Logo Exchange

Journal of the ISTE Special Interest Group for Logo-Using Educators

LOGO RENAISSANCE

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Peter Reynolds 97

ISTE

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Hard Fun

In *The Childrens' Machine*, Seymour Papert tells the story of one kindergarten telling student another that Logo is **hard** fun. Papert goes on to use **hard** fun as a metaphor for thinking about the deepest learning which occurs when passion, challenge, context, and purpose are all present. Any educator who has tried to make Logo or Logo-like learning a staple of the school day understands how **hard** and fun this process can be.

Logo Exchange is thrilled to publish a provocative speech by Dr. Seymour Papert. The "Father of Logo" has spent decades challenging our thinking and inventing learning tools used by children around the globe. His unbridled optimism and advocacy for children has been tireless and infectious. Although Dr. Papert is arguably one of the great minds of the 20th century, his ideas are too often marginalized. In the intellectual-free zone of educational computing his ideas are not debated or even disputed—merely ignored. *Logo Exchange* is one of the few educational publications to review his ground-breaking books, *The Childrens' Machine* and *The Connected Family*.

Papert's speech reminds us that Logo was always about more than just turtles. Since the 1960s, Dr. Papert has viewed school's ability to embrace increasingly powerful personal computers as a measure of the institution's willingness to respect and support student learning.

While the availability and power of personal computers begin to make possible the ideas Cynthia Solomon and Seymour Papert described in *20 Things to do with a Computer* (1971), many schools react with increasingly authoritarian policies and trivial computer usage. In the hands of many schools the democratizing power of the Internet is used to cover the curriculum. New laptop computers are being advertised for their ability to deliver disembodied content and take student attendance—not as powerful vehicles for learning and self expression.

Those of us still healing from the psychic scars left by our own schooling are thrilled to assist Logo's creators in realizing their visions of constructionism and personal computing. Perhaps Papert's greatest achievement was creating a transitional object (Logo) with which adults charged with the care of children could feel creative and intellectually powerful. Logo is great **fun**. I can't imagine what my life would be like without the joy of learning and teaching with Logo.

I am reminded of how much **fun** learning and teaching can be when I visit Cathie Galas' class in which 8- to 11-year-old kids create sensational Logo simulations of the brain or when I help Wesley College children program their own virtual pets. Watching graduate students and veteran teachers giggle with joy while struggling to solve a turtle graphics challenge reminds me that Logo is a powerful object to think with.

Bob Tinker makes the case that the availability of low-cost ubiquitous computing will support a reemergence of Logo. This will occur only if schools begin to trust teachers and support their desire to create rich personal learning environments for kids.

About a decade ago the citizens of Costa Rica made such a **hard** decision. They decided to leap-frog the instructionist technologies of 19th/20th century schooling and embrace the **hard fun** of Logo. They invested a great deal in professional development and in supporting the dreams of their teachers. Along the way, these educational pioneers had a great deal of **fun** and their work has inspired educators around the world. Well, it seems that their hard work and commitment to excellence is beginning to pay off. The Intel Corporation has decided to build its new $500 million chip plant in Costa Rica. Intel chose Costa Rica instead of 10 other countries because of its "well-educated, highly-skilled, highly-motivated labor pool" and "the skills of the Costa Ricans are only going to grow as a result of a MIT media program that has already placed computers in 30 percent of Costa Rica's primary schools."[1] Congratulations are certainly well deserved for our Costa Rican Logo-using colleagues.

Many of you know how **hard** it is to "shoehorn" Logo into an overflowing curriculum or justify open-ended projects in an age of national testing. In spite of the obstacles, *Logo Exchange* readers work **hard** to make schools wonderful places for children. You know how **hard** it is to sustain Logo and constructionism in increasingly

Home Work

I have always enjoyed the thinking that different Logo commands sometimes stimulate. Recently, I was working on a Logo project and things were not going well. I had moved the turtle around quite a bit and had lost track of things. What to do?

For the first time in a long while, I used the **home** command. Bam! In a twinkling, the turtle blipped to the middle of the screen, ready to start over. Cool!

As I began anew on the project, I also found myself thinking about the home command. It had rescued me from a confusing and somewhat complicated situation. It had returned the turtle to its starting point and its initial heading. In a way, it was revolutionary, because it gave me a fresh start on the problem I was trying to solve.

Suddenly, my mind was flooded with aspects of home.

Remember ever being in the home stretch, and then arriving after a long trip? The exclamation "I'm home!" has been music to many an anxious parental ear. "Home sweet home" reminds us of our hedge against the bitterness of life, a place where they have to take you in if you show up.

Got any of that good ol' home brew? Well, one mix developed into a pretty good concoction not too long ago, when two Steves had members of their Homebrew Computer Club help them develop the first Apple home computer. Let's follow that line a bit further.

Ever hear of a home truth? This is usually defined as a fundamental or key truth, especially one that is some-

what unwelcome or that is uncomfortable to acknowledge. Stay with me now.

The July 1997 issue of *The Atlantic Monthly* magazine carried a cover article titled "The Computer Delusion," in which Todd Oppenheimer described how many school districts are cutting entire programs from their budgets to free up funds to purchase computers. The problem was the home truth: Oppenheimer had difficulty finding evidence that computer use improved teaching and learning significantly in the schools.

He mentioned a few shining examples, such as Dennis Frezzo at Thurgood Marshall Academic High School in San Francisco using computers and an "advanced Lego engineering kit" (presumably LEGO® TC logo) to challenge his students to solve realistic problems, and an elementary school using computers to assist children with disabilities. Quoting from books such as *Endangered Minds: Why Children Don't Think and What We Can Do About It, Silicon Snake Oil: Second Thoughts on the Information Highway*, and *The End of Education*, however, Oppenheimer sketched out a broadly pessimistic picture and suggested that perhaps priorities have been misplaced when it came to procuring more computers for schools. This is certainly some home-cooking food for thought.

Anything else for home? How about a home remedy? In a recent lament about the sorry state of learning with technology and computers in the

schools, Seymour Papert suggested that "the locus of innovation in thinking about learning is moving rapidly out of the school and into the home." Home education and home learning with a home computer have the potential to create a force for change that schools might not be able to ignore. If children (and parents) begin doing things at home with a computer that are more interesting, more stimulating, and more challenging than at school, won't the schools have to respond? Hmmm. This could get interesting, folks.

Like the home command, have we now come full circle in education, back to where education started in the first place — in the home? Perhaps we'll soon see if that is so. In the meantime, let's keep the home fires burning — and don't forget to do our homework!

FD 100!

PS: Speaking of home, my family and I have blipped to a new one! 105 Hickory Drive, Murray, KY 42071, to be exact. My new professional home is at Murray State University, teaching science education and working with nearby schools. Ⓛ𝐗

Tom Lough, Founding Editor
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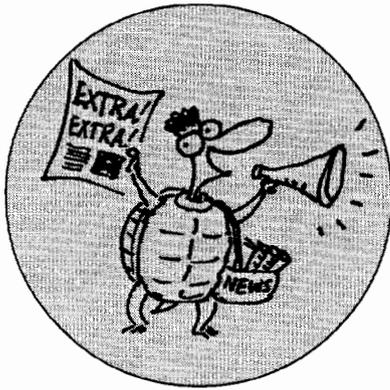
Logo News

EuroLogo 1997, Budapest, Hungary
August 20-23, 1997
by Dr. Brian Harvey,
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Here are my impressions from EuroLogo. I wasn't in every session, so this isn't an authoritative report! There was some tension between the original idea of Logo as a tool for learning mathematics (that is, for learning how to be a mathematician, which may or may not be connected with school math) and the newly influential school subject of Informatics, into which a lot of recent Logo-related effort is going in Europe. A plenary session with Celia Hoyles and Richard Noss (UK) on the first day included a strong reaffirmation of mathematics as the goal. Mike Doyle (UK), who ran the last EuroLogo in Birmingham, strongly argued the intellectual case for the computer as a new thing that shouldn't be understood in terms of old topics. Many more pragmatic presentations were about using Logo in various countries as part of the national Informatics curriculum. The long-standing tension between reform and revolution is still in evidence, although reform seems to be winning. That is, most people are talking about using Logo in the context of public schooling (in the American sense, not the British sense), not about creating alternative institutions.

In contrast, what struck me most strongly was something outside of the conference itself, as I walked around

Budapest. The kids there are completely unafraid! Maybe I'm romanticizing because I don't speak the language and could only judge by body gestures, but I had a strong sense that kids don't look over their shoulders expecting to be told to stop doing something. At the conference, I did a workshop about logic puzzles in which most of the participants were around junior high age. Because of language problems, I wasn't able to give them as much one-on-one help as I would have liked, so a lot of them were stalled on small notational issues a lot of the time, but they all maintained a cheerful demeanor and apparent interest.

This experience suggests to me that reform instead of revolution might be okay in Europe, or at least in Budapest. Maybe kids' lives are basically okay there, and maybe the schools really are pretty much okay places. I certainly got the impression that Hungarian adults actually like kids.

I was excited by Comenius Logo, a commercial product called by various other names in assorted countries. It's too bad it's commercial, but it combines real support for multimedia glitz (e.g., movies and melodies are first-class objects; they can be members of lists, arguments to procedures, and so on) with real support for debugging (pause, trace, and the like). MSWLogo, a free extension of Berkeley Logo, has a similar spirit; both are widely used in Europe. A team in Greece has made another extension to Berkeley Logo to allow dynamic extension with new sets

of primitives. For example, the turtle commands are removed from the core language and are just one of several loadable sets. They showed a "variation" tool that lets you track graphically the effect of changing a parameter to a procedure with sliders.

Disclaimer: I'm a software developer and computer hacker; a classroom teacher probably would give you a completely different report!
—**edited by Jeff Richardson**

Learning In a Multimedia World
A Residential Workshop for Computer-Using Educators, Presented by Gary Stager and Fred D'Ignazio
by Brenden Morris
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Multimedia and the multimedia-ready version of MicroWorlds 2.0 offer an ideal environment for students to explore learning in a collaborative, constructivist, student-driven, and opened-ended way. The workshop presented at Avalon in Victoria, Australia, demonstrated not only the software and hardware that teachers and students can use to explore multimedia as a learning tool, but also modeled the learning environment and philosophy that suits the use of this tool. This may well become the classroom model of the future.
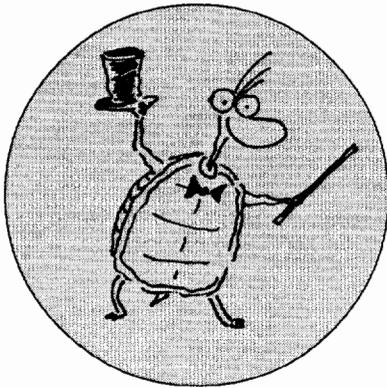
Logo's Return

by ROBERT TINKER

There are major changes in the wind that will bring some important opportunities to the Logo community. Computer costs are finally dropping, with the eMate and WebTV starting a trend that will end with $200 computers in this academic year. Ubiquitous computing will finally be within reach of every student, and this will make it possible for us to finally realize the dreams of vastly better education fueled by technology.

Big visions for education have been articulated by technology advocates for two decades. Pessimists have termed these "faded dreams" that have yet to be realized in any substantial way, and they use this non-result as a way of discrediting the entire idea of using new technologies in education. I believe, on the contrary, that we are on the threshold of realizing these dreams. Computer technology and networking, and knowledge of how to use them in education, are only now sufficiently evolved to have a huge impact on improving education.

The key barrier to date has been that the technology is too expensive to give learners sufficient exposure for them to master and appropriate these technological tools for their own use. With the recent emergence of low-cost computers specifically designed for students, schools can finally redesign their entire educational offerings on the assumption that every student has continuous, ready access to powerful, networked computers. The implications of this change are momentous, urgently need to be explored, and can be studied only in a real, functioning school district devoted to large-scale experimentation and supported by the best experts available.

The problem posed by information technology is that its best use in education, as it is in business, involves learning and applying tool-like applications such as word processors, spreadsheets, programming languages, and other specialized tools. For maximum benefit, the user must invest substantial time to learn the full set of functions each tool offers and then change one's own thinking patterns to exploit the new options the tool creates. For instance, the power of a

> **Now that ubiquitous computing is near, Logo can reemerge to take the leading position in education it deserves.**

word processor cannot be realized just by typing in an essay, running a spelling checker and printing out the result. Only when the user is familiar with outlining and able to move sentences and paragraphs around fluidly, can the word processor really help to conceptualize an essay and help the writer capture its logic succinctly in powerful, expressive words. In addition to very general "productivity" tools, the last two decades have seen the development of dozens of tools designed especially for education, such as Logo, the Geometer's Sketchpad, and probeware, that have proven effective. Each of these require an investment of time to master before returning rich educational dividends.

