables, charts, graphs, and text.
- Media for inquiry. New media expand the definition of reading to include hypertexts and multimedia; they represent in easily accessible forms all sorts of information that learners need about books and authors, about history, science, and the arts, and about how to inquire in different domains. They make the regularities, the beauties, and the difficulties of language something that students can examine and interact with in new ways.
- Media for construction. New media allow students to produce and format texts easily; they facilitate revision of texts, check for spelling and grammar; provide interactive style sheets; they assist in the construction of tables, charts, and graphs.

It is not possible to present a survey of computer use within each of these roles that is both comprehensive and brief. Instead, this chapter presents some representative uses as a way of suggesting possible directions. Because computer use is still rapidly evolving, the examples represent categories of applications. We have examined the language arts software offered through Sunburst, as a representative range of widely-used applications, both as a way of clarifying our taxonomy and as a way to see what parts of the taxonomy are well-represented with current off-the-shelf software and which parts have only a few instances. After we describe and exemplify the taxonomy, we will look at ways in which it can point to potential new applications that might prove useful for learning and teaching language arts.

### ***Media for Communication***

Increasingly, computer-based writing never appears as words on a printed page. Electronic mail, on-line documentation, and 'electronic encyclopedias' are read directly from a video screen. The computer has thus become a new communications medium, one which facilitates traditional paper-based writing, but allows other forms of writing as well. There are now multimedia messaging and conferencing systems which allow users to send not just text, but images, graphics, spread sheets, voice and video. These systems are being equipped with a variety of fonts, to permit writing in languages such as Arabic, Russian, and Chinese; they can also display text in appropriate orientations, such as right-to-left, or down a column.

In the original version of our taxonomy (Bruce & Levin, 1997), we proposed four subcategories of media for communication: 1. Document preparation, 2. Communication, 3. Collaborative Media, and 4. Teaching Media. Document preparation includes word processing, outlining, spelling, grammar, usage, and style aids, desktop publishing, and presentation system. In the Sunburst catalog, there are seven different programs available for document preparation, including word processing (*Sunbuddy Writer*), outlining (*Expression, Author's Toolkit*), graphic organizers of writing (Visual Planner), multi-media word processors (*Kid's Media Magic, Media Weaver*, multimedia dictionaries (*Bubble Land Word Discovery*), and book and newspaper publishing programs (*Easybook*). The main difference among these different programs is the age-level of the users, ranging from preK-4 to 4-12.

Another major subcategory is direct communication with other students, teachers, experts in various fields, and people around the world. Examples are direct communication via email, asynchronous and synchronous computer conferencing, distributed information servers (the web), and student created hypermedia environments. This is an increasingly common use of technologies for language arts learning and teaching. The only program in this category in the Sunburst catalog is a web editor for students (*Web Workshop*).

A third subcategory is collaborative media. These include collaborative remote environments for sharing data, graphics, and text, group decision support systems, shared document preparation, and other ways that people can remotely work on common text and graphic objects. This is a category not represented in the Sunburst catalog, probably because many of these are relatively new and still cutting-edge applications. This is likely to be a real growth area for language arts uses of new technologies.

The last subcategory, teaching media, includes tutoring systems, instructional simulations, drill & practice systems, telementoring, and educational games. This subcategory is well-represented in the Sunburst catalog. There are applications for teaching at all ages. At the preK end are classic tutoring systems (*Type to Learn, Every Child a Reader, Learning to Read on the Promenade, Reading Who? Reading You!*) and educational games (*Type for Fun, First Phonics*). Note that some of these teaching media include several different approaches in one package. The Sunburst catalog also contains numerous teaching media for older students as well: *Reader's Quest, Write On! Plus, Read On! Plus*.

Individual software applications such as those represented in the Sunburst catalog were the dominant form of new digital tools ten years ago. But at the time the previous version of this chapter was being written, Tim Berners-Lee and Robert Calliau were proposing a computer system that would significantly alter the literacy practices of a generation. They wanted to implement in a major way the hypertext ideas that Ted Nelson, Doug Engelbart, Vannevar Bush and others had written about earlier (Berners-Lee & Calliau, 1990). Their idea was to implement simple browsers for finding "large classes of information (reports, notes, data-bases, computer documentation and on-line

help)" (p. 1) and also allow users to add new material.

