Literacy by Design: Why Is All This Technology So Important?

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"When there is a [division] between upper and lower classes of our information society then computer literacy will be the distinguishing talent. The elite will be those who can read and write with the computer; they will use the machine in their work and probably for their recreation as well. The computer illiterate will at best be passive users/readers of the machine. They may be able to enter data—as cashiers now do for cash registers that are already microcomputers—but they will not be able to compose and design with the machine across the spectrum of semiotic [multimedia] communication." (Bolter, 1991, 224)

"Technology has *everything* to do with literacy. And being able to use the latest electronic technologies has *everything* to do with being literate."

I direct a summer technology institute for teachers, and lead the strand for teachers of the English/Language Arts. This past summer, when I made this opening remark to my participants, I heard some murmurs that hinted at a few raised hackles. Little did they know that the fun was just beginning!

Next I told them that J. David Bolter, a renowned classics scholar and the author of *Writing Space* (1991), argues that if our students are not reading and composing with various electronic technologies, then they are *illiterate*. They are not just unprepared for the future, they are illiterate *right now*, in our current time and context. Bolter stresses that hypermedia is just our most current communication tool in a hypertextual world. He writes that if kids aren't composing with hypermedia right now, then they are already way behind the curve.

But What *Is* Hypermedia?

It became apparent that many of the teachers weren't absolutely sure what "hypermedia" really is, so I launched into an explanation. Hypermedia is, quite simply, a computer software platform that allows us to communicate through nonlinear, multimedia text.

By *nonlinear*, I mean that there are multiple ways to navigate through the text. Unlike a traditional book where the text naturally flows from page 1 to page 2 to page 3, in hypertext the reader can go from any "hypercard" (or Web site, or screen display) to any other "card" that is part of the "hyperstack"—or text as a whole, made up of various cards. From any one card, you can access any other related cards you would like by using "buttons" or "hotlinks" (see Figure 1). *Multimedia* means that the hypertext will include various "sign systems" or communication media. This may include traditional forms of written text, composed on what is known as a "text field," as well as sound, video, graphics, scanned images, animations, and other forms of media that can be put on the hypercard's "background" or accessed through "buttons" on the card.

Because of the nature of hypermedia, documents tend to be long, linked with multiple other documents and composed by various authors. Hypermedia is the platform of the World Wide Web, and it is clear that it already plays an important role in how we communicate and do work in the world.

Let's use the World Wide Web as an example of hypermedia. You use a search engine and find a Web site of interest to you, for instance "skateboards." There will be a variety of graphs, visual images, video clips, and text for you to "read." There will also be hotlinks to other Web sites with related

information, which were probably composed by other authors. By clicking on those hotlinks, you can proceed immediately to another site of your choice—about skateboards, roller skates, other extreme sports, or any other related topic. In fact, the Web itself can be seen as a single "text" made up of compositions by multiple authors who have linked their creations in various ways. Search engines help us to navigate these texts.

This explanation complete, and my victory secured, I boasted to my institute participants: "Now you surely see the importance of hypertext as a current communication form that will only become increasingly important in the future. Soon, even our television sets will be connected to the Web and more and more personal and professional work will be done over the Internet."

The Future of the Book; the Future of Reading

Still unconvinced, the teachers with whom I was working started to argue with me, so I pulled out the big guns. "Seen any papyrus scrolls lately?" I harangued them. "No? Guess why not? They used to be the very latest form of text, totally *en vogue*. The most literate people used them. But guess what? The scroll was supplanted—totally *obliterated* and replaced by a new kind of text: the medieval codex."

They fell momentarily silent, so I seized the advantage and was not about to let up. The full court press was on.

"Been to the local library lately? Seen any codices? No? Why not? Because a new technology came along that made the codex totally and utterly *obsolete*. Yes, Gutenberg's printing press and Gutenberg's book created