Becoming fluent with technological tools takes time. Even if there were more computers available in school, there is not enough time in the school day to make the required investment. For most teachers today, we cannot use time at home for this investment because we cannot assume everyone has access to a computer at home, and to pretend otherwise would put students from poor families at an unacceptable disadvantage. The result is that most students exposed to information technologies gain only a very superficial understanding of their capacity, and teachers cannot rely on student facility with technology to change instruction in any major ways. Unless schools can provide computers for home use, home time is unavailable for using computers and, as a result, regular tool use in instruction is almost impossible.

This year, the situation changed dramatically with the introduction of the first rugged, inexpensive, portable, networked computers designed specifically for education. Two commercial entries, the Apple eMate and the NetSchools StudyPro, represent what could well spark the revolution in education technology that visionaries have been predicting. Until this year, computer manufacturers have used the steady improvements of the underlying technologies to produce ever-faster, larger, more sophisticated computers at approximately the same price. The new class of educational computers is unique because for the first time adequate perfor-

mance is made available at a lower cost in a package designed from the ground up for education. Both computers substitute flash RAM for hard drives and depend on networking for extended memory as well as communication. As a consequence, there is a more rugged computer with no moving parts, longer battery life, instant-on convenience, and lower cost. The result is an affordable portable computer that schools can give to every student.

The educational implications of this new class of computers are enormous, because (1) we can now have regular computer-based home assignments for all students, (2) we can use the technology to engage parents and care-givers in their students' learning, (3) we can assume student fluency in tools, and (4) we can restructure the curriculum to exploit this capacity.

Technology alone, no matter how promising, cannot cause educational change. We urgently need models for the intelligent implementation of this technology to support curricula, meet standards, and then improve the curriculum and set more ambitious standards for the future. What little research that has been done on "ubiquitous computing" supports the idea that huge improvements are possible, but it cannot provide guidance for the environment we can create now, with networking, portability, software, and care in implementation not represented in prior research. We must move quickly to seize the opportunity presented by the new technologies and show how it can enable our vision of a vastly improved education for all.

Information technologies can have four different levels of impacts on the curriculum:

Level 1. *Module replacement.* At the first level, information technologies are used to accomplish the existing curriculum goals by doing them better or to a higher level of student comprehension. For instance, labs based on probes connected to computers have the ability to reach very high levels of student comprehension of material previously mastered by few students.

Level 2. *Addition.* At this level, technology makes it possible to achieve new curriculum goals, usually by adding new material to an existing course. For instance, the TERC Global Lab project adds to existing science courses the possibility of international collaboration on environmental investigations by creating groups of schools linked through telecommunications.

Level 3. *Disciplinary restructuring.* At this level, the capacity of information technologies makes it possible to redesign a course or series of courses within a discipline. For instance, graphing can be introduced far earlier in the math sequence, giving students skills to help speed their understanding of many concepts that might have a graphical interpretation.

Level 4. *Interdisciplinary restructuring.* At this level, technology supports the redesign of courses across disciplines. For instance, if modeling using system dynamics was learned in ninth-grade math, then subsequent science courses could use this capability to address a broader range of science material at a deeper level.

These four levels involve increasing difficulty and educational payoff as illustrated in the Figure. Clearly, the first level is simplest to implement, because it is easy to substitute an improved, technology-based approach to a topic for a less effective one. This strategy has given rise to tens of thousands of small computer programs. The ease of imple-

mentation has often outweighed considerations of quality; just because the material is treated with technology does not guarantee that the learning is better. As illustrated, when there is a low level of technology implementation, there is sometimes a negative educational impact that can result in less learning.

Level two is more difficult to implement because curricula represent a zero-sum game: for every topic added, something must be dropped. Making curriculum changes and justifying them to all the concerned educators and parents takes time and effort. This it the level envisioned in the science and more-ambitious math standards. In the Figure, this level is shown as leading to linear gains, because the educational gain is proportional to the amount this strategy is employed. Most current efforts to use technology in education are considered successful if reach this level and actually show some payoff from the technology. We take this level as a starting point and plan to use project resources to go further.

Levels three and four represent the
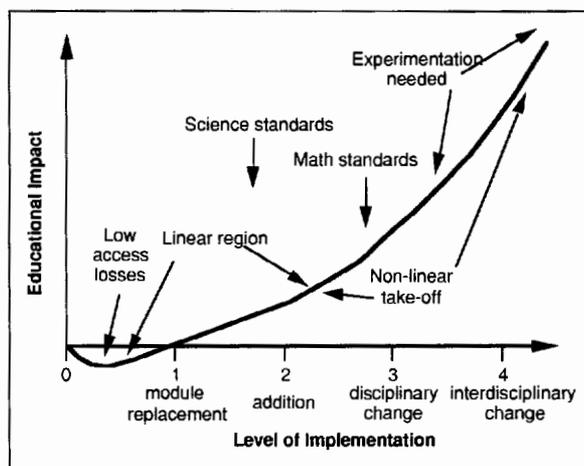
Figure: A representation of the potential educational gains for various levels of use of information technologies.

large-scale curriculum changes that are possible only with ubiquitous technologies. Changes of this nature promise the greatest rewards, providing students with far deeper understanding of much more content than is currently

expected. The gains are represented in the Figure as non-linear because implementations at one point in the curriculum have a ripple effect, permitting changes in all future studies. Such large-scale changes are difficult to implement in a single class or grade, because their graduates might not have the familiar set of knowledge and because transfer students will face difficulties. As a result, such really large-scale changes have not been practical in the past. Now for the first time, it is possible to dream of the kind of major education improvements that result from level-four implementations.

A mix of tools will be needed, but first and foremost among them should be Logo. Because it is a programming language, Logo is likely to be the tool with the largest potential payoff across the curriculum. Furthermore, there are three decades of research and extensive classroom experience on its use. It is frustrating that there is a perception in the educational community that Logo has been tried and rejected. In my opinion, it has had a bum rap because it was simply too far ahead of its time.

Now that ubiquitous computing is near, Logo can reemerge to take the leading position in education it deserves. We need to prepare for this re-emergence by codifying what has been learned, developing increasingly Web-friendly Logo, and developing the capacity for a massive teacher professional-development effort. We also desperately need testbed schools willing to provide leadership in implementing level-four curriculum changes based on a mix of technology tools where Logo plays a prominent roll. **(LX)**

About the Author

Dr. Robert Tinker is the Director of the Concord Consortium. For many years he was associated with TERC where he helped develop the Global Lab, National Geographic KidsNetwork, and the Personal Science Laboratory.

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The workshop modeled a classroom in which the teachers acted not as conveyors of information but as facilitators of student-driven exploratory learning. The students of the workshop decided on projects for exploration using multimedia as the platform and formed groups based on a common interest. The presenters helped by challenging groups to not limit themselves but to be ambitious. Ideas were generated when participants made a suggestion of an area of interest to pursue, ranging among such subjects as "design a simulation of a garden growing," "make a multimedia project about making a multimedia project," or "a presentation about gold"—all very broad and open topics.

As students, we chose a project, and individual focus and enthusiasm were generated immediately, as everyone was working on something they found interesting. Each group decided on a direction, divided the job into a number of tasks, and allocated group members to do each of them. We then set about exploring. We had at our disposal video and video-editing software, digital cameras, microphones, modems and the Internet, keyboards and midi software (even a digital guitar), and MicroWorlds 2.0 to tie it all together.

The institute program allowed for large chunks of time to devote to the task at hand, which was a necessity as most of the learning was through exploration. Groups worked within the same space, and we were encouraged to help each other solve problems. On three occasions during the two-day workshop, we were all gathered together to "demo or die," where all groups demonstrated their progress to-date and told of their trials and tribulations.

Gary and Fred were always on hand, moving among the groups, offering advice and challenges, providing tutorials on some of the hardware and

software, and providing encouragement. To break up the time, Gary and Fred gave short presentations on their work and ideas, and led debates on current educational philosophy.

At the end of the two days, we had learned a great deal about using multimedia and had also experienced a learning environment that is ideal for facilitating the type of learning that will allow students to make the most of multimedia as a tool in their own learning.

StarLogo Models Available for Download

The Tufts University project, Making Sense of Complex Phenomena through Building Object-Based Parallel Models, has many StarLogo models available for download on their Web page. They encompass a variety of different traditional content domains including mathematics, physics, chemistry, biology, economics, engineering, art, and the social realm. Many of these models have been designed to be used in schools as so-called "extensible models"—that is, first used for demos, then for exploration, and finally for modification of the underlying assumptions (and code) of the models. These models include lots of accompanying explorations and activities.

This project is closely linked to the Connected Probability Project. As a result, many of the models explore what global effects can be achieved using probabilistic distributions and algorithms.

The web page is at:

http://www.tufts.edu/as/ed/cm/index.html **(LX)**

Send Logo News to
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The Cyber Self

Life on the Screen: Identity in the Age of the Internet

Sherry Turkle

1995, Simon & Schuster (New York)

ISBN: 0-68480-353-4

It is now over a decade since *The Second Self: Computers and the Human Spirit* burst into our lives, precipitating what was for most of us a very different way of looking at computers and at ourselves, both in combination and by contrast. Of special interest were a number of issues, brought into focus by the presence of computers, relating to what it really means to be "alive" and to be "human."

During the intervening period, there has been a great deal of change in the attributes and capabilities of computing technology and, consequently, in the use we make of it. The computer of the 1980s was "personal" not simply in our striving for individual ownership of the hardware, but in the relationship between user and machine. For the most part, interactions between computer and user were on a one-to-one basis. In many instances the software interface, which for the majority of users effectively "is" the computer, was deliberately personified, adopting a range of tones and stances according to the purposes of the software and the imagined characteristics of the user. Beyond this level of anthropomorphism lay a number of inadvertent expectations and reactions to computers shaped by the heavy reliance of most interfaces on language

and by much of the imagery implicit in the terminology of computing, such as the concept of artificial "intelligence." Small wonder that these artifacts, apparently possessed of at least two of the defining characteristics of human beings, could be seen as occupying an ambiguous and complex position relative to their users.

> Underpinning the argument of the book is a rich and subtle understanding of the extent to which a culture of simulation is increasingly permeating our lives

The computer of the 1990s is a very different kettle of fish. The relationships currently enjoyed by users are less commonly with the computer as an entity in itself than with a range of other users, or with information, accessed through the computer but physically remote from the desktop. The once personal, personified machine, its functionality residing unequivocally within the boundaries of the plastic container atop the individual desk or lap, has been transformed into a conceptually transparent conduit or gateway to rich and complex environments of interaction. It is these new worlds that provide the context for Turkle's more recent work, in which the focus shifts from the general issue of what it means to be "hu-

man" to the vexed but eternally intriguing question of what constitutes "reality" and, most particular, the "real" self.

Underpinning the argument of the book is a rich and subtle understanding of the extent to which a culture of simulation is increasingly permeating our lives, its practical manifestations both encouraged by and giving support to various strands of contemporary philosophy and theory, in particularly aspects of postmodernism. It is an extremely "personal" book in the most satisfying sense, in that its insights derive from a unique blend of direct personal experience and depth of scholarship in what many would justifiably regard as fairly diverse areas.

The book falls into three fairly discrete but thematically linked sections within which individual chapters address in considerable depth the new directions and styles that characterize recent developments in computing. While the first two sections provide a wealth of fascinating and extremely accessible discussion of a range of concepts and practices sometimes regarded as a trifle esoteric, it is perhaps predictable that the casual reader (including most of my tertiary level students) makes a beeline for section three, On the Internet, arguably less "technical" in focus and of most obvious relevance to their personal lives. This section addresses the issue of the special opportunities provided by the Internet for a person to construct and enact a multiplicity of identities. While the traditional beliefs

John St. Clair

by JIM MULLER

In 1984, Apple Computer Inc. made a bold move to advance the use of computers in California schools. They gave an Apple IIe and Apple Logo to each public school in the state. This is how John St. Clair was introduced to Logo. As he describes it, "it motivated me to learn more about computers."

Logo fan(atic)s around the world are certainly glad John became motivated. He has become an active Logo spokesperson serving on the Board of Directors of the Global SchoolNet Foundation and moderator of Schl-sig-logo and Logo-L listserv. In his "spare time," he is technology teacher and mentor at Vina Danks Middle School, Ontario, California.

How did you get started using Logo?