Computers can now be used to create webs of related information. Explicit connections between texts allow readers to travel from one document to another, or from one place within a document to another. The computer can help a reader to follow trails of cross-reference without losing the original context. Electronic document systems also facilitate co-authoring of text. A group of children can create a common electronic notebook, by making their own contributions, viewing and editing one another's items, then linking the items together.

Authors and readers can now be given the same set of integrated tools to create, browse, and develop text. They can move through material created by other people, add their own links and annotations, and merge the material with their own writings. In consequence, the boundaries between author and reader may begin to disappear. Research is needed to understand these changes and the consequences they have for reading and writing instruction.

The development of the web over the last decade has been changing our concepts of texts, documents, and media. Educators are only now coming to recognize the significance of these new practices and to understand the full possibilities for enhancing communication and exploring language (see Reinking, McKenna, Labbo, & Kieffer, 1999). Electronic networks are being used increasingly for communication among students. Research is underway (see Riel, 1988) to explore different ways of organizing such networks. Some networks are focused on specific tasks; others have a looser conference structure. Some have centralized direction and others do not.

Research has been conducted on using real-time communication networks to teach English language skills or composition, as in the ENFI consortium (Bruce, Peyton, & Batson, 1993). In these systems, students engage in a written form of conversation. Their typed messages are transmitted immediately to others in the group. Such an environment requires students to formulate their ideas as written text but allows faster response than traditional writing or even electronic mail. Many students find these environments more conducive to writing than traditional writing classes.

Word processing has become such a commonplace fixture within English and language arts classrooms that some students now take it for granted, saying, "We only do word processing; when will we start real computer use?" Of course, word processing is real computer use, and serves an important function, even if it only helps with the practical details of creating and sharing texts within a classroom. Moreover, there is some, albeit mixed, evidence that in making it easier to compose and revise, to see problems with a text, and to share texts, students learn to be better writers and readers (Bruce & Rubin, 1993; Bruce & Michaels, 1988; Daiute, 1985; Levin, Boruta, & Vasconcellos, 1982; Rubin & Bruce, 1985, 1986; Wresch, 1984).

There are now hundreds of word processing programs, all of which allow writers to enter and revise text. Some present menus of functions from which the author chooses, thus making them easy to learn and to use, but with some sacrifice of flexibility. More complex programs allow writers to control details of text format, permit access to indexed notes, and have capabilities for tables of contents, lists, footnotes and endnotes, bibliographies, and indexes.

It is in the area of writing that we find the widest range of tool-like uses of computers. Many programs and web sites have been designed to help with the tasks of planning and generating ideas. Several word processing programs have an option to turn off the screen, when text is being entered, so that the student is not distracted by the visual image of what is written. This technique of "invisible writing" (Marcus & Blau, 1983) is a

way to facilitate "free writing" (Elbow, 1973) and encourages students not to focus on editing prematurely. Idea generation activities are included in many other programs. Outline generating programs can create empty, numbered outline structures within a word processing program. These programs have become known as "idea processors."

The web offers unlimited opportunities for communication. For example, the TeenLit site <<http://www.teenlit.com>>, which is administered entirely by secondary teachers, provides "a forum for teen writers to publish and discuss their writing, review and discuss books they read." Young writers anywhere can submit their creative works to share with others around the world. Now that any student with web access can set up their own web page, personal pages have become another important medium for communication (Bruce, 1998/1999). Young people throughout the world now routinely build sites with their own stories, photos, music, and graphics.

### ***Media for Expression***

Another major use of technologies in language arts learning and teaching is as media for expression. Uses of media for expression have as a major goal for a person to express his/own thoughts for their own future comprehension, while uses of media for communication have as a major goal the expression of thoughts for the comprehension of others. Technologies that are used for expression include drawing and painting programs, music making and accompaniment, music composing and editing, interactive video and hypermedia creation and editing, animation software, and multimedia composition more generally.

Many of the same programs in the Sunburst catalog listed under media for communication can also be used for media for expression if the intended audience is the author him/herself. So the use of multimedia word processors (*Kid's Media Magic*, *Media Weaver*) could be used for expression to create personal diaries or documents primarily to be viewed later by the author. Many of the uses of the writing tools in the catalog (*Sunbuddy Writer*, *Write On! Plus*) include language arts activities that are typically self-expression, such as poetry writing (even though poetry writing can then be shared in communication with others). In addition, almost all the other technologies described previously as uses as media for communication can also be used as media for expression.