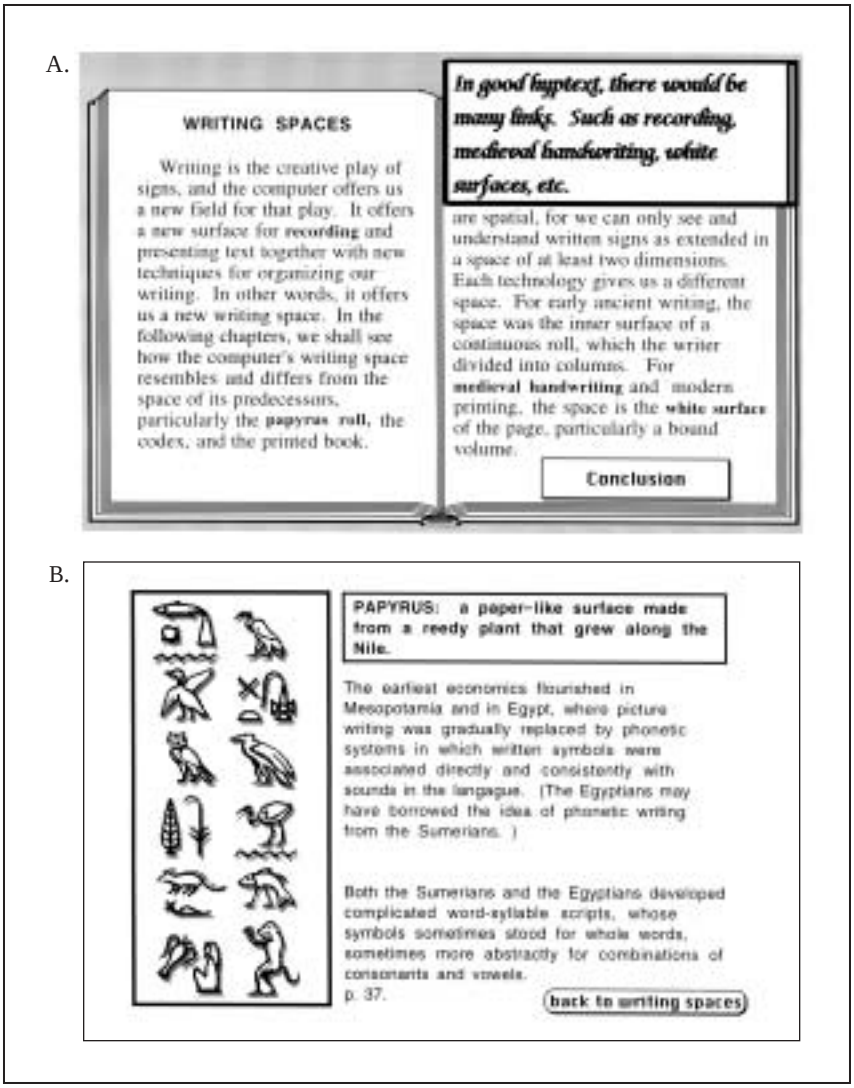

FIGURE 1.

(a) The image of the book is a textual field on which the author can word process text. The words from the text that are in bold are "hotlinked," which means that clicking on them will take you to another hypercard that explains more about this particular term or idea. The popup field in the upper right-hand corner was exposed by clicking on a button now hidden beneath it. Another button in the lower right-hand corner, labeled "conclusion," can be clicked to take you to a discussion of hypermedia as our most current form of "Writing Space."

(b) This is the card for Papyrus that will be brought up on the computer screen by clicking on "papyrus."

a completely new kind of writing space—one that was more efficient and effective. So the codex became history. And the scribes? They became obsolete, too! Do you want that to happen to you—or to your students?

"But here's the exciting part, *and* the scary part," I almost half-whisper, building to my denouement. "Pretty soon you will go to the library and there will be no more books. You can kiss your beloved leather-bound volumes goodbye! They are already being replaced by a new technology and a new kind of writing space—much more powerful, available, and useful than the printed page. And this writing space is *hypermedia*!"

This doesn't mean that literature is dead, or that we won't read novels or poetry—it just means that these arts will exist in a new writing space, with new possibilities and permutations.

At this point a certain kind of controlled pandemonium broke loose. Even though my strand was made up of fairly progressive practitioners who were attending our institute precisely because they wanted to know how to integrate new technologies into their language arts teaching, they were in no way ready to participate in a revolution—particularly if it meant giving up life, literacy, and teaching as they had experienced and known it, and even more particularly if it meant giving up their beloved books. Well, someone had to break the news to them and I guess it was coming down to me. It's not that I didn't empathize; I know that teachers are already too busy and may be overwhelmed by the idea of "going online." But we are in the midst of a huge cultural shift in the history of literacy, and as uncomfortable as that may be, we need to roll with it or get knocked to the ground by "all the cyberspace going 'round" (to paraphrase the famous Eisley Brothers tune).