I started using Apple Logo with my kindergarten students in 1984 because that was the only software that was delivered with the free computer from Apple. I was amazed at how creative my kindergarten students were at drawing geometric designs using a single-key Logo procedure that I wrote for them.

What did others in your school think?

Actually, I was the only teacher in my school district who was enthusiastic about using Logo. I enjoyed reading *Logo Exchange* articles to get ideas and support for what I was doing. To get more people interested, I used more user-friendly versions of Logo, as they became available such as Apple Logo II and LogoWriter.

What did or do you see in Logo? What got you so interested?

There are two things I like about Logo. Students with low academic abilities are able to be successful using Logo and students with high academic abilities are challenged to be independent learners. I now work with all levels of students including limited English- speaking students and those learning disabled students who can't read. It is very gratifying to see "wanna-be" gang members get excited about making the turtle draw a car or a truck, to see them truly earn an "A" grade in my class. I always hope that some of those students will remember what it was like to succeed in my class and give that same effort towards making a better life for themselves.

What have you done to get others involved?

Out of necessity, I have become a great believer in on-line communication. After I became a technology mentor-

teacher in my district, I became the sysop (systems operator) of the local FrEdMail BBS. I pushed for a Logo newsgroup topic on FrEdMail so that I could get in touch with other teachers who used Logo. Through this group, I did several LogoWriter project exchanges with teachers from Nebraska and Pennsylvania. When FrEdMail incorporated as a non-profit foundation in 1991, I became a founding member of the Board of Directors. It is now known as the Global SchoolNet Foundation (GSN). When Michael Tempel, President of the Logo Foundation, and Al Rogers, Executive Director of Global SchoolNet Foundation, asked me to be a co-moderator with Michael of the Logo-L listserv, I was delighted. There are now close to 300 Logo subscribers worldwide, including those from the Logo newsgroup. I handle technical difficulties, read and cross-post messages from comp.lang.logo (the Logo Usenet newsgroup). *To join Logo-l send subscribe logo-l in the body of an e-mail message to majordomo@gsn.org*

What happened to your Logo work as you developed this electronic network?

In 1992, I moved from teaching at a K-1 school to teaching at a middle school with sixth- to eighth-grade students. I currently spend all day in a computer
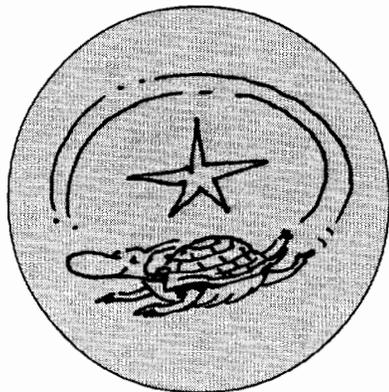
Self-Organizing Behavior

StarLogo is used primarily for modeling systems that have no leaders. Some examples of these leaderless, or self-organizing, systems in our everyday world are bird flocks, traffic jams, and termite and ant colonies. StarLogo provides a useful means for students and researchers (and we are all researchers of one sort or the other!) to study and manipulate models of these systems to understand their dynamics.

To help familiarize yourselves with the modeling power of StarLogo, we'll create a program step by step to model a colony of termites. The intent is to introduce some turtle and patch commands, as well as an understanding of programming, in StarLogo. You will also learn to make simple changes to StarLogo programs.

Tutorial

Before we go on, be sure to obtain StarLogo and install it on your computer. [At the time of this writing, only Macintosh computers are supported.] See the end of the column for ways to obtain StarLogo.

As we go along this tutorial, we will ask you to type some things on the computer. These will be in **Bold** letters, so it will be easy to figure out when and what to type.

Start up the StarLogo program, and select the "New" menu command from the "File" menu (File/New) to start a new model.

We'll be doing some of our work in the Command Center and some in the Procedures window. You can find each

of these in the "Windows" menu if they are not visible. We'll start by using the Command Center.

The first thing we need to do is create some "turtles," which we will call termites. (We'll call them turtles, too, because that's what StarLogo calls them).

An easy way to create turtles is to use the create command: crt 100, which will create 100 turtles on our screen. Type **crt 100** into the Command Center window, followed by a Return (or Enter).

You might be asking, "Where are all the turtles?" because there is now only one spot in the center of the Graphics window. Well, they're actually stacked up on top of each other. Also, they won't really look like turtles, they will look like colored spots. [In future columns, I'll describe a way to use turtles with unlimited shapes.]

Try typing **fd 10** (with Return) into the Command Center. And there they are! Because they all have a slightly different compass heading, their moving forward creates a circle.

Also notice that you typed **fd 10** only once, and all 100 turtles moved at the same time! Each command you type is used by all the turtles.

Let's put these first few commands into a setup procedure, which is a collection of instructions, such as the ones you have typed in the Command Center, with a name attached. To use a procedure, all you have to do is type its name.

All procedures are entered in the

Procedures window. Find that window and type:

```
to setup
crt 100
fd 10
end
```

Remember that the word "to" begins every procedure. Unlike commands typed in the Command Center, procedures typed into the Procedures window are reusable until changed or deleted.

Let's try out our first procedure. First type **ca** into the Command Center to clear all. Now type **setup**, and watch our turtles appear. Typing setup caused the setup procedure to run.

But what if you don't want to have to type ca every time before starting over? Incorporate that into the setup procedure, too:

```
to setup
ca
crt 100
fd 10
end
```

Now our screen will be automatically cleared each time we type setup. Try it.

To make this even easier, let's create a setup button. Then, when we press the button, it will do the procedure setup without our having to type anything in the Command Center.

Click on the Interface window (or use the Windows/Interface menu item), and choose the blue button icon in the palette. Now click in the empty Interface window to make a button.

When a dialog window pops up, type **setup** in the box where it says logo instruction. Then click OK.

Now you have a setup button that when pressed will perform your StarLogo procedure called setup, which will create 100 turtles and move them forward. Try pushing the button.

Now that we have 100 turtles (or termites), let's give them something to do. Why don't we create objects called woodchips. Then we can give the termites certain rules about what to do with the woodchips.

Let's make all of our termites red and our woodchips yellow so we can tell them apart.

To do that we say: setc red to set the color of the termites to be red. Type **setc red** in the Command Center.

Now add that to your setup procedure:

```
to setup
ca
crt 100
setc red
fd 10
end
```

We're now ready to create the woodchips. Let's use yellow-colored patches for the woodchips to contrast them visually from the termites. This will be only a little trickier than creating turtles.

What we want is one out of every five (20%) patches to have a woodchip. We'll use a random number to do this. A random number is one that the computer picks, kind of like out of a hat. We're going to ask the computer to pick a number between one and 100. If the number is below 20, then we'll drop a yellow woodchip; otherwise, the patch will stay black indicating that it is empty.

So, let's put these ideas together to create the woodchips. Type this in the Command Center:

```
if (random 100) < 20 [setpc
yellow]
```

This says that for each patch, if the number you get from "random 100" is less than 20, do what is inside the

square brackets. The other 80% of the time, do nothing and leave the patch black. Unlike setc, which is used for turtles, setpc sets the color of the patch. StarLogo understands that because setpc is a patch command, that this entry applies to all the patches instead of the turtles. As with the turtles, each patch executes this command line in turn.

Add this command to the setup procedure, which now looks like this:

```
to setup
ca
crt 100
setc red
fd 10
if (random 100) < 20 [setpc
yellow]
end
```

Now when we press the setup button, we see red termites and yellow woodchips.

We've completed the setup procedure for our program and learned something about making a lot to termites, coloring things, and using procedures.

So now let's make our termites interact with the woodchips. To do this, we need to make them move around and do something.

Let's have the termites search for woodchips and place them into piles. There are three rules that each termite needs to follow to successfully do this:

- If you see a woodchip, pick it up
- Search for another woodchip (presumably in a pile of at least one)
- Find an empty space near that pile and put this woodchip down

We'll start with a go procedure that will call these three rules. Type the following into the Procedures window, after the setup procedure (for clarity, leave a blank line between the procedures):

```
to go
;;search-for-chip
;;find-new-pile
;;find-empty-patch
end
```

The two semicolons mean: Ignore everything after the semicolons on this line. We use them because we haven't yet written these three procedures, and StarLogo will complain until they exist. Later, when the procedures are written, we'll remove the semicolons. [Semicolons are also very useful for embedding comments and notes in a program.]

Let's write the procedure called search-for-chip. In search-for-chip, we want the termites to first find a woodchip. How about this: If the termite moves over a yellow woodchip, then it removes it from the patch.

To do this we type this in the Procedures window after the go procedure:

```
to search-for-chip
if pc = yellow [stamp black
jump 20 stop]
end
```

What this means is that every termite checks whether the patch it is on is yellow, and if it is, turn it to black, jump far away, and stop executing this procedure.

So far, we have search-for-chip changing yellow woodchips to black to indicate that they have been picked up and are no longer on the ground.

But what if the termite isn't on a patch with a woodchip? We don't want those termites just standing around doing nothing! (What would Henry Ford say?) Let's get the termites to move while they search.

First, we'll write a simple moving-around procedure. We'll call it wiggle:

```
to wiggle
fd 1
rt random 50
lt random 50
end
```

This procedure just moves the termite forward one unit and then wiggles by turning randomly a little to the left and to the right.

Let's also change our search-for-chip procedure to do the wiggle before checking for a woodchip, and to keep going as long as it hasn't found one. Find the search-for-chip procedure in

the Procedures window and change it to look like this:

```
to search-for-chip
wig
if pc = yellow [stamp black
jump 20 stop]
search-for-chip
end
```

Now click on the Interface window. WHOOPS! I'm sorry. I made you make an error, and a pop-up box shows you what it is: StarLogo doesn't know anything about a procedure called wig. Sometimes errors will occur during programming, and a pop-up box will help you figure out what went wrong.

Click OK in the pop-up box, and change wig to **wiggle** in the search-for-chip procedure. That should fix the bug in our program.

Before, when we made the go procedure, we put semicolons in front of the procedures until we wrote them. Well, now we've written the search-for-chip procedure, and we can remove the semicolons from in front of it. The go procedure should now look like this:

```
to go
search-for-chip
;;find-new-pile
;;find-empty-patch
end
```

Test our go procedure by typing **go** in the Command Center. This will result in the termites moving around and turning many of the yellow woodchip patches to black. Of course, the red termites will be covering the black patches, so you won't be able to see them yet.

So far, so good. Save our work up to this point. Use the File/Save As menu, and type your name as the file to save. Click OK. It's a good idea to save your work regularly, even as you are working.

Now get the woodchip-carrying termites to keep searching for other woodchips. This procedure will look a little like search-for-chip:

```
to find-new-pile
```

```
wiggle
if pc = yellow [stop]
find-new-pile
end
```

All we had to do for find-new-pile was tell the termite to wiggle and, if it sees a yellow woodchip, to stop executing this procedure. Otherwise, keep looking (do find-new-pile again).

Test our latest procedure by typing find-new-pile in the Command Center. The termites will move around looking for another yellow woodchip and then stop.

Good, we've written the second of our three rules, so we can remove the semicolons from the find-new-pile call of the go procedure. It should now look like this:

```
to go
search-for-chip
find-new-pile
;;find-empty-patch
end
```

Now, we're ready for the last step: finding an empty patch to place the woodchip.

We know a patch is empty if it's color is black; that is, if pc = black.

To drop the woodchip, we make the black patch turn yellow by stamping it yellow. Here's the last rule:

```
to find-empty-patch
wiggle
if pc = black
[stamp yellow
stop]
find-empty-patch
end
```

Here we tell the termite to wiggle, and if it finds an empty (black) patch, stamp the patch yellow (the same as dropping a yellow woodchip) and stop. If not, keep searching for an empty patch.

After they've found an empty patch and dropped the woodchip, we want them to get-away and look for more woodchips. If we don't do this, the termite will likely pick up the same woodchip and start all over again in the next round.

Let's write a simple get-away procedure to accomplish this:

```
to get-away
seth random 360
jump 20
if pc = black
[stop]
get-away
end
```

Seth random 360 sets the heading of the termite to be some random compass direction from zero to 360 degrees. jump 20 is similar to fd 20, but much faster, more like teleporting. If a termite lands on a black patch, stop executing the procedure. Otherwise, keep jumping to get away.

Add get-away after it puts the woodchip down in our find-empty-patch procedure:

```
to find-empty-patch
wiggle
if pc = black
[stamp yellow
get-away
stop]
find-empty-patch
end
```

Test our last rule by typing **find-empty-patch** in the Command Center. The termites will move around looking for a patch to drop their yellow woodchips and jump away.