### ***Media for Inquiry***

A third major category of new technologies for learning and teaching is as media for inquiry. In our earlier description of our taxonomy (Bruce & Levin 1997), we found a large number of uses of technologies for inquiry when looking at software developed for science, mathematics, and technology education. However, when looking at the language arts software described in the Sunburst software, there are only a few programs that serve as media for inquiry. For younger students, a program called *M-SS-NG L-NKS* is a language puzzle generator. In each puzzle, learners use their knowledge of context and language to make educated guesses to fill in blanks in the puzzle. For older students, there are *Write On! Plus* modules that focus on the analysis of settings, characters, plot, and themes focusing on "great literature."

Some technologies exist to support composition within a genre, or discourse mode, such as poetry. Some programs help in analyzing or revising a poem. *The Poetry Processor* (Newman, 1986) aids the developing poet by displaying a line of a poem in a specified meter. For example, the first line of Shakespeare's Sonnet 18 (in iambic pentameter) would appear as:

Shall I comPARE thee TO a SUMmer's DAY?

If a student wanted to try the same line in trochaic pentameter, the program would show:

SHALL i COMpare THEE to A sumMER'S day?

Upon reading the line, the student might decide to rewrite the line or change the meter.

Word processing is only one of the ways computers serve as tools for writing and reading (see Wresch, 1988). Programs with speech synthesizers or digitized speech now assist readers who encounter unfamiliar words. On-line dictionaries help with word meanings. Hypertext systems, which allow the storage of multiple linked texts, can provide further explanations, additional examples, or commentaries on the text at hand.

Databases of information make it possible for students to browse text as a method of stimulating their reading and writing. There are now large data bases available on compact disk as well as the web. These include the *Oxford English Dictionary*, the *Encyclopedia Britannica*, and complete statistics from recent Olympics games. Many computers now come with a library of bundled software that include thesauri, dictionaries, or even the *Complete Works of Shakespeare*. There are also many computer-based databases which allow students to explore new worlds of information.

Despite extensive research on writing (Graves, 1982; Hillocks, 1986), we still know too little about how writers generate ideas, how they revise, how they use what they have read in writing, or how their writing changes over time. One reason is that such processes occur in the writers' heads, and external manifestations, such as pauses, backtracking, use of resources, oral interactions with others, and so on, are difficult to record and interpret. The use of technology to support inquiry in language arts is a promising domain for developing powerful new media for learning and teaching.

### ***Media for Construction***

The fourth major use of technologies is as media for construction. These are uses of technologies to affect the world. In the area of language arts, this would include uses of technologies to create text and multimedia. For example, in the Sunburst catalog, there is software that provides environments for students to create animated stories (*Storybook Theatre Bundle*). There have been several such "storymaker" programs developed over the recent past, but this remains yet another domain that may be open to substantial opportunities for development of innovative approaches in the future.

For example, computer-based microworlds have been developed in various areas of science and mathematics to allow students to explore new domains, test hypotheses, construct models, and discover new phenomena (Papert, 1980). The same technology can be used to create microworlds for language. Investigations within these microworlds can be highly motivating for students; moreover, they lead students to think deeply about language patterns, conceptual relationships, and the structure of ideas. We are only at the beginning of this potentially powerful role for computers in language instruction.

There are also an increasing number of tools that allow the construction of web pages, building from pre-existing templates under the guidance of software "wizard" agents. These tools, even when the ultimate goal is the construction of a web site for communication or expression, can also be used for just for pure construction goals as well. The use of technology to support construction in language arts is another promising domain for developing powerful new media for learning and teaching.

## Summary of the Catalog Analysis

Our analysis of the Sunburst catalog shows a variety of uses of technology in language arts being marketed today. Table 1 shows our placement of these programs within our four main categories and their subcategories. It is evident that while there are a variety of uses of new technologies represented, certain of the subcategories predominate, notably Document Preparation, Teaching Media, and Media for Expression.