After listening good and hard to the remonstrations of my group, and enjoying some good chuckles, I eventually got the floor again. "*Wake up, people*!" I told them. "The cyber-revolution has been won! It's *over*! We live in a hypertextual world and must prepare our students to live in one! This doesn't mean that literature is dead, or that we won't read novels or poetry—it just means that these arts will exist in a new writing space, with new possibilities and permutations, sometimes in conjunction with art and video and sound."

As I spoke, I was reminded of something Ted Nelson (the visionary coiner of the terms "Magic Paper," "hypermedia," and "docuverse"—his concept of the Internet) once said, "All writing and reading are . . . the try and try again interplay of parts and details against overall and unifying ideas which keep changing. Hypertext makes these activities visible, more available, and more possible for students. . . . The fundamentals of reading and writing will not change, but will be enlarged and made richer."

So I pressed on, trying to address their concerns. "Some stories are meant to be read in a particular order without other media, and you'll still be able to do that in electronic form. You can already download several of your favorite titles into an eBook (electronic book). If you are sentimental, you can buy one that looks and feels like a book and you can take it to the beach and you can flip pages with a click of an on-screen mouse. And when you are done, you can download another favorite book. And you will be reading it just the way you read now, but with the possibility of clicking on any word to get a definition, on any idea to get further information on it, etc., etc. Our ability to support and enrich our own reading will be extended. People, where's the downside here?"

But the protest continued; most were worried about the status of literature. "Any text that has an index is attempting to be hypertextual—to allow you to navigate your own way through a text," I tell them. "And think about all the canonical texts that are essentially nonlinear—that can be read in various orders and ways—and are therefore hypertextual." I quickly brainstorm a list on the overhead.

Tristram Shandy, Sterne

Spoon River Anthology, Masters

Hopscotch, Cortazar

Pale Fire, Nabokov

Remembrance of Things Past, Proust

Giles Goat-Boy, Barth (which actually uses hypertext)

The French Lieutenant's Woman, Fowles

The Name of the Rose, Eco

Borges's stories, such as "Library of Babel" or "The Labyrinth."

"All of these great literary works could have been written on hypertext to great advantage. The same is true for the popular Choose Your Own Adventure books. And now there are literary works that are being written on hypermedia platforms. I'm thinking of Michael Joyce's bestseller *Afternoon*."

But the outcry bubbles up again; new protests are voiced. "This stuff won't happen," someone yells out. "There is no way to see what the future will look like."

"The technology for all of this *already exists*," I tell them. "In fact, there is a patent out for a liquid crystal newspaper. Your personal electronic servant, or 'knowbot,' can be programmed to gather all of the news that interests you to create your own personalized newspaper. Which, if you happen to be sentimental, you can then download into your electronic newspaper which looks and feels like a newspaper and that you can carry around and read on a park bench. And if you want to know more about a particular term, person, or issue that comes up in your reading, you can click on a hotlink to find associated stories and explanations. This is hypertext! And this is the text of the present and of the foreseeable future."

I sense another source of their fear. They see hints that integrating technology into their classes will change how they teach, what they do in their classrooms, and what will be read and written—what the very stuff of the curriculum will be. And they are right. But to my mind, this is all to the good. After all, if the world and literacy change, we must change, too. We must embrace a permanent state of change and learning as our lot, and part of living a happy life as a teacher and as a Net denizen. I am reminded of Landow (1992), who wrote, "Educational hypertext redefines the role of instructors by transferring some of their power and authority to students. This technology has the potential to make the teacher more a coach then a lecturer, and more an older, more experienced partner in a collaboration than an authenticated leader. Needless to say, not all my colleagues respond to such possibilities with cries of glee and hymns of joy. . . . But the possibilities for the learners are endless." (p. 123)

Now I head to the conclusion of my opening pep talk. "Literacy has always been about using the most powerful cultural tools available to make and communicate meaning. At the present, those tools happen to be multimedia tools that use video, graphics, sound, and traditional text in a hypermedia format. If we or our students don't know how to critically use these tools to their fullest meaning-constructive potential, then we—and they—are illiterate. We are riding on the crest of a huge cultural tidal wave—a massive textual Tsunami. The question is this: will we surf on the crest of the future's breaking wave—which will be exciting, scary, and outrageously fun—or will we drown in it?"

Still sensing their profound unease, I try to reassure them. "The current technologies are very easy to learn; the harder part will be using these technologies to teach kids to read and write and think better. The electronic information revolution doesn't make teachers or pedagogical knowledge obsolete. Oh no. It makes us as teachers all the more important. The foundational competencies of reading, critical interpretation, and composing are more important than ever, and the effective ways of teaching these things are more important than ever. At the same time, these skills have become more complex and more challenging. Now kids need to know how to read traditional text *and* how to critically read videos, pictures, and graphs. And they must understand how these work together.