We also must change the go procedure because all the rules are now written:

```
to go
search-for-chip
find-new-pile
find-empty-patch
end
```

Now all our procedures are complete and tested!

Unfortunately, our go procedure tells each one of our 100 termites to move a woodchip to another pile, but only one time. What we need is a button to run the go procedure over and over again.

MicroWorlds for Munchkins

by GARY STAGER

Since the 1960s, Logo was intended to have no threshold and no ceiling. It derives its magic from how little kids and graduate students find the same environment challenging, exciting and expressive. Although a variety of forces have conspired to make MicroWorlds use most common in fourth through seventh grades, little kids can use it in quite creative ways. Much has been written about how MicroWorlds can be used to enhance the learning of secondary school concepts. This column makes the case for using MicroWorlds in the lower primary grades.

A Great Value

Schools that own MicroWorlds site-licenses already have a "free" multimedia paint, animation, music and web-page creation software appropriate for young learners. There are many entry-points through which children may enter the world of MicroWorlds.

Painting the Picture

At its simplest level, MicroWorlds is a terrific paint program for little kids. It has everything but 100 different ways to erase your creation. Kids can paint with the paint tools, stamp pre-defined shapes or create their own shapes to stamp. Make a new page, add a button to go to that page and create the next picture. Add a text box to the page and an illustrated story, poem or report is born. All of the techniques associated with process writing can be applied to the experience.

Painting a picture...

Click on the drawing centre to open the paint tools

Paint your picture

Hatch a turtle by clicking on the eye tool

Open the shapes centre to choose a "stamp"

Click once on the shape of your choice or double-click on a shape to edit it

Click on the turtle to change its shape

Choose the magnifying glass (+ or -) from the tool menu and then click on the turtle to change the size of the turtle

Choose the stamp icon from the tool menu and then click on the turtle to leave its fossil on the screen

Drag the turtle to another position and stamp it again (or change its shape)

Remember that there is still a "live" turtle on the screen so be sure to cut it with the scissors tool or hide it with HT

Creating multiple pages

Choose Pages-New Page

Choose the button tool and click it on the screen in the position where you wish the button to appear

Type the name of the page you wish to turn to in the *Instruction*: line

Select Once

If you don't like the appearance of MicroWorlds buttons, hatch a turtle, dress it in a great costume and make its instruction the name of the page you wish to turn to.

Put a transition on a page

Choose Pages-Transition...

Select the transition you wish to use

Click OK

The transition will appear whenever this page loads.

Getting Moving

Why should little kids be limited to mindless drill or painting pictures? Even early readers can program MicroWorlds to perform simple animations. Write or print the names of simple turtle graphics commands (FD, BK, RT, LT, SETSH) with sample inputs on index cards next to the computer. Names of the standard turtle shapes next to their pictures may also be placed on reference cards.

Baby animation

Hatch a turtle

Turn it in the desired direction by clicking and dragging its nose

Open the shapes center and select the shape you wish for the turtle to wear

Click on the turtle

Click the eye tool on the turtle to edit its instruction

Type the command, FD 5, in the *Instruction:* line

Select Many Times

Click on the turtle to make it go and repeat the process for additional turtles

Encourage kids to change the distance (number) by which the turtle goes forward and observe what happens.

Kids can even program colors to make a turtle reverse when it hits the brown mountain (see the MicroWorlds online help or users guide to learn how).

Toddler animation (flipbook animation)

Follow the same steps as above, but add a command such as, SETSH [bird1 bird2] FD 5, in the *Instruction:* line of the turtle. These instructions may be written on student reference cards.

You can find out the name of turtle shapes by opening the shapes centre and holding the mouse over the shape (in Windows 95) or double-clicking on the shape (Macintosh).

Making Magic

Five year-old John Richardson uses MicroWorlds to tell stories, create insect reports and even design copies of his favorite commercial software products like *The Logical Journey of the Zoombinis*. Making software is not beyond the imagination of young kids. Why not make your LEGO rocket fly on the computer screen? In the past it was impossible for pre-readers to program computers.

Kids like John can hatch turtles, design turtle costumes, paint backgrounds, create multiple pages, compose music and record narration and sound effects without assistance. They can even create simple animations by typing the commands prepared on teacher-made reference cards.

After John creates all of his desired objects, he directs his Dad in how to program motion and interactivity. This process is quite similar to when pre-writers dictate a story to an older student or adult. The advantage of Micro-Worlds is that projects require the use of mathematical processes, different sense, and action.

The success of early-childhood MicroWorlds projects is dependent on three factors:

- sufficient computer access
- adult support
- a great open-ended tool (Micro-Worlds)

After little kids spend a few years "messing-about" with MicroWorlds they will have the fluency required to tackle more complex problem solving in specific school subjects. These children will appreciate the intellectual satisfaction and joy associated with teaching the computer to do something it may never have done before. **LX**

About the author

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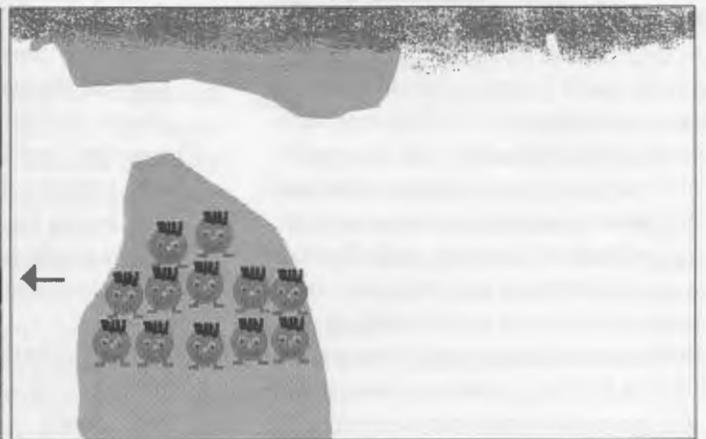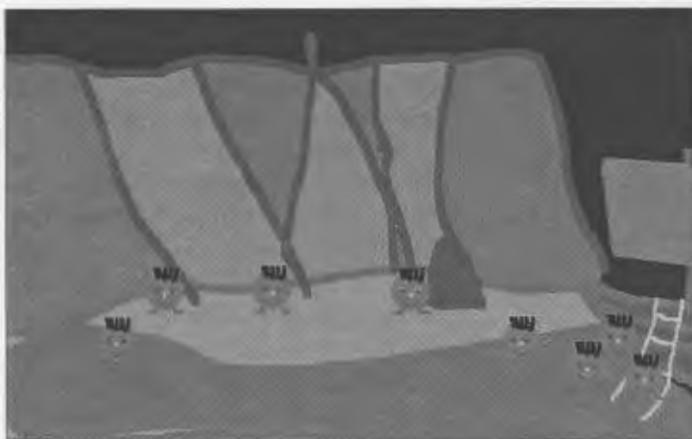
Graphics by John Richardson, Clifton Hill, Australia

Looking at Technology Through School-Colored Spectacles

by SEYMOUR PAPERT

Illustrated by Peter Reynolds

Presented at the MIT Media Lab, June 4, 1996, at an event sponsored by The American Prospect Magazine.

I'd like to give an overview of some direction of writing that I've been trying to develop and I've been engaged in over the last year and has engaged me in a lot more talking than I usually like to—listening too. And that is the kind of discourse going on about technology in education. That is, a slightly different slant on it. I usually jump in and I know what I want to say and I know what will happen and I have a particular thing to position in those debates. But I thought recently that it might be a very interesting thing to stand back and look at the nature of the debate, what is going on and what kind of positions people are taking and most important, what positions are people not taking. If this little talk has a title it's something like "Looking at Technology through School-colored Spectacles." Basically my thesis is that the idea of school in many of its features is so deeply ingrained in people's thinking that when they look at technology to discuss it in relation to computers, they see it in a particular and very narrow way dominated by the nature of school as they've known it. And so, it is not surprising that the discussion and not only the discussion but the serious research and the large amounts of money and people's time being expended on technology in education really consists on taking sides about an enterprise that consists of in-jecting technology into an otherwise unchanged school system and then coming to the conclusion that is not going to change school very much.

Now, some people of course think that it is a good thing that it is not going to change school very much, it will just make it work better. They think it is a good thing and that's OK. That's one position. But then there are the others who think that it is a bad thing. That school ought to be changed - that they don't see technology as the potential agent for changing it. Then of course there are the people; those are really the two camps.

Way back in *Mindstorms* I used a little parable that I find useful for guiding thinking. The parable is about a brilliant engineer around 1800 who invented the jet engine. Since he was dedicated to improving transportation, he took his invention to the people most involved with transportation, namely the makers of stagecoaches. He said, "Look I've got this thing. Find out how to use it." So the makers of stagecoaches looked at it and they said, "Well, let's tie it on to a stagecoach and see if it helps the horses." So they tied the jet engine on the stagecoach and of course it shattered the stagecoach to pieces. So that wasn't any good.

However, somebody got a brilliant idea, "We'll make a tiny little jet engine. And we will put that on the stage-coach, and it won't shatter it to pieces. Besides, its price is affordable. In fact, very careful statistics managed to show that this did have a minor affect on the performance of the horses. I hate to say it, but I do think that this is a very accurate portrayal of not only what is being done with computers in schools, which wouldn't be so bad. In fact, it's not an accurate portrayal of what is being done, because here and there, there are scattered attempts to do (more), scattered people are doing much better with the computer than that (parable) would imply. But overall on the average its what is being done. What I find very serious is that in the talk about computers in schools, the stagecoach model fits exactly.
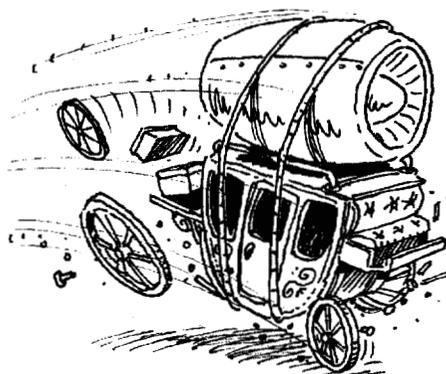
Namely, what is exact about the stagecoach model is that these people have a certain idea about transportation, namely you have this wooden box and you put people in it and you have horses that pull it and it runs on wheels and so on. Within that concept of transportation they did the best thing with the jet engine that anyone could probably do, which was to get rid of it, I suppose.

And I think if your concept of

school is what school is as you've seen it in the past, well what else would you do with the computer except put it in there? But why is there no discussion about whether school could be very different, and how different it could be? Now, very different can mean very different things to very different people, to everybody.

So, I'd like to run through a few of the features of school which I think very clearly, or at least plausibly enough, to warrant serious discussion are technologically determined. In particular, they are technologically determined by the previous epoch of information technology where print and standing up and writing on a chalkboard and all the rest of the stuff we know, when that was the only way we had of disseminating knowledge. And when the need in the society for knowledge was the way it was, certain ways of doing "education" took form. I would like to say that almost everything you can think of about school is a product or reflection of that epoch. And so it is oximoronic not to mention just plain moronic, to think that the role of the computer is to get in there and improve the way that a system which only exists because the computer doesn't exist, comes from a previous epoch (that) was what it was.

Let's take some examples. I'm going to pick on one little corner of school, namely mathematics. I am a mathematician; it is easier to talk about it because it exemplifies to a higher degree all the crazy things about school. But what I have said applies to everything. Now, in mathematics the first dominating feature is the content of the mathematics. I recently did a little research on what discussion there is in the world about real change about the content of school mathematics.

For example, should we teach fractions? Should we teach them at all? Some people say yes, you need to know that a half is two quarters. OK, well this is stuff that I've noticed that my six-year old grandson knows. He likes playing in the kitchen and he has learned a few things about halves and quarters and thirds. I have no doubt that is very good stuff. But that is only a tiny sliver of what they do in school. There is all this other stuff, like knowing how to add 17/18 and whatever
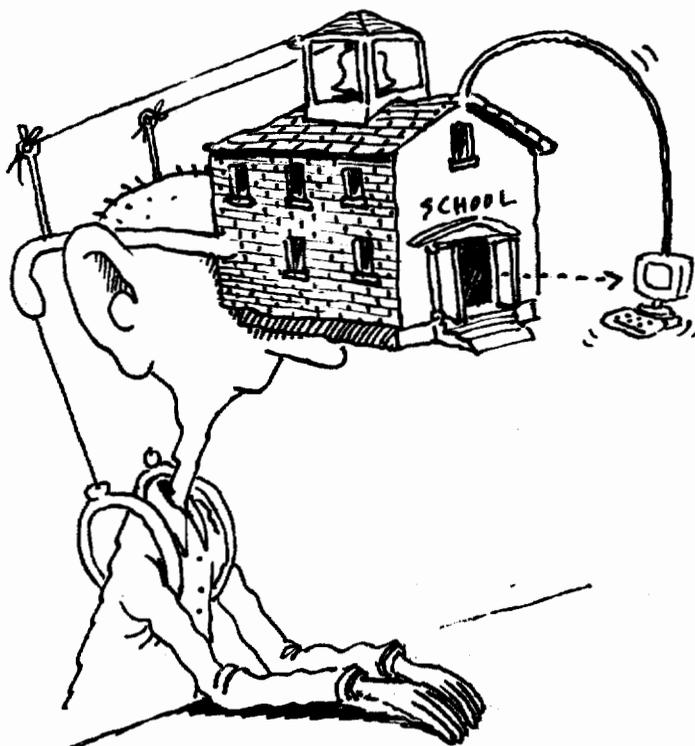
and knowing how to divide fractions. Well what reason could there possibly be for teaching this?