Table 1

### *Catalog Software in the Taxonomy*

A. Media for Inquiry	1. Theory building-- technology as media for thinking.	
	2. Data access-- connecting to the world of texts, video, data	
	3. Data collection-- using technology to extend the senses	
	4. Data analysis	<i>M-SS-NG L-NKS, Write On! Plus modules</i>
B. Media for Communication	1. Document preparation	<i>Sunbuddy Writer, Expression, Author's Toolkit, Visual Planner, Kid's Media Magic, Media Weaver, Bubble Land Word Discovery, Easybook</i>
	2. Communication-- with other students, teachers, experts in various fields, and people around the world	<i>Web Workshop</i>
	3. Collaborative Media	
	4. Teaching Media	<i>Type to Learn, Every Child a Reader, Learning to Read on the Promenade,</i>

		<i>Reading Who? Reading You!, Type for Fun, First Phonics, Reader's Quest, Write On! Plus, Read On! Plus</i>
C. Media for Construction		<i>Storybook Theatre Bundle</i>
D. Media for Expression		<i>Kid's Media Magic, Media Weaver, Sunbuddy Writer, Write On! Plus, Expression, Author's Toolkit, Visual Planner, Bubble Land Word Discovery, Easybook, Web Workshop</i>

In Table 2, we summarize this analysis in terms of the four main categories and contrast those numbers with previous results derived from an analysis of science education projects (Bruce & Levin, 1997). What we see here is that Communication plays an important role in both science and language arts software. On the other hand, the science projects emphasize software that fits within Inquiry uses whereas the language arts software includes a number of examples of Expression uses.

Table 2  
*Examples of Software Organized by the Taxonomy*

Category	Language Arts Software in the Sunburst Catalog	NSF Science Education Projects
Inquiry	2	43
Communication	17	27
Construction	1	3
Expression	10	0

### ***Using the Taxonomy to Look Ahead***

One of the uses of a taxonomy is to help us classify a diverse set of things, to help us better understand them. Another use is to predict new cases suggested by gaps in instances of categories defined by the taxonomy. The majority of the uses of technologies in language arts that we've covered so far have been largely uses of media for expression and media for communication. In contrast, the majority of uses of technologies for science, mathematics and technology classified in an earlier paper (Bruce & Levin, 1997) were in the uses of media for inquiry. Are there powerful uses of technologies for language arts that fall within this category? What about uses of technologies for language arts that are largely media for construction?

#### **Potential inquiry uses of technology**

Let us look at the subcategories of media for inquiry. These are 1) theory building, 2) data access, 3) data collection, and 4) data analysis. Certainly language can be used as a theory building tool. Most of our scientific, political and other theories are

expressed in words (in addition to other media like mathematics, graphics, or computer models). The taxonomy points to a need for technologies for writing that support this kind of theory building language uses.

Language is used to store and retrieve data. Some trace the origins of written language to its use for recording business transactions and inventories, a specific kind of data storage and retrieval. Something as simple as a shopping list is a kind of data storage (recording what needs to be bought) and retrieval (its use in the store to remember what to buy). Now with palm-top devices (and soon, wearable computers), uses of technologies of language arts for data access (calendars, to-do lists, address books, etc.) will become very common. Teaching students effective uses of these language arts uses, however, remains a largely neglected domain.

Language is used to record data. In its broadest sense, any history or other written notes describing the world (meeting notes, newspaper reports, personal diaries, etc.) is a sort of data collection. New technologies are impacting these recording/reporting functions — reporters are using laptops and wireless networks to create news stories on the site of the news and immediately send them to their editors. Web cams allow new multimedia "diaries" of personal life to be recorded and widely shared. In Japan, written personal diaries are common on the Web (Sugimoto & Levin, 1999), turning a use of language for the self-expression of recorded personal events into a use for communication of that data to others.

Language is used in the analysis of text that has recorded data. Reflections or analyses of reports of the world are common both in society generally and also in intellectual work. We are just starting to see technologies that aid in that analysis process. Thus this is another area in which language arts uses of technology presents opportunities for innovation.

Now these subcategories are not the usual ways that we think about language uses and technology. However, the fact that they are unusual for language uses (but common for number uses) may generate more powerful ways of thinking about how to use the new technologies for more effective language arts learning and teaching.

Let us look briefly at how biologists have recently started using new computational and communication technologies for their work, and then extend that notion into the language arts. Computational biology has become increasingly important for making progress in the biological sciences. A new tool for conducting computational biology is the "Biology Workbench" (Lathrop, Jakobsson, & Bourne, 1999). This tool allows both professional biologists and students of biology to access web-based databases of protein and DNA sequences and to compare and contrast the sequences of different organisms.