"Years ago, a student who was not a good reader or composer could look forward to a happy and fruitful experience in particular walks of life without a lot of literacy challenges. No longer. Custodians must program the microcomputers on climate controls and furnaces. Auto mechanics use computers to diagnose and repair cars—cars are, in fact, run by computers! Every Web site visited needs to be critiqued, cross-checked, and examined for reliability and validity. The challenges are greater than ever; the need for the most excellent teaching in the language arts is greater than ever.

Literacy has always been about using the most powerful cultural tools available to make and communicate meaning. . . . If we or our students don't know how to critically use these tools to their fullest meaning-constructive potential, then we—and they—are illiterate.

. . . When you start to use technology for important learning goals, you will enliven your teaching, motivate your students, and teach them more effectively for the world they already live in.

And we can't teach kids what they need to know to participate in a hypertextual world unless we come to understand it and make use of it ourselves."

Thus began this past summer's technology institute—and an exciting, fulfilling, and rollicking time it turned out to be.

Remember, we aren't educating students for the past, but for their present and their future. Understanding the links between current technologies and literacy is vital to our profession. If you are a teacher who is not fully embracing current technologies and integrating them into your classroom, I direct the same speech—and the same promise—to you: when you start to use technology for important learning goals, you will enliven your teaching, motivate your students, and teach them more effectively for the world they already live in. And you will be in for an exciting time riding the crest of the wave of the future!

So, How Can We Do It?: A Curriculum of Design

Computers possess what Sherry Turkle (1995) calls "holding power." Turkle, who studies the psychology of the cyberworld, argues that computers engage people in powerful ways, and that we can create powerful attachments to the machine, its uses, and its artifacts. Though there are costs as well as benefits to this power, I have found the computer to be a very useful tool for motivating and engaging reluctant students, and for assisting them to read, compose, and learn in new ways (Wilhelm and Friedemann, 1998).

Part of this holding power might stem from the insight that we must teach students from where they are to what they might become, from their current reality to their future possibility. Computers are an integral part of many students' current reality and are therefore a powerful starting point from which to teach them. For those students who do not have access to computers, it is ever more incumbent upon us as educators to introduce them to this technology, for all the reasons cited above.

Professional teachers know that though content is important, knowing *how* to learn is even more essential and transferable. Students must be able to take new and more expert ways of knowing forward with them to the next learning situation, be it in or out of the classroom.

The notion of "student-design" learning environments (Lehrer, 1993) is an attempt to make the classroom a part of real-life endeavor, and to therefore create more meaningful and powerful learning in terms of both content *and* cognitive skill. But it is also an attempt to meaningfully reform education from the bottom up. In such a curriculum, students inquire and experiment together with the ultimate goal of designing a good and useful product. This inquiry involves the reading of a variety of texts (including literature) that address a vital issue, and then composing a knowledge artifact that represents what has been learned.

"Design curricula" restructures traditional teaching and learning in ways that are transformative and that work toward further transformations. As Landow (1992) predicted, implementing a design curriculum necessarily and simultaneously transforms many aspects of the classroom, including the roles of teachers, students, and outside experts, as well as of knowledge artifacts, assessment, and the place and use of technology in the classroom.

Though I have worked with students to design many things, including video documentaries, museum exhibits, electronic security systems, artificial joints, city plans, dramas, and social campaigns, I believe that hypermedia design has particular strengths that help to support student literacy development. Hypermedia design is also easily adaptable into current school structures and constraints.

Baseball

Over several years, my team-teaching partner Paul Friedemann and I have worked with students to assist them in designing electronic artifacts such as Web sites, hypermedia and video documents, and computer kiosks for museum exhibits. Most of our work has been

conducted during blocks of integrated social studies and reading classes. The school in which we worked has about 750 students and a lab of 27 badly outdated, and intermittently operable, Mac Classics. (When we began doing video design, we had access to 4 Power Macs with AV capacities.) Despite our lack of the most current technology (in both quality and quantity), our students were able to learn a lot while creating personally relevant and meaningful products. Since most of our work was done without the computer (asking questions, finding information, reading, note taking, organizing and analyzing information), we needed relatively little of the highly sought-after computer time—usually a week or less of computer time would suffice to complete any given project.