Now, I am not advocating the abolition of fractions. I am drawing attention to the fact that here is a human activity on which billions of dollars are spent, countless hours, incredible psychological harm is done by people who don't succeed in doing it and therefore, classify themselves and are classified by others as whatever they are classified as. And there is no discussion whatsoever about why this is a good thing to do.

There is a little bit of discussion

about when sometimes people have proposed abolishing it, there is a little bit of discussion about the reasons the people gave for abolishing it. For example, there was a big movement in the late '30s to abolish fractions on the grounds that people had done statistical studies of how much people ever used the fraction stuff they learned in school. And they came up with the obvious result that you all know, nobody ever uses them. Not even mathematicians. Nobody ever uses things like dividing one fraction by another. so it was said, "Let's throw it out of school." so the other people said, "Well, people do use it occasionally." You can find an occasional use here and there. But anyway that's not the basis on which we should settle this. You can judge if the knowledge is good knowledge on the basis of whether you actually use it, because knowledge can serve all sorts of other purposes and this seems to have quelled that movement. Obviously because everybody wanted it quelled anyway because it is just too hard to contemplate the idea of eliminating these things.

Now what this other thing that learning factions is supposed to do to you is not very clear. It's never been spelled out. It's rather like the old argument that learning Latin was good for developing the mind. And you might say that learning fractions is good for developing the mind. Some people say that learning fractions is good because you need it to do the more advanced mathematics. Well, why do you need it to do the more advanced mathematics?

OK, you can prove that to me because you can find an advanced mathematics book that will use an example that presupposes that the reader knows

about fractions. Of course, why shouldn't the writer of the book use that example since everybody has been through this experience? But that doesn't *prove* that you needed that experience. If you take it all together, my personal view is that this is just harmful stuff to teach. In any case, there is no rational discussion about why it should be taught. So there is room for making theories about why it is taught and I think there are a couple of theories.

One (theory) was that it was actually closer to what people needed back before there were calculators. So a lot of school math was useful once upon a time, but we now have calculators and so we don't need it. But people say that surely we don't want to be dependent on the calculator. To which I say, "Look at this thing, these eyeglasses, that make a dramatic difference to my life and the life of everybody who reads or looks at any fine detail. Once upon a time we would have been crippled, severely handicapped. Now we've got these and we don't need to go through all that suffering. So we are dependent on this little thing.

Well, so what? There is nothing wrong with being dependent on a little thing that everybody can have lots of. It doesn't even cost much. So, that is no argument. But I think historically that was a factor. I think the other important factor was for various reasons people thought we ought to teach something called mathematics because since the days of the Greeks mathematics was ensconced there as one of the ma-

jor areas of knowledge. In fact, I don't know how many people know this, but if you want to know where the word mathematics comes from the stem, math, comes from Greek mathein which is the word to learn. In fact, all the words in math in ancient Greek didn't mean what we mean by them, they meant learning. And somehow in the course of intervening centuries, my sort of intellectual ancestors, talking now as a mathematician, somehow managed to con the world into thinking the only good learning was this kind of learning. And so the word slipped over without hardly a trace of its original meaning.

Well there are some, like the word *polymath*, is one of them. *Polymath* is not a person who knows a lot of math. It is a person who has learned a lot of different things. But that word has been thoroughly appropriated by mathematics and so this is ensconced there as a piece that is by definition the grammar of what knowledge is, includes doing some mathematics. Actually, I would agree except I don't think that fractions is really mathematics. And I do think that if we think about what mathematics means to me as a mathematician, its got nothing to do with things like those formal operations that you do in fractions and its got especially nothing to do with the way you do it in school. And so if we are going to (prescribe) mathematics for children we need to do something very different from that.

Now, this something very different isn't very hard to imagine, although it will need a lot of work to develop. And that is one reason why it isn't done. It is not hard to imagine in the context of having modern technology. We have developed lots of examples to show how with computers there can be a radically different relationship between children and learning - all sorts of things, including mathematics.

My favorite example recently has been having kids learn enough programming so that they can make their own video games. Almost all kids find

this an exciting thing (to do) because video games are important things in their world. Besides, it is very challenging to make a video game. It leads you to reflect about yourself and interact with others. It has got all sorts of wonderful advantages that kids are sensitive to. But if you are going to make a serious video game you are very likely to run into mathematical problems. Like if you take a jump, how do you describe the trajectory?

. . . this is what's happened to computers in schools. They're being used in ways that have nothing to do with the potential of the computer to allow the possibility of a radically different way of learning.

Well, how do you describe it? You need a mathematical concept for describing it. Well, actually it is a parabola. And how do you find that out? Well, these same computers that give children the occasion to want to find it out are also for the means. We can have all kind of search procedures. You can get at all sorts of kinds of knowledge embedded in the computer system somewhere.

You can also get at people. Michelle Evard here (at the MIT Media Lab), one of our graduate students, is working on a project in which children making video games use a kind of mail system/newsgroup system to ask questions and pose problems to others who have had similar experiences before. So all those children who have done something like that before get mobilized as consultants and teachers from which they learn as much or more than they learn from doing it in the first place. So there are other ways through this computer system that

have opened up that enable somebody to get knowledge when you need it. Now this leads not only to a radically different idea about what kind of knowledge it is, because there is nothing numerical and nothing about fractions in the description of the parabola that we give them. But this is also radically opposite to the idea of the curriculum, where you learn a piece of mathematics because it's the 17th of May and your third-grade year and so it's inscribed somewhere that on this day you are going to learn this.

...so it is oximoronic not to mention just plain moronic, to think that the role of the computer is to get in there and improve the way that a system which only exists because the computer doesn't exist, comes from a previous epoch (that) was what it was.


That's no way to learn, not if there's an alternative and the alternative is you get into situations where you need it. The problem of the education innovators to create those situations where you need it, and to create means so that you can find the knowledge when you need it for your purpose; but this is going a long way. We have thrown out the content, we've thrown out the idea of curriculum, and we might as well now throw out the idea of grade level. The very idea of having first grade, second grade, third grade has no sense except that we are going to chop up knowledge into little pieces and dish them out in some sort of systematic order; for which we need to organize people in a way that we can know that we are getting this piece this year and this piece this year and this piece this year and this piece this year, and so on.

But if knowledge is going to come by other roots there's no sense in dividing people up by ages. Now of course we have developed a whole discourse of about why there are advantages, why it's terrible to have people mixed with people of other ages... well you are. If I insisted here that people separate into tables according to their age, well you are grownups not children, but what about children, before they to school , or at home in the family, where excellent learning and psychological development happens, people are in all sorts of mixtures of all sorts of ages and it worked better when it was an extended family with great grandparents and little siblings all living together and learning from one another. In fact, it is quite absurd to think that there's any social or psychological advantage in segregating children by ages. All that is merely the consequence of technological epoch that has gone by but by now it is there, it is dug in and it is hard to change. That's the only reason why it's there.

So, standing back then . . . if we want to discuss what computers mean for education, we might come to the conclusion that all there things are so hard to change that we'll never change them. It's just impossible. Well, ok, so be it if that is the truth, but let there be talk. Let there be discussion. Let this be what the debate is about. About whether there are ways in which we can envisage different different kinds of learning environments that are not colored by the school spectacles that make you see things in terms of curriculum, fractions, grammar, periods THE CLASSROOM. If you pick up the books they are all about how can computers be used in THE CLASSROOM to teach THE CURRICULUM for THE SUBJECT but presupposing before you even start the answer - namely that school is going to be like it is, and so it is not going to change. I think that they are serious difficulties and I do think that we have learned that you can't just come along and design a new social system, like school, and impose it. It won't work, that kind of social engineering doesn't work. But I think we can draw from the experience of how things have

happened and how things haven't happened..... A number of lessons that we at least could digest and at least talk about, which is all I am appealing for. Talk about them.

First of all, something that is very clear form the outset is that the categories of subject matters have become

deeply ingrained. I see Howard Gardner here, and so I am going to take express a little admiration and also a little quarrel. I think he has heroically fought against the idea of a sort of single intelligence that all people are the same and for this there is nothing but applause and it's totally in the line of the kind of enterprise I am suggesting. I think there is something not intended perhaps but essentially mischievous in the idea in the idea that there are several kind of intelligence; maybe seven of which one is mathematical because I do not believe that. Of course there is empirical evidence that some kids can and some kids can't do that stuff that you call math at school but that's not math in any sense that I understand it as a mathematician. To call the ability to do that, even if this is innate in some people, which I doubt, but even if it is, to call that mathematics and to recognize it as a kind of intelligence is as if people who don't like to or don't want to that sort of stuff are missing something, even if they have something else that is very great, I think is something we need to through radically out of our minds. It's a very hard job to throw out of our culture the idea that there is a thing called mathematics and it consists of the stuff you did in school and that some people are good at it and most of us aren't and all the rest.

There are a lot of deeply ingrained cultural assumptions that need to be faced at least. I don't know how to get ride of them but I think they need to be recognized. Somebody who wants to at least probe the possibility of change has to feel the resistance of *trying* to change these things. So we need to recognize the need for deep reconceptualizations of how people think about themselves, about learning, about their children. I am not trying to minimize, I am trying to say it is hard but lets recognize it as hard.

Now, if we are going to do that we've got to see that making little steps is a dangerous sort of thing. I think that another metaphor is useful; like my jet

engine inventor. I think that an incredibly mischievous thing is being done by Al Gore and Clinton, but especially by everybody who is propagating the idea that these NetDays, in putting one computer in every classroom connected to the Internet, that this is a

good thing. Now of course, it's a good thing... there's no question that it is a good thing but if this is allowed to get confused with the idea of using technology to change education and to open new vistas for children, it is a very bad thing.

It's a bad thing for a number of reasons. One of them being that incremental change, if you've looked at any system, has a particular way of breeding immune reactions and resisting further change. If you bring in a little bit of change people adapt to it and then it gets professionalized. For example, in the early 80's it was terribly exciting. The only times you saw microcomputers in schools is when visionary teachers had brought them there. But when schools started having computer labs and putting the computers in them and giving them an hour a day and having a computer literacy curriculum... although some wonderful things continued to be

> Making little steps is a dangerous sort of thing. If you bring in a little bit of change people adapt to it and then it gets professionalized.

done, at the same time they came about a professionalization of people who were teachers of this little itty bitty piece of computer knowledge. That knowledge is their thing now. They have their professional associations and their journals, and their masters' degrees on how to do that, and once it's build in you have a devil of a job ever changing it to take the next step.

So the incremental change can be self-defeating; it's not a step on the way to the big change. A silly example: suppose that the inventor of the refrigerator found that the only way to persuade people to buy them would be to make a refrigerator that could drop the temperature just one degree. Now that thing would be no use as a refrigerator, it would be a kind of step towards a real refrigerator. If you distributed these around people would develop ways of using them, they'd use them as storage boxes, they'd use them for all sorts of things because people are ingenious beings and they try to use what they've got. So, there'd come about a refrigerator-culture of how to use refrigerators for purposes that had nothing to do with what we know refrigerators are good for.... this is what's happened to computers in schools. They're being used to ways that have nothing to do with the potential of the computer to allow the possibility of a radically different way of learning. So when you do these, it gets built-in.