Let us imagine a "Language Workbench", in analogy to the Biology Workbench, which scholars and students could do a variety of analyses of literature texts. This would be a web-based interface to distributed texts, with a set of tools for analyzing those texts, allowing a user to compare and contrast patterns in the texts. With such a Language Workbench, both scholars and students could participate in debates about whether Shakespeare wrote Shakespeare's plays, how much was writer A influenced by writer B, etc. Such a Language Workbench could span the range of inquiry uses, and could involve students in joint activities with literature scholars as well as their use of it in more self-contained ways.

### **Potential construction uses of technology**

An example of this approach is the use of the programming language, Logo, to

construct models of language structure and use (Goldenberg & Feurzeig, 1987). Students work within any genre, or mode of discourse, to build up their theories about meaning and form. For instance, they can write programs that "gossip." In this case, gossip is viewed as comprising descriptions of actions that someone else has allegedly taken, actions which are newsworthy because they involve surprising revelations about the other's character. Thus, there is a predication about a subject. In Logo, this might be expressed by the following procedure:

TO GOSSIP

OUTPUT (SENTENCE PERSON DOESWHAT)  
END

This procedure is a small computer program, which, when executed, produces a sentence composed of a first part, which is the name of a person, and a second part, which is a description of some action that person did. Now, this only works if the procedures, PERSON and DOESWHAT, are appropriately defined. For example:

TO PERSON

OUTPUT PICK [SANDY DALE DANA CHRIS]

END

TO DOESWHAT

OUTPUT PICK [CHEATS. [LOVES TO WALK.]

[TALKS A MILE A MINUTE.] YELLS.]

END

The first procedure, PERSON, selects one person from a list. The second procedure, DOESWHAT, selects a predicate to apply to that person. In this case, the predicate is expressed by an unanalyzed verb phrase. With these procedures, a student can then ask the computer to print out any number of gossip statements. At first, the interest for students comes from the fact that they can be playful, making the computer print out funny, and sometimes, surprising statements, even though they provided it with all its data. As they continue to explore the gossip domain, though, the interest comes from something deeper, a developing appreciation of the complexities, beauties, and regularities of language.

For example, students can revise the original procedures to produce more versatile GOSSIP programs. They can break apart the predication into transitive verbs with objects, or expand the range of possible subjects. They can add conditional actions to the procedures, for instance, that only certain people can do particular actions. As they construct their GOSSIP programs, they are forced to confront fundamental questions about language, such as, "What is the relationship between syntax and semantics?," "What is a word?," or "What makes a sentence interesting?" While the program has no means for answering such questions, it provides an environment in which students can seek answers themselves; it allows them to see the consequences of their own hypotheses about language.

This approach is but one example drawn from a family of programs and activities designed to encourage students to explore language. Phrasebooks and Boxes (Sharples, 1985) are two extensions of Logo that allow children to classify words, create their own dictionaries and phrasebooks, devise a quiz, write a program that will

converse in natural language, or build their own 'Adventure Games,' in which other students explore a student-created fantasy world. It would be interesting to develop a general purpose Language Construction Set, which students of language could use. Imagine an environment, in which students could be given a set of words, phrases, or other language elements, displayed visually on the screen. Then they could build language construction machines, that combine those language elements and then display the "output" of the construction. There is still little research regarding classroom use of these constructive approaches to language understanding.

## ***Conclusion***

Technology can be used to change writing instruction in a variety of ways. Computers can aid at places where teacher time and attention are insufficient. They can facilitate the processes of generating ideas and organizing text. Unlike teachers, they can give feedback at any convenient moment. They can comment upon features of written texts. With the aid of a text editor, revision of text is more efficient and rewarding. Computers can increase the time-on-task and can help lessen the teaching load. They can thus create time and opportunity for teacher involvement with essential aspects of writing processes that are beyond the reach of the computer.

New technologies can also help to realize a more functional way of teaching writing. Ideals of writing across the curriculum may become more feasible with the support of computers. By means of computer networking, communities of student-writers can be established. Real audiences and meaningful goals can stimulate the development of competency in written communication as well as enhance motivation.