Most of our hypermedia work has been done around student inquiry during our cultural journalism unit (see Figure 2) or our human identity / psychology unit (see Figure 3).

Typical of our experience was a group of boys with whom I worked this past year during a unit on popular culture. Obviously fueled by the much publicized home run race between Mark McGwire and Sammy Sosa, one group of seventh graders became interested in the question of who is the greatest baseball player of all time. As this group was busily reading, interviewing a local sports columnist, visiting Web sites, and learning how to create their own database, one of the boys looked up and sighed, "Man, this is way more complicated than I ever thought . . . ." Another group member rejoined, "Yeah, and *way* more interesting!"

Though considered at-risk students, these boys had been thriving in an environment of a technology workshop. Their design classroom was using technology to assist them in asking their own questions, to use their own initiative, to make decisions, to work together, and to become better readers, writers, and learners. They all reported that they read more, including literary works like the McKissacks' *Black Diamond*, than they had at any other time in their memory.

When the boys originally asked the question: "Who is the greatest baseball player of all time?" they thought they already knew the answer: Mark McGwire, by virtue of his 70 home runs, was the greatest hitter and baseball player of all time. This assumption was soon shattered when they interviewed a

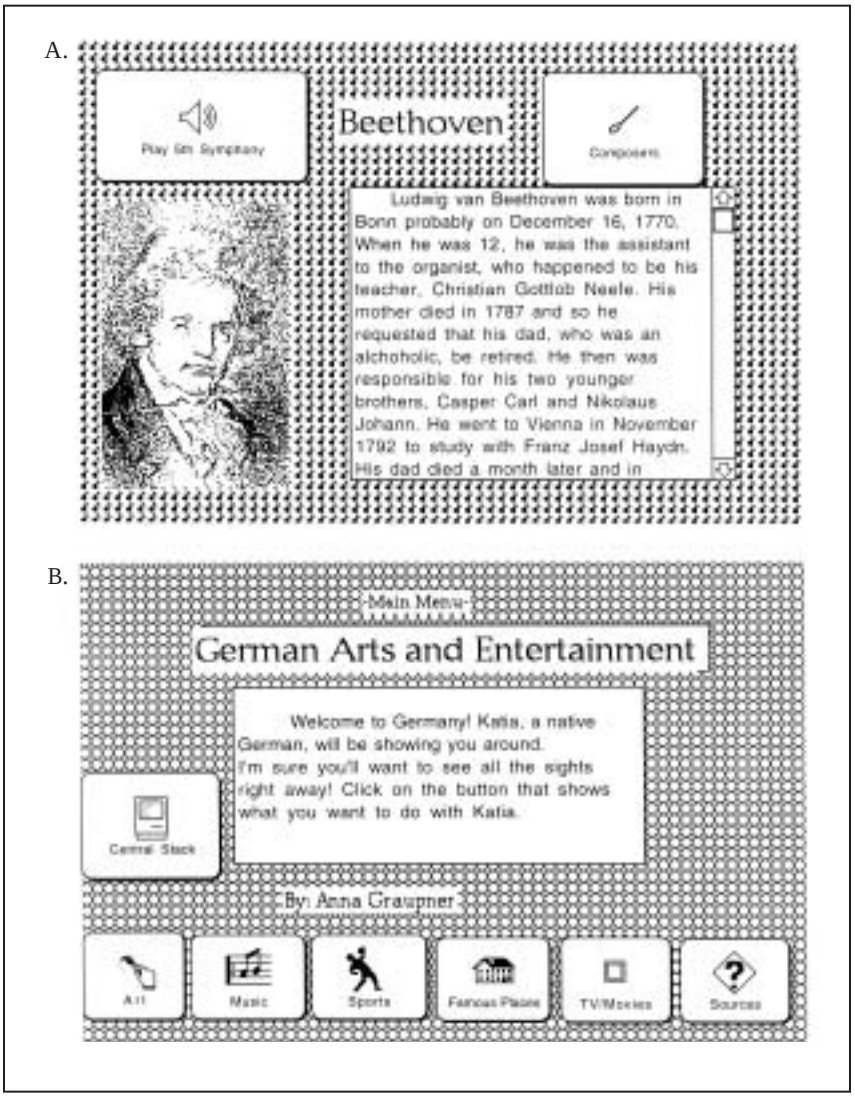

FIGURE 2.