Since time is running out I'd like to just mention one more which I've mentioned over and over again. It's amazing, you can write it down... There's a proof about the artificial nature of the way people have learned arithmetic in school that keeps on cropping up again that people who have gone through school, in fact the people who are running schools, think that computers are expensive. Now, ok, in some sense they are expensive. I can feel it in my budget when I go and buy one. If you really went out and bought 50 million computers you'd be in debt for the rest of your life, or worse. On the other hand, we shouldn't ask questions like,

is it expensive or not? We should quantify it and relate it to other amounts. Now, the piece of arithmetic I want to do is the following: suppose we want to give every child, about 50 million of them, a computer. So we say how much will that computer cost? Well I say $500 or less, actually we could go buy a pretty good computer for $1000, but if you really went out and bought 50 million of them I bet that industry could beat the price down to $500 or less. Let's say it's $500. That computer would be good for 10 years. I know lots of schools where they are using Apple IIs from the 80's. So that's $50 a year. Now $50 a year, well how much are you spending per child, five, six, seven thousand and going up. So it's like 1%. It would increase by %1 the cost of education if we gave every child a computer.

OK now, why do people think it's expensive? They do not know enough, they are not comfortable dealing with numbers to realize that this is just an accountant's trick. If the computer has to be bought out of the same budget that's there for buying pencils, of course it's outrageously expensive. But if it's going to be bought out of the same budget that's used for building buildings, it's a different story all together. It's amazing that it's so hard to break down this wall, and it's because they're looking at he whole problem through all sorts of school-colored glasses. School-colored glasses, are the way they learned to think about numbers

when they were kids, hopelessly abstract and inflexible; but also in terms of how schools make decisions, and what's expensive for schools, and what can change and what can't change. If you take a more flexible approach at least you see that wherever the difficulties might be in putting together that money, it is not that it is too expensive that we can't afford it.

There is nothing wrong with being dependent on a little thing that everybody can have lots of.

I want to end on a few examples of the kind of discourse we get about that. Last year I attended, and for the same reason I am here, during the last past year I have reversed a long-standing policy of not taking part in policy discussions because they don't get anywhere, but I thought I'd better find out how people are talking. So for a while I accepted all invitations, and wow wasn't it dizzying. Well, one of them was for congressional hearings. They had congressional hearings about technology in education. I did this arithmetic and at that meeting a certain gentleman, who is the chairman, I couldn't believe this, of a committee created at the White House to study technology in education. He said (and you can read the Congressional Record

or get the videotape from C-Span) the following reasons what I was saying was not only absurd but also irresponsible, to give congress that idea that inexpensively they could give kids computers. First of all, industry practice says that computers that have to be changed not every 10 years, but on average last they last thirty months before you replace them. So, what kind of argument is that? Why does industry replace them after thirty months? Well, we don't know, we don't think about why, it's not the custom in this kind of discussion, that's a fact. Well the reason why they change them is because there is this crazy dance going on between the computer makers and the software maker.... the computer makers make a more powerful computer and the software makers make a thing that needs that more power and so it goes. Ultimately, the argument that we have to abolish, retire this computer after thirty months because it is no longer the latest thing sounds like taking an awful attitude to children. Certainly they deserve the latest thing, but what it boils down to is that unless we can give them a Cadillac that they should walk barefoot.

So, that was just one of the arguments. The next argument was maintenance was expensive. He said it cost

$70 an hour to pay a maintenance guy to fix the computer. Actually last time I had one, I got a bill for $160 an hour. I can't believe it. I am just going to use this as my last example, because it really points to something about assuming school is always gong to be what it is. I would imagine that if we really are having a sensible policy of a computer

for every kid that also every kid should become so proficient and competent and deeply understanding of computers that if they break you don't pay $70 an hour to get some guy to come in. The kids fix them.

There's nothing that those people getting $70 or $160 an hour are doing that a fifth grader couldn't be doing after a few years of experience or a third grader. Maybe very occasionally you may need a 12-year-old but the fact is that this could be a self-sufficient enterprise of the kids in the school repairing their computers, making their software even, developing the uses for it. But, this is outrageous, because we are exploiting kids I suppose, it's making kids work. And so I will just end on that. It's one of those other hangovers that we have laws about kids working, because once upon a time, kids in sweatshops and other places where made to do destructive work that was bad for them.

Today, with this exciting new technology a lot of the stuff that you could call technological and vocational is the work with the deepest intellectual content of anything in our culture and our society. Making kids do that is so far from exploiting them that it's almost the opposite. Not allowing them to do that is, I suppose, exploiting them in the name of our conservatism of maintaining a system that is only there because it's always been there and there's no justification for it. Well, maybe things that are sufficiently deeply rooted can't change, I doubt that's true, but if it's true lets face it and acknowledge that that's the reason.

Personally, I think that if we adopt a different way of thinking and ask, "what interventions can we make that would create fertile ground for an evolution of change?" I think giving everybody a computer is an example. Don't tell them what to do with it. Give everybody a computer. Then here and there and there and there, more and more people will find interesting things to do with those computers. The new ideas will grow and spontaneously grow

and if we want to spend more money on it then we should have forces of people who are watching what's growing and amplifying and improving and nurturing a better model. . . . A horticultural model is maybe the best one.

These things will grow. We'll nurture the growth. We'll favor certain mutations and adaptations. I think that's saying that you could conceive of social policies that are very different from the ones that admittedly have not worked when you try to superimpose from top down a predigested, preplanned, prestructured solution to an important social problem.

I think this image of planting the seeds for it to grow everywhere is already happening. In fact, of the more interesting educational acts that I've seen recently many more have been in homes where kids have computers than in schools. In fact, I think that the locus of innovation in thinking about learning is moving rapidly out of the school into the home. Maybe the force for change that will really be effective in the end is that the kids who have had something better at home won't stand it anymore. Kid power will force school to change or go out of existence. ⓛⓧ
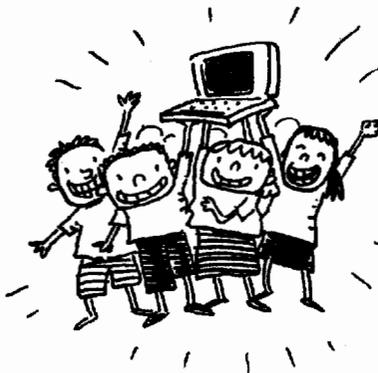
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chaotic schools. . . **hard**, but not impossible.

Whenever you find yourself frustrated or tired of battling the curriculum police, spend some time in a classroom where kids are using Logo, tackle that programming project you have put-off for so long or find inspiration in the work of colleagues around the world. Until next issue, go out and have some **hard fun**. You and your students certainly deserve it!

[1]Shepherdson, Nancy. (1997) "Intel Inside" in *Continental In-Flight Magazine*. October 1997. pp 47-49.

Enjoy!

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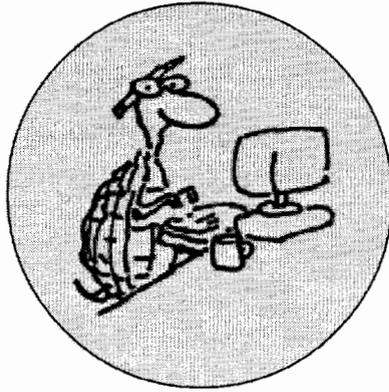
Logo and Thinking Writing: Part II

by LESLIE F. THYBERG

Establishing a thinking writing classroom (Where is Square One?)

Invariably one of the first questions in response to getting an approach like this started is, "How can I get them to write anything?!" To begin one of the best techniques is a surprisingly short, risk-free assignment, in close keeping with Piagetian thinking. Having students write about what they know best (themselves) is generally a very effective starting point. For example, at the beginning of class, ask students to do one of the following:

- Describe what we did in class (yesterday, last session, just now, etc.)
- Explain what went wrong (in procedure x, in subprocedure y, etc.)
- Discuss the most difficult problem you have encountered so far
- Explore the relative merits of two different procedures
- Write a letter to an absent classmate about the new (command, project super/subprocedure, etc.)

Why do this? Countryman states, "Instead of waiting for the teacher, or another student, to do, explain, discuss, summarize, or evaluate, each student is engaged in the learning process." (pg. 13) This gives students an active role. This is simply a springboard to what can and should become a routine part of your use of Logo.

There are many kinds of writing to employ in developing a thinking writing classroom environment. A few initial strategies to adopt that can become ongoing procedures throughout the course of the year are free writing, learning logs, and writing prompts.

Freewriting is writing rapidly for a short and fixed period of time. Toby Fulwiler describes freewriting as a good technique for dumping ideas out quickly. Peter Elbow describes it at length in his book *Writing without Teachers*. Ask your students to freewrite for three to five minutes at the beginning of the period about anything that occurs to them (or about the subject of a new unit). This writing encourages them to let their thoughts flow freely, to raise questions, and to discover what they already know about topics. You may elect to have your student do this using LogoWriter, any other word-processing package, or separately at their seats with paper and pencil.

It has been my experience that students are surprised by how easy it is to start. In fact, some become frustrated by the rush of topics that emerge. They complain that their pens or fingers on the keyboard cannot keep up with their thoughts. It is equally true that some will need to be prodded. If a student can't think of anything to write, it is appropriate to prompt them by suggesting that they simply start with, "I have nothing to write." Some students may do so repeatedly, but eventually boredom takes over, and they do discover that they have something about which they can write. In fact, it's okay to do so repeatedly until something else comes out. The intention of freewriting is to fill as much of the page as possible. It is strictly a quantity model. This kind of informal writing fosters independent thinking because it reminds students that learning and thinking are active, not passive.

If you are familiar with silent sustained reading, sometimes referred to as DEAR (Drop Everything and Read), then you know that one of the cardinal rules is that the teacher must model what is being asked of the students. It is important to try to join the students while they write. It is even better if you are willing to share your journal entries with the class.

Many teachers of mathematics or science courses find that having students keep an informal learning log is a good place to start. Basically, it is a notebook that serves as a personal record of what is transpiring in the class. You may choose to focus it however you like. A five- to 10-minute session at the end of the week is a good time for students to assess and synthesize their understanding and progress with a new topic or an ongoing project.

Use the learning log to encourage students to:

- write comments about the material
- write comments about their own work
- write comments about their progress
- write comments about the class in general

Once you have begun using the preceding strategies, other writing activities to use are autobiographies, journals, word problems, and formal writing (such as research papers). Everyone has an autobiography that can be tailored to any content area or experience. Some possible starting points are:

- Write about your triumphs/disasters (with Logo, computers, etc.)
- Go back as far as you can remember. What is your first experience with (Logo, etc.)?
- What do you like about learning Logo? math? science? etc.
- What do you not like?

Asking students to write a Logo autobiography at the beginning of the school year gives them permission to talk about themselves. It gives them the freedom to express their thoughts and feelings in a more private and comfortable manner. It also helps students focus on their own learning styles and think about what does and does not work for them. Writing enables many students to take more responsibility for what goes on in class. Best of all, sharing their experiences builds community; students are often surprised to discover that others feel the same way they do. This is a great invitation for students to see themselves as empowered learners.

Teachers who ask their students to write their Logo histories early in the year will end up knowing considerably more about their students much earlier than they would using a more traditional approach. An additional advantage is that the autobiographies set the tone for year-long conversations between the teacher and the students about their interests, their learning styles, and their performances. Self-assessment can be surprisingly accurate. Reading Logo histories helps teachers see their students as individual learners. Confidence and self-esteem also can be addressed.

The preceding suggestions lay the groundwork for a thinking writing classroom. Their implementation paves the way for the more intensive use of journals within the classroom in all curricular areas, but in particular as a way of "thinking writing" using Logo.

Journals

In recent years, teachers in elementary and secondary schools as well as in college have been asking students to keep personal notebooks most commonly called journals. These informal notebooks serve a range of educational purposes, from practice in self-expression to figuring out problems in basals/texts, etc. Sometimes students write about whatever they want. Other times topics are carefully specified. For a writer, a journal is a crucial ingredient in focusing the author's thoughts. So, too, having students maintain Logo journals or Turtle notebooks can be an invaluable learning tool for learning with Logo (or more aptly, learning about learning if appropriately utilized). Whatever students deem valuable can be stored inside. Theories, patterns, new ideas, designs, and bug collections can be kept "for reflection, remembering, and refinement" (Watt, 1986, p. 74).

A journal is a good place for freewriting, as well as an appropriate place for asking questions, experimenting, and making strong statements, but not an appropriate place to censor grammar, spelling, or punctuation. The teacher should not evaluate or criticize student writing in a journal. Toby Fulwiler wrote a document for the NCTE Commission on Composition (1986) suggesting that there are strong pedagogical reasons for asking students to keep journals. His article is one of many in a magnificent resource titled *The Journal Book*. It is a collection of various authors' perspectives on the uses of journals in English, the Arts and Humanities, and the Quantitative Disciplines. In an introductory overview, Fulwiler proposes that journals are predicated on five assumptions about language and learning.