But the potential value of computers is far from full realization. Many of the uses described here require a rethinking of student and teacher roles, of curricula, and of school activities. Moreover, current programs and models for computer-based activities are often clumsy to use or difficult to integrate with other learning. Costs are still high, especially when viewed as only a portion of the meager resources available for instructional materials. And too often, the best computer resources are inequitably distributed. Despite these problems, the use of computers for English language arts instruction is in fact growing and promises to be an increasingly important aspect of learning in the future.

## ***References***

- Alessi, S. M., & Trollip, S. R. *Computer-based instruction: Methods and development*. Englewood Cliffs, NJ: Prentice-Hall, page 9, 1991.
- Barker, T. T., & Kemp, F. O. Network theory: A postmodern pedagogy for the writing classroom. In C. Handa (Ed.), *Computers and community*. Portsmouth, NH: Boynton/Cook, pp. 1-27, 1990.
- Bates, M. & Wilson, K. (1982). *ILIAD: Interactive language instruction assistance for the deaf* (BBN Report No. 4771). Cambridge, MA: Bolt Beranek and Newman, Inc.
- Batson, T. (1988, February). The ENFI Project: A networked classroom approach to writing instruction. *Academic Computing*, 2(5), 32-33, 55-56.
- Beeman, W. O. (1988). *Intermedia: A case study of innovation in higher education*. Final Report to the Annenberg/CPB Project. Providence, RI: IRIS, Brown University.
- Berners-Lee, T., & Cailliau, R. (1990, November). *World-Wide Web: Proposal for hypertext*. Geneva, Switzerland: Conseil Europeen pour la Recherche Nucleaire Memo.

- Bruce, B. (1991). Roles for computers in teaching the English language arts. In J. Jensen, J. Flood, D. Lapp, & J. Squire (Eds.), *Handbook of research on teaching the English language arts* (pp. 536-541). New York: Macmillan.
- Bruce, B. C. (1998-1999, December/January). Learning through expression. *Journal of Adolescent and Adult Literacy*, 42(4), 306-310.
- Bruce, B. C., & Levin, J. A. (1997). [Educational technology: Media for inquiry, communication, construction, and expression](#). *Journal of Educational Computing Research*, 17(1), 79-102.
- Bruce, B. C., Peyton, J. K., & Batson, T. W. (Eds.) (1993). *Network-based classrooms: Promises and realities*. New York: Cambridge University Press.
- Bruce, B. C., & Rubin, A. D. (1993). *Electronic Quills: A situated evaluation of using computers for writing in classrooms*. Hillsdale, NJ: Lawrence Erlbaum.
- Buruma, I. (1999, May 31). Tiananmen, Inc. *The New Yorker*, 75(13), 45-52.
- Daiute, C. (1985). *Writing and computers*. Reading, MA: Addison-Wesley.
- Dewey, J. (1956). *The child and the curriculum & the school and society*. Chicago: University of Chicago Press. (Original works published 1902 and 1915)
- Elbow, P. (1973). *Writing without teachers*. London: Oxford University Press.
- Goldenberg, E. P., & Feurzeig, W. (1987). *Exploring language with Logo*. Cambridge, MA: The MIT Press.
- Graves, D. H. (1982). *Writing: Teachers and children at work*. Exeter, NH: Heinemann Educational Books.
- Hawisher, G. E. Blinding insights: Classification schemes and software for literacy instruction. In C. Selfe & S. Hilligoss (Eds.), *Literacy and computers: The complications of teaching and learning with technology*. New York: Modern Language Association, pp. 37-55), 1994.
- Hillocks, G. (1986). *Research on written composition: New directions for teaching*. Urbana, IL: National Conference on Research in English.
- Knapp, L. R. (1986). *The word processor and the writing teacher*. Englewood Cliffs, NJ: Prentice-Hall.
- Lathrop, S., Jakobsson, E., & Bourne, P. (1999). Educational enhancements prepare Biology Workbench for the classroom. In G. Moses, R. Giles, and R. Tapia (Eds.), [Touch the future](#). Champaign, IL: Education, Outreach, and Training Partnership for Advanced Computational Infrastructure.
- Levin, J. A. (1982). Microcomputers as interactive communication media: An interactive text interpreter. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition*, 4, 34-36.
- Levin, J. A., Boruta, M. J., & Vasconcellos, M. T. (1982). Microcomputer-based environments for writing: A writer's assistant. In A. C. Wilkinson (Ed.), *Classroom computers and cognitive science* (pp. 219-232). New York: Academic Press.
- Long Bow Group (1995). [The gate of heavenly peace](#) [Film transcript].