(a) This card was part of a stack of over 140 cards put together by a team of seventh-grade girls who designed a stack on the question of "What do you need to know if you travel to Germany?" created as part of a cultural journalism unit. Notice that the background has been designed into musical notes by the student designer. The "5th symphony" button allows you to hear the initial bars of this symphony. The other button takes you to a menu card of other famous German composers. Notice that the student has designed her own conducting baton icon to help you, the reader and navigator, to know where you are going when you click this button. An engraving of Beethoven has also been scanned onto the background. The text field contains information about Beethoven and is scrolled because it contains more than two typed pages of information. Of course, this information could have been divided into separate cards about phases of Beethoven's life, if the designer had chosen to do so.

(b) This is the menu card for this part of the Germany substack.

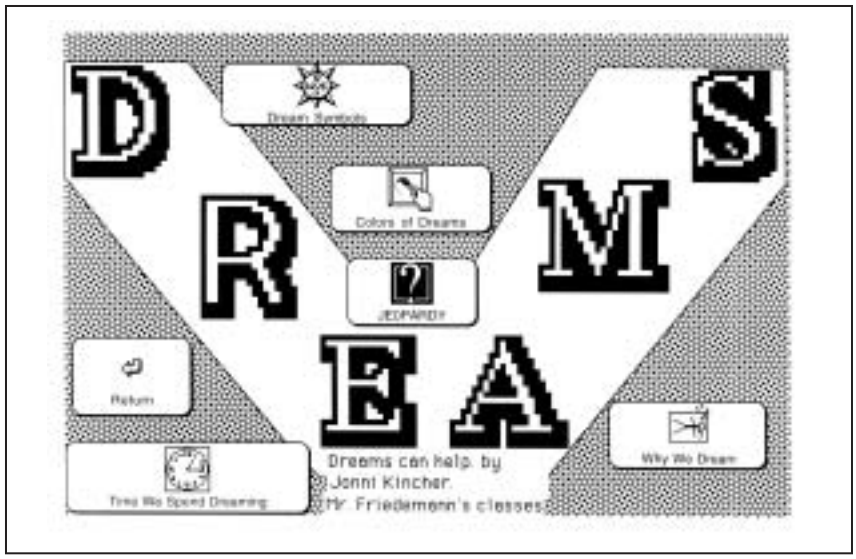

FIGURE 3. *This is the initial menu card of a substack on dreams. From this card, you can visit four different cards to learn about dreams, or go to the Jeopardy card to play an interactive game that tests what you have learned from this substack, or return to the menu card of the whole stack, which would allow you to navigate to other substacks on different topics related to the unconscious.*

local columnist who asked how Mark McGwire could ever be considered the peer of Ty Cobb or Babe Ruth. Their initial belief was further eroded as they went to the World Wide Web to access databases of baseball statistics about a variety of hitting, fielding, and throwing categories. Their inquiry was complicated by their discovery of the Negro Leagues and the many great players who had been denied the chance to play in the Major Leagues, or who, like Satchel Paige, did so only in the twilight of their careers. They also began to discuss the intangible qualities that make a player great, and finally, inspired by a series of ESPN commercials, they considered the difficulty of comparing pitchers and hitters, and of comparing fielders to catchers.

Demonstrating their inquiry process, their final hypermedia document presented their final conclusion and argument—a multimedia case that Babe Ruth, the one and only Bambino, is in fact the greatest player of all time.

What Is Design?

To summarize briefly, let me cite David Perkins' (1986) notion that all knowledge must, in fact, be designed, and that the metaphor of design provides a global purpose and motivating goals for student learning. This purpose frames and gives meaning to student work and provides continuity over long periods of time, from initial problem identification and planning sessions, through reading and developing information, to the actual development, testing, and final presentation of a product. The artifacts of design that students create throughout the process and the final products themselves become concrete "objects-to-think-with" (Papert, 1980). Since design products are used for such purposes as teaching other students or solving an actual problem, there is a high degree of motivation and authenticity for all tasks. Classroom work is organized around learning to design and learning to think about design. [*Editor's note*: See the review of Wilhelm's and Friedemann's book *Hyperlearning: Where Projects, Inquiry, and Technology Meet* in Clip and File. In that book, they explain the process of design and provide examples of instructional strategies and student work.]

Design, then, is really about "learning how to learn," which Papert (1996) argues is the only thing really worth learning in a technologically advanced world where knowledge itself and the way it is represented are constantly changing, and where available information doubles in a matter of months.