Fulwiler's assumptions are:

1. When people *articulate connections* between new information and what they already know, they learn and understand that new information better (Bruner, *Towards a theory of instruction*, 1966, Harvard Univ. Press)
2. When people *think* and figure things out, they do so in symbol systems commonly called languages, most often verbal, but also mathematical, musical, visual, and so on (Vygotsky, *Thought and language*, MIT Press in 1962)
3. When people *learn* things, they use all of the language modes to do so—reading, writing, speaking, and listening; each mode helps people learn in a unique way (Emig, *Writing as a mode of learning*, 1977)
4. When people write about new information and ideas, in addition to reading, talking, and listening, they learn and understand them better (Britton, *The development of writing abilities*, 1975 by Macmillan)
5. When people *care* about what they write and see connections to their own lives, they both learn and write better (Moffett, *Teaching the universe of discourse*, 1968). (Fulwiler, pg. 5)

One of the best uses for journals is written conversation. When journals are part of the writing environment, children use them to write about anything they please. From doodles to comments to poems to letters, they form a mechanism for written conversations between child and teacher, and child and child. The advantage of a teacher reading a Logo journal is that the entries will tell him or her what students grasp and what they do not understand, as well as what they like and dislike. Students may write anything they like, as long as they are willing to let you read it.

What are the kinds of journals—how might they be applied to Logo?

1. *Dialogue journals* allow the student and teacher to enter into a personal relationship through the vehicle of the journal writing. This has been documented by Gambrell in 1985 in the *Reading Teacher* in an article titled "Dialogue journals: Reading-writing interactions." A teacher's response to children's entries may include comments, questions, and invitations to children to express themselves. Gambrell suggests some guidelines:

    a. write daily (It is better to make the journal a frequent short routine than one that is random and long.)
    b. focus on communication (Like most whole language advocates, he stresses that one should not correct entries, but instead, model the correct form in the response.)
    c. respond in a way that encourages written expression (Such feedback as "tell me more about, describe..." will elicit more from the student. In Logo terms, it becomes a recursive procedure.
    d. dialogue journals are private. Unlike some form of writing which are intended for a broader audience, dialogue journals are private between teacher and student. They may share entries if they wish, but this is always to be a voluntary thing.

2. *Buddy journals* encourage written conversation between children using a journal format, as the name implies. Before beginning buddy journals, children should be familiar with the use of journals as a tool for writing and be comfortable with dialoguing with a teacher. Simply divide students into pairs. They may choose a buddy, or the teacher can select randomly by drawing names

(even more appropriate is to use a Logo procedure that randomly generates partners names). To maintain interest, change buddies periodically. A buddy journal is a context for conversing about anything that matters. This can enhance socialization because it allows students a forum for learning about each other.

3. *Double entry journals* have their pages divided into two parts. On the left two-thirds of each page, students make notes, list predictions, and draw diagrams before and during reading. On the right side, they write a response to their reading. These journals have been recommended for use with all students, including at-risk learners. This may or may not be read by the teacher or peers. It simply allows students a chance to jot ideas down before and during their work on one side and give reactions to their work after reading on the other.

4. *Learning logs* are daily records of what students have learned. These may be treated as dialogue or response journals.

5. *Diaries are* private records of personal observations and thoughts. These are not read by anyone unless the student requests accordingly.

6. *Response journal/literature logs or reading journals* are places to record reactions, questions, and reflections about what has been read or done. Sometimes they are just a personal record, but occasionally they are read by the teacher. A typical writing prompt might be: What surprised you about the section you read/worked on/edited today? How does this change affect what might happen next in the story/procedure/project? What startling, unusual, or effective words/ phrases/expressions/error messages did you come across today that you would like to have explained or clarified? The kinds of response options or entries can include story mapping, rewriting, retelling, and illustrating. I have also had students write scripts for

sharing, puppetry, dress-up, book talks, mobiles, movies, newsreels, and debates.

Journals provide the teacher with a "window into the student's mind." A student's writing sheds light on what he or she is doing and thinking. The Watts state: "The journal should be a safe place to record process in a style useful to the student. They should not be graded and never corrected" (Watt, 1986, p. 74). Even in my former primary level classroom, I found students were more than willing to maintain journals. I had a second grader who went so far as to persistently doodle on his dinner napkin or paper placemats with "Logo ideas" he had. It always delighted me to see him bring his "stained notes" in, file them, and try them.

Thinking Writing

Let's return to the original proposition of this paper. "Writing to learn is different from writing to show that you have learned what the teacher or the text has set for you to learn" (Countryman, pg. 88). It was my proposition that despite Logo's word-processing capabilities, most applications we witness of LogoWriter are not using writing to learn more about Logo or even more about learning. Another way of stating this would be to say that "assigning writing is not teaching writing" (Olson, pg. 11). I also suggested that our belief systems and perspectives affect the way in which even the practice of writing (Logo, etc.) takes place. To ensure a process-oriented, whole language approach to learning with Logo, learning about one's learning, and thinking while composing with Logo (be that graphic or text compositions), it is necessary to maintain the "big picture." As Logo teachers, we are like reading teachers, now emerging into a culture that seems to support technology. The question is where we fall on the continuum. Are we skills-based (phonic teachers) who approach learning in a parts-to-whole progression?

Are we whole language/language experience-based in our approach to Logo and language learning, where we take a whole-to-parts progression? While I have clear biases about the preferred methodology and philosophy, I believe that if we approach Logo and its capabilities with an informed perspective, we will be better teachers and our students will profit.

I have found the tenets of the UCI Writing Project to be equally applicable to a theoretical framework for "whole Logo" learning. By keeping these as a part of one's "big picture," it has been my experience that significant changes will come about both in the process and product. The most notable tenets are:

- Writing is a tool for learning that fosters critical thinking.
- Writing as a learning tool should be used across the curriculum.
- Interaction of the literacy skills (listening, speaking, reading, and writing) is essential to a writing program.
- The teacher is a facilitator of the learning process who creates an environment conducive to learning, and who demonstrates by encouragement and example what it means to ask challenging questions and to take intellectual risks.
- The composing process—prewriting, precomposing, writing, sharing, revising, editing, and evaluation—involves all levels of critical thinking and is a recursive process (students must go back to go forward).
- Students should write for audiences other than the teacher-as-assessor. A proposed order is self, peers, trusted adult, teacher-as-collaborator, teacher-as-assessor, and unknown audiences.
- Peer sharing groups validate writing; group members function as supportive listeners, constructive critics, and editors.

Writing in different domains should be emphasized at every level of learn-

ing. . . . [The UCI project examines the following domains: sensory/descriptive; imaginative/narrative; practical/informative and analytical/expository] . . . Each domain of writing has its purpose; no domain has more value than the others.

- The formal study of grammar in itself has no significant correlation to the improvement of writing skills.
- Teachers of writing should write; good teachers are themselves learners (Olson, pp. 11-12).

This brings us back full circle to Dan Watt's (1984) premise of a computer culture. The most direct and relevant way to demonstrate to a child the power of reading is to read to the child. The most direct and relevant way to demonstrate to a child the power of writing is to write with the child. If we view Logo as a communication skill, then it follows that the most direct and relevant way to demonstrate to a child the power of Logo is to do Logo with the child. This shifts the emphasis from Logo as a separate subject (yet one more thing to be tackled during the day) to something that is embedded in the whole language curriculum. Cambourne's model (1988) for successful literacy learners describes that there are very specific conditions for learning to occur: immersion, demonstration, expectation, responsibility, use, approximation, response, and engagement. "Cambourne's conditions . . . are necessary conditions for all effective language learning" (Routman, pg. 12).

The progression might work, much like a typical whole language classroom—from *shared* reading and writing, to *guided* reading and writing, to *independent* reading and writing—all with the understanding that one is reading and writing to learn. Imagine a Logo learning environment where the day is filled with Cambourne's conditions: students immersed in Logo—thinking, reading, writing. The possibilities are limitless!

Conclusion
The Carnegie Task Force on Teaching as a Profession stated that:

> An economy based upon people who think for a living requires schools dedicated to the creation of environments in which students become very adept at thinking for themselves, places where they master the art of learning and acquire a strong taste for it (Carnegie Task Force, 1986, p. 45).

Based on personal experience as well as the observations of others, I believe I have devised a direct and simple means for teaching children to control their learning situations. Empowering students to perceive themselves as learners and writers, and to be able to act on the perception, is a large part of what I believe our role as educators should be. Applying such whole language models as the Graves' process approach, UCI's thinking writing project, Cambourne's conditions, and Bransford's IDEAL problem-solving model to Logo are steps toward helping kids "master the art of learning and acquiring a strong taste for it." It is my hope that if you follow these guidelines and apply your own creative processes to them, you will not only see your students become IDEAL, process-oriented problem solvers and language lovers, but you will be joyfully immersed in and engaged in the process of learning as well.

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This Much We Know:
Part II, Mathematics

BY DOUGLAS H. CLEMENTS AND JULIE SARAMA

This part of our "What do we know?" research review features higher-order thinking, creativity, language arts, and social-emotional development. (We featured mathematics in the previous column.) We finish by asking, "Where do we go from here?"

Higher-Order Thinking

Logo can develop higher-order thinking skills. Why "can," rather than "*does*?" As with mathematics, mere exposure to Logo does not lead to positive effects (Bruggeman, 1986; LeWinter, 1986). With mediation, however, Logo does facilitate higher-order thinking. For example, several studies in which such mediation was present reported an increase in mathematical problem-solving abilities for elementary students using Logo (Billings, 1986; Reed, Palumbo, & Stolar, 1988; Wiburg, 1989). Comprehensive reviews also have concluded that there is evidence of a substantial and homogeneous effect for Logo in developing problem-solving skills (Clements & Meredith, 1993; Roblyer, Castine, & King, 1988). The most positive results have involved teacher mediation based on a well-developed theoretical foundation (Clements, 1990; De Corte & Verschaffel, 1989; Delclos & Burns, 1993; Lehrer, Guckenberg, & Lee, 1988; Lehrer, Harckham, Archer, & Pruzek, 1986; Littlefield et al., 1988). Overall, 84% of studies favored computer programming over comparison groups for developing higher-order thinking (Liao & Bright, 1989). Logo programming pro-

duced stronger effects than computer programming in other languages.

Logo develops "metacognitive" abilities. Research shows that most students do not monitor their own problem solving, from early childhood to the college level. After they begin working on a problem, they rarely pause to see if the procedures they are using will actually help them solve it. They do not check their work for mistakes, and they believe they can learn little from such errors. In computer programming, however, errors are unavoidable. Feedback from the computer makes any errors or misconceptions salient (Hoyles, Healy, & Sutherland, 1991). Thus, the act of debugging Logo programs that do not quite do what was intended provides students with valuable experience in using their monitoring skills. As a result, Logo students were more likely to find and fix the errors in programming, reading, and problem solving (Clements, 1990; Lehrer & Randle, 1986; Miller & Emihovich, 1986; Poulin-Dubois, McGilly, & Shultz, 1989). *Each* of these studies employed mediation; further, the teachers based their teaching, or "mediation," on a specific theory. Mediation included the following:

1. providing metacognitive prompts and asking higher-order questions
2. ensuring that students are explicitly aware of the strategies and processes they are learning
3. discussing and providing ex-

amples of how the skills used could be applied in other contexts
4. providing tailored feedback regarding students' problemsolving efforts
5. promoting both student-teacher and student-student interaction
6. discussing errors and common misunderstandings
7. facilitating students' use and awareness of problem-solving processes

Creativity

Logo drawing helps students create pictures that are more elaborate than those that they can create by hand. They transfer new ideas to art work on paper (Vaidya & McKeeby, 1984).

Logo can increase children's figural and verbal creativity, even on "transfer tests" (Clements, 1991; Clements & Gullo, 1984; Clements & Nastasi, 1992; Horton & Ryba, 1986; Reimer, 1985; Roblyer et al., 1988; Wiburg, 1987). Originality, in contrast to fluency or flexibility, was most often enhanced.

- A theory of creative thinking processes
- The role of Logo
- Assessing across domains

Language Arts

Logo engenders language rich with emotion, humor, and imagination in young children (Genishi, McCollum, & Strand, 1985; Yelland, 1994).

Working with Logo in a narrative context (a) *enhances language-impaired*

preschool students' perceptual-language skills (Lehrer & deBernard, 1987); (b) *increases kindergartners' readiness scores on visual discrimination, visual motor skills, and visual memory* (Reimer, 1985); and (c) *increases first graders' scores on assessments of visual motor development, vocabulary, and listening comprehension* (Robinson, Gilley, & Uhlig, 1988; Robinson & Uhlig, 1988).