- Marcus, S., & Blau, S. (1983, April). Not seeing is relieving: Invisible writing with computers. *Educational Technology*, pp. 12-15.
- Marcus, S. (1982, March). Compupoem: CAI for writing and studying poetry. *The Computing Teacher*, pp. 28-31.
- Means, B. (1994). Introduction: Using technology to advance educational goals. In B. Means (Ed.), *Technology and education reform: The reality behind the promise*. San Francisco: Jossey-Bass, pp. 1-21.
- Michaels, S., & Bruce, B. (1988). *Classroom contexts and literacy development: How writing systems shape the teaching and learning of composition* (Technical Report). Urbana, IL: Center for the Study of Reading, University of Illinois at Urbana-Champaign.
- Olds, H. F. (1985). A new generation of word processors. *Classroom Computer Learning*, pp. 22-25.
- Olds, H. F., Schwartz, J. L., & Willie, N. A. (1980). *People and computers: Who teaches whom?* Newton, MA: Education Development Center.
- Pea, R. D., & Kurland, D. M. (1986). Cognitive technologies for writing. *Review of Research in Education*, 13.
- Reinking, D., McKenna, M., Labbo, L., & Kieffer, R. (Eds.) (1999). *Literacy for the 21st Century: Technological transformations in a post-typographic world*. Hillsdale, NJ: Erlbaum.
- Riel, M. (1988). *Telecommunication: Connections to the future*. California State Educational Technology Committee.
- Roblyer, M. D., Castine, W. H., & King, F. J. (1988). *Assessing the impact of computer-based instruction: A review of the literature*. New York: Haworth.
- Rubin, A. D., & Bruce, B. C. (1985). QUILL: Reading and writing with a microcomputer. In B.A. Hutson (Ed.), *Advances in reading and language research*. Greenwich, CT: JAI.
- Rubin, A. D., & Bruce, B. C. (1986). Learning with QUILL: Lessons for students, teachers and software designers. In T. E. Raphael (Ed.), *Contexts of school based literacy* (pp. 217-230). New York: Random House.
- Schell, O. (1994). *Mandate of heaven*. New York: Simon & Schuster.
- Schiebinger, L. (February 1996). The loves of the plants. *Scientific American*.
- Schwartz, H. (1982). Monsters and mentors: Computer applications for humanistic education. *College English*, 44, 141-52.
- Sharples, M. (1985). *Phrasebooks and boxes: Microworlds for language*. Paper presented at the World Conference of Computers and Education, Norfolk, Virginia.
- Sirc, G. (1988, April). Learning to write on a LAN. *T.H.E. Journal*, 15(8), 99-104.
- Sirc, G. (1989). Response in the electronic medium. In Chris Anson (Ed.), *Writing and response*. Urbana, IL: National Council of Teachers of English.
- Sugimoto, T., & Levin, J. A. (1999). Multiple literacies and multimedia: A comparison of Japanese and American uses of the Internet. In C. Self & G. Hawisher (Eds.), *Global*

*literacies and the World-wide Web* (pp. 133-153). London: Routledge.

Sunburst Communications. *Sunburst 1998 Educational Software Catalog*. Pleasantville, NY: 1998

Taylor, R. P. (1980). *The computer in the school: Tutor, tool, tutee*. New York: Teachers College Press.

Thomas, R. H., Forsdick, H. C., Crowley, T. R., Robertson, G. G., Schaaf, R. W., Tomlinson, R. S., & Travers, V. M. (1985). Diamond: A multimedia message system built upon a distributed architecture. *IEEE Computer*.

Thompson, D. (1987). Teaching writing on a local area network. *T.H.E. Journal*, 15(2), 92-97.

Turkle, S. (1984). *The second self: Computers and the human spirit*. New York: Simon and Schuster.

Warren, B., & Rosebery, A. S.. (1988). Theory and practice: Uses of the computer in reading. *Remedial and Special Education*, 9(2), pp. 29-38.

Wresch, W. (1988, April). Six directions for computer analysis of student writing. *Computers and the Language Arts*, pp. 13-16.

Wresch, W. (Ed.) (1984). *The computer in composition instruction*. Urbana, IL: National Council of Teachers of English.