It is essential that students be actively taught throughout the process of design, and that this teaching meet their emerging needs as designers. Both the product (the artifact being designed) and process of learning (e.g., ways of reading and writing particular kinds of texts) are always kept in view and actively supported by the teacher. This creates a meaningful situation for all the learning that takes place, and an immediate and visible use for what has been learned.

Throughout this process we continually modeled procedures, scaffolded and assisted student development through minilessons and test runs, provided multiple practice opportunities, and eventually diminished our assistance as students came to use new strategies independently. Then it was time

for us to teach and assist students to use new strategies at a different stage of their design process. Though the process does take time, our own research and that of other design researchers show that the payoffs are great, particularly for students who may be the most disenfranchised by school (see Wilhelm and Friedemann, 1998).

The Power of Design

Let's return to our baseball group to demonstrate a key advantage of a design classroom: the decentralization of the system of learning in the classroom (i.e., the distribution and sharing of expertise across group members). For instance, in our baseball group, the boys divided up different eras of baseball history and dispatched two boys to learn all they could about the Negro Leagues. Content knowledge was developed individually and then distributed to other group members. Everything was brought back and processed by the whole group for use in their joint project.

This also worked with technology use and procedures for doing things. One boy knew about spreadsheets and another about databases. A third boy learned how to use a graphics program for representing statistical data. These boys then became the experts who did that kind of "work" for the group, and who taught others how to do it. Another group member learned how to use AvidCinema so that video clips could be edited and downloaded into their stack. Joe learned how to use MIDI (Musical Instrument Digital Interface) tools and taught the members of the group how to use them to create a soundtrack for certain cards. In these cases, expertise about technology, about particular software packages and intellectual tools, and about ways of doing things were also shared and used for the overall purposes of the group.

As we can see from these examples, design provides a context in which students learn ways of learning. In order to design, the group members need to know how to find information, read it, share it, and distill it. There are plenty of opportunities here for teachers to teach search strategies, reading strategies, note making strategies, and analysis strategies that span across the language arts, math, music, and other domains of knowledge.

In the process of design, knowledge is not separated into arbitrary domains like math, science, or social studies. Students use the tools and learn the content that are important to answering their questions and solving their problems. In this way, design is a powerful tool for integrating curriculum (Beane, 1990). Not only are knowledge domains integrated and balanced, but other aspects of learning that are often divorced in school but blend together seamlessly in real life are called upon as we "design" schedules, solutions, lessons, etc. In other words, because a product must be created, knowledge (e.g., about baseball statistics) is never divorced from its use (to rank, to assess, to make a case about who is the best baseball player of all time). Process and product are also balanced: students must learn ways to find and work with data that will help them make arguments and convince audiences (in this case, their classmates and the community audience at a Parents Night).

Additionally, format must be balanced with meaning: students must figure out the best way to present what they have learned (e.g., introducing the question about baseball's greatest player through a direct statement of the question, through an interactive quiz, or through a video clip of McGwire's record-breaking home run; this would engage the current audience and lead to a surprise as an argument against McGwire is subsequently undertaken). Individual agency and local level tasks (learning the graphics program or learning about the Negro Leagues) are balanced with collaboration and global level tasks (helping each other to combine and represent data so that the final case for Babe Ruth can be made).

As these examples show, design is a powerful metaphor that provides both a way to use technology for learning and a way for transforming school settings and the work we do there. This is because design connects intimately to students' interests and their

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need for relevance in the world as they know it. Design is immediate because it requires the knowledge to create a concrete product that will be made available not only to other students, but to wider audiences as well (e.g., we offered a community learning fair and posted hyperstacks with QuickCard on our Web site). In addition, as students use the latest technologies to do research and to compose meaning, they develop critical standards about how these technologies work, and how documents using these technologies are constructed and used.

DiSessa (1992) writes that creating an environment for student designers is valuable on many levels. First, it is a highly reflective activity. Students need concrete objects to reflect on; an object that they have designed allows them to reflect on process and product and to articulate and reflect on their own standards for successful problem solving.

DiSessa further argues that design is democratic. It simultaneously addresses the interests, goals, skills, and needs of multiple students. Students have choice and do meaningful work, with assistance provided quite naturally by other students, teachers, community members, and electronic resources. Because design is a collaborative, purposeful activity (in this case, to teach each other about issues of popular culture) that meets the needs of a community, it also meets Dewey's criteria for democratic work. And, I should note, it is an evolving activity that cannot be fully planned in advance. Design immerses participants in the excitement of exploring, the creation of something new, and in the joy of understanding. It is the essential nonstandardized activity.

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Critical Standards

In a world where students can access information through a variety of electronic sources of varying quality and origin, it is essential that students develop critical standards for information. And in a world where message can be overwhelmed by format and media, it is important for students to develop their own standards for all compositions, including multimedia ones, from the inside view of designer.

Toward the end of our popular culture unit, the design teams presented drafts of their hyperstacks to classroom review boards. Over the course of the unit, students had developed their own critical standards for information quality, local level tasks like questioning, design tasks like creating hypercards, and the final product itself. These standards had been continually revisited and had, therefore, continually evolved as we worked together to understand and articulate what made a question work, what was necessary to a useful hyperlink, what constituted information quality, etc.

Students become good at what they have the opportunity to do and at what they are assisted to do. When students are helped to make and apply critical standards in a variety of situations, they become good at doing so (see Erickson and Lehrer, in press). In the case of the critical standards for our final products, the criteria evolved from an initial near obsession with presentational qualities (e.g., using glitzy multimedia tools like video and music, including long chunks of text, etc.) to a clear consideration of audience (text must be short and readable, media must connect to card topic, the single point of each card must be clear, links between cards must make sense, navigational tools must be provided).

In this and other cases, the original criteria were superficial and very concerned with the technological capacities of search engines or hypermedia programs. However, the final criteria matched up much more closely with teachers' critical concerns about good reading, writing, sense making, and understanding. Through technology, technological goals for learning can be met. But more than that, students can come to develop and share our understandings about foundational competencies like reading and writing.

When teams presented their questions to roundtable groups or when they presented a draft of their hyperstack, they were making their learning visible to others. Once others offered critiques and suggestions (e.g.,

during the questioning roundtables or the initial presentation of the baseball stack), peers and the teacher could provide the help students needed to make improvements.

Conclusion

Current recommendations for transforming schools focus on leaving behind the dominant teacher-centered, information transmission model (the sage on the stage) to one that embraces student-student and student-teacher collaboration; scheduling flexibility; highly relevant, exploratory, integrated curricula; and democratic participation of students, staff, parents, and community in a problem-centered educational process. Prominent recommendations also point to the need for more meaningful contexts in which to read and learn, and for the greater integration of technology into meaningful learning projects. (See, for example, NASSP, 1996; Maine Commission on Secondary Education, 1999.)

The influential educational psychologist Vygotsky argued long and hard that teaching must be organized in such a way that inquiry, reading, and writing "are necessary for something, in a way that is part of complex cultural activity, not as isolated motor skills for school" (Dixon-Krauss, 1996, p. 128). Otherwise, he feared, no real learning would occur.

A design curriculum meets these recommendations for transforming learning environments and enhancing student learning. Design curriculum, according to Brown and Campione (1994), is not just about helping students to design powerful artifacts. It has an additional agenda: to transform schooling. They argue that design "synergesticly" motivates kids and motivates new ways of teaching and "doing school." Design simultaneously transforms many aspects of traditional classrooms, such as the roles of teachers, students, and community resources; of curricular design and its relationship to assessment; of instructional procedures and contexts; of the place of technology and other tools in the classroom; of the relationship of school knowledge to the real world. Ultimately, all this serves to restructure the purposes, structures, and activities of school at the deepest level. This kind of transformation of our language arts classrooms is badly needed during a time when literacy and text are being radically transformed.

This is how Jon summed up his "transformative" work with the baseball group: "We went in thinking one thing, and came out thinking something really different, and knowing . . . *really* knowing what we knew and why we knew it and why knowing it that way made, you know, sense! And before, we would have disagreed with other people, but now we could really argue with them. And probably win—because now we know stuff and how to argue with it."

Jon is describing quite a transformation. If we design classrooms in which students can design knowledge with our latest cultural tools, such transformations will become our stock in trade.

Ultimately, [design curriculum] serves to restructure the purposes, structures, and activities of school at the deepest level.

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A Word to Readers about Web Addresses

Our issue on technology contains a large number of Web site addresses. This configuration is relatively new to printed text, so we made some decisions for consistency that we want to share with our readers.

Web addresses will be kept intact on a single line, occasionally causing the line above to be unusually short. On those occasions when an address will not fit on a single line, the address will be broken at the last possible slash mark.

Web sites will not be listed in the reference section, since additional information can be accessed by visiting the site itself. We will, however, indicate who sponsors or maintains the site whenever possible.