The talk students weave around their Logo is impressively task-related, other-directed, cooperative, and nonplayful (Genishi, 1988).

Logo work also enhances reading skills. Emersion in a Logo culture can lead to increases in language mechanics and reading comprehension, even without direct instruction (Studyvin & Moninger, 1986).

Social-Emotional Development

Students exposed to Logo programming are more likely to interact with their peers. They engage in group problem solving, sharing, and acknowledging expertise and creative thinking. Social isolates benefit the most (Carmichael, Burnett, Higginson, Moore, & Pollard, 1985; St. Paul Public Schools, 1985). Students working in Logo also exhibit more learning-oriented interactions than do those in non-Logo classrooms (Kinzer, Littlefield, Delclos, & Bransford, 1985). They are eager to cooperate and share what they have learned with others (Genishi, 1988).

Students who have the ability to use problem-solving skills in real-life situations can better work and play cooperatively. Students learn to solve social problems cooperatively and flexibly in Logo classrooms (Carmichael et al., 1985). Students work cooperatively more often on computers with either Logo or CAI drill than off (Clements & Nastasi, 1985).

Students get into more conflicts. Students working in Logo, compared to those working in spreadsheet and paper-and-pencil environments, experienced more conflicts, which had the ef-

fect of destabilizing inappropriate solutions before students formed incorrect generalizations. This helped students keep "on track" (Hoyles et al., 1991). These conflicts, and the social interaction at the computer, have been identified as leading to positive gains in learning (Healy, Pozzi, & Hoyles, 1995).

Students working with Logo are more likely to resolve these conflicts (Clements & Nastasi, 1985), especially conflicts about ideas. Opportunities to experience and resolve conflicts are necessary for the development of problem-solving competencies. So, Logo contexts may enhance the development of social and cognitive problem-solving skills.

Logo may also promote social sensitivity. Students working with Logo help and teach each other more than those working in CAI drill environments (Clements & Nastasi, 1985). Elementary students working with Logo learn to listen, be critical in a constructive fashion, and appreciate the work of others (Carmichael et al., 1985). Overall, there is consistent evidence that Logo can contribute to social growth.

Students working with Logo show an increase in self-esteem and confidence. This may occur only *if* their teacher gives them greater autonomy over their learning and fosters social interaction (Carmichael et al., 1985; Fire Dog, 1985; Kull, 1986).

Logo can provide special needs students with prestige and respect from their peers, enhancing their self-esteem (Michayluk, Saklofske, & Yackulic, 1984).

Students working in Logo environments engage in more self-directed explorations and show more pleasure at discovery (Clements & Nastasi, 1985; Clements & Nastasi, 1988).

Similarly, Logo can increase mastery-oriented thinking and a belief that one can work to become more intelligent (Burns & Hagerman, 1989). We need additional long-term studies, but Logo may have the power to enhance students self-esteem and attitudes toward school.

Summary

The claim that Logo's most beneficial effect may be in the area of social and emotional development may not have been exaggerated. Research supports this optimistic position and suggests that educators build classroom cultures that encourage students to take responsibility for their own learning; to engage in tasks that are challenging, but not too difficult; and to work cooperatively, asking each other questions (King, 1989), engaging in cognitive conflicts, and always working to resolve them through discussion of ideas and negotiation (Clements & Nastasi, 1988; Hoyles et al., 1991). This should not be taken to mean that children should always work together, however; a balance of cooperative and individual work may be ideal. Indeed, teachers who specifically plan for "cooperative" work should recognize that such arrangements are benefiical only if certain conditions are met, including appropriate tasks, students who can manage both themselves and the task, and students who are not antogonistic. A combination of structured interdependence and individual autonomy, with a high-status student coordinator, may be best (Hoyles, Healy, & Pozzi, 1994).

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Acknowledgment

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Dr. Douglas H. Clements, Professor at the State University of New York at Buffalo, has studied the use of Logo environments in developing children's creative, mathematics, metacognitive, problem-solving, and social abilities. Through a National Science Foundation (NSF) grant, he developed a K–6 elementary geometry curriculum, *Logo Geometry* (published by Silver Burdett & Ginn, 1991). With colleagues, he is working on the previously mentioned NSF research grant and finishing a second NSF-funded project, "Investigations in Number, Data, and Space," to develop a full K–5 mathematics curriculum featuring Logo. With Sarama, he is coauthoring new versions of Logo for learning elementary mathematics.

One, *Turtle Math,* is currently available from LCSI.

Dr. Julie Sarama is an Assistant Professor at Wayne State University. She previously taught secondary mathematics and computer science, gifted math at the middle school level, and mathematics methods courses. She is coauthor of several investigations units and of *Turtle Math* and is currently designing and programming new versions of Logo and other computer microworlds.

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STARTING WITH STARLOGO / Continued from Page 12

Let's create a go button. On the Interface palette, press the button icon again. Click in the Interface Window and make a new button. In the pop-up window, type **go** as its logo instruction, and click the box that says forever button to make the procedure go continuously. Finally, click OK.

Now, press setup, then press go, and watch the termites walk around collecting woodchips into piles.

If this is your first StarLogo program, congratulations! Feel free to make any changes to the program you like, such as changing the termite's color while it is carrying a woodchip, or the distance each turtle will jump when it finds a woodchip. Can you predict how the latter change will affect making the piles? [Don't forget to save your models to a file.]

Learning StarLogo Commands

One of the most useful of the documents provided with StarLogo is the StarLogo Reference. It requires an Adobe Acrobat Reader (which can be obtained free on the Wide World Web) and provides a complete list of StarLogo commands organized into consistent use groups. Users of StarLogo would be well advised to print this document for use while writing programs.

What's Next?

In next issue's column, we will investigate bird flocking behavior.

References and Further Reading

This article is based on a simple StarLogo tutorial, originally created by the StarLogo development team, MIT Media Lab, 1997.

The StarLogo program can be downloaded from:

http://lcs.www.media.mit.edu/
groups/el/Projects/starlogo

For those without internet access, the program can also be ordered at a cost of $20 plus $5 shipping, from:

Logo Foundation
250 West 85th St
New York, NY, 10024 USA
212-579-8028
212-579-8013 (fax)

Be sure to specify PowerPC or 68k (older) Macintosh format. ⬛

About the Author

Alan Epstein has been developing software since 1975, and most recently has been studying ways that computer technology can be effectively used in schools. He is most interested in robots, especially for children.

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lab at Vina Danks Middle School, teaching seventh- and eighth-grade students using MicroWorlds, StarLogo, and LogoWriter. The students create geometric designs during a unit on turtle geometry, as well as create animation projects, music, games, and stories.

I also teach an after school class using LEGO Dacta TC, Control System, and Control Lab materials. Students build Lego machines that are programmed with a computer using Logo. Some of my students' projects can be seen at:

http://www.cyberg8t.com/jstclair/vina_danks/logo.html

As a Technology Mentor, I have also taught Logo and LEGO Logo classes for teachers in my district. I teach a computer class, every quarter through the University of California at Riverside Extension, which satisfies the technology requirement for a California teaching credential. The teachers spend 12 class hours using MicroWorlds to do turtle geometry and animation projects. It amazes me how many teachers haven't heard of Logo and are impressed with the examples of student work that I show to them.

With all your experience with Logo and the computer, what is it that you want most at this point?

I want software that allows the student to be actively in control of her or his learning environment without too steep a learning curve. However, this environment must challenge the student who is motivated to try more advanced projects. I also want software

of a number of schools of psychological thought suggest potential dangers in such deliberate fragmentation of the self, Turkle points to other theoretical positions that might support the harmlessness of such activity, and even its potential for assisting in the resolution of certain types of personal difficulty or conflict.

For me, the final pages of the book are the least compelling. I find the sobering note of caution regarding the possible "dark side" of simulation and virtuality to be at odds with the lively engagement of the preceding chapters. At the same time, its position at the end of the book gives this section perhaps an undue emphasis.

What is the special significance of this book to educators? Apart from a certain narcissistic fascination in comparing one's own experiences with those of others, these are the computing environments and the issues that are increasingly a part of the experiences of our students both at home and at school. The book provides a wonderful opportunity to explore and reflect on some of the less obvious implications of current directions in computing theory and practice. And for Logophiles? This is a book about construction—the construction of environments, of "life," of communities of interaction, and ultimately about the construction of the self. What more could one ask? 🄻🄾

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Dr. Carolyn Dowling is an Associate Professor and Head of the School of Arts and Sciences at the Australian Catholic University. She is the author of Logo books and numerous articles on technology and learning.

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Storytelling and Situated Cognition

Several years ago, while perusing the graduate course offerings in educational psychology at a major university, a course titled Instructional Technology and Situated Cognition caught my eye. It caught my eye because I was a veteran technology using educator, yet I was unfamiliar with the term *situated cognition*. (I thought maybe they needed to come up with such fancy, esoteric titles to justify the high and growing tuition rates.)

I asked the professor teaching the course what the term *situated cognition* meant. His response: Basically, it means that all learning is situated. With that insight, I went away still wondering about the meaning of *situated cognition*.

As it turns out, one of the main tenants of the theory of situated cognition is that the context in which learning occurs and the activities through which it occurs—not just the content —have a direct and significant impact on what is learned and on its utility to the learner. In other words, all learning occurs through some kind of situation, but not every situation provides equal learning value or power.

My experience in making this claim to fellow educators is that as they digest its meaning, they nod in agreement at its sensibility. Yet, if it is to inform our curriculum decisions beyond mere cognitive acquiescence, we must examine its meaning closely.

One of the key concepts here is the phrase utility for the learner. Typical classroom learning is certainly authentic in that it has a defined purpose (i.e., preparation for an upcoming test).

Learners want to pass the test, and thus they learn the content in that context. It should, therefore, be no surprise that after the test is taken and passed, the learner discards the learning because it has achieved its purpose; it has served its utility.

If we are to overcome the common teacher's lament of "we taught them, but they didn't stay taught," we must teach toward a utility for the learner that goes beyond test preparation. That, I believe, was the reasoning behind Alfred North Whitehead's proclamation some 70 years ago that we shouldn't teach too many subjects, and that what we teach we should teach thoroughly. His admonition was to create a utility for the learner that transcends the artificial and contrived environment of the typical classroom. A learning grounded in real-world application or at least in a context that has meaning to the learner outside of test preparation accomplishes this.

Researchers at Vanderbilt University and the University of Connecticut have done pioneering work in using technology-based resources to affect the utility of learning to the learner. The primary focus of this work has been on using video-based story lines to create *instructional anchors* for learners. An instructional anchor serves as a real-world situation (or context) for learning, and gives students and teachers a basis for pursuing understanding in multiple disciplines as they seek to formulate and solve problems.

In fact, creating an instructional anchor is at the heart of the theory of situated cognition or situated learning. In

a recent conversation with Dr. Michael F. Young, associate professor of educational psychology at the University of Connecticut, I asked him for the essence of what makes a good learning situation. His response: A good story generally makes for a good situation for learning [that lasts].

I like that. Good storytelling makes for a great learning context (nothing new under the sun there). Even more important, significant learning can occur, not only through hearing a good story, but through telling one as well. The challenge is to bring good storytelling materials to the classroom, and therein lies one of the great strengths of Logo. It provides a powerful vehicle to engage students in the art of storytelling by providing them with the capacity and opportunity to construct and tell their own stories using multiple media.

Think on this for a moment. In a very real sense, Logo provides users with a blank slate and a set of tools. Unlike an electronic book (e.g., Broderbund's *Stellaluna*) in which the story line is predefined (which isn't bad if all you want to do is be on the receiving end of the story), Logo invites the user to be the author of the story. Combining the power of language and mathematics into the same media-enhanced programming environment, Logo affords users an electronic easel of sorts for constructing and manipulating ideas.

When young authors are encouraged to combine Logo's various programming resources to create coherent stories (i.e., to unify the media in a way that focuses the reader on the content

of the story), they are working in an environment that by nature has them acquiring knowledge in the context of applying it. This requires a different kind of understanding of the content, and it certainly provides a utility to the learner that goes far beyond preparation for the traditional test.

A great example of this was provided by Seymour Papert when he described a "microworld" created by several students based on their interest in video games (here microworld can be used interchangeably with terms like instructional anchor, situation, or story line). In essence, their microworld was a *math and physics land* in which these disciplines could be studied and applied in the context of developing a video arcade game. In developing the video game, these students struggled with the problem of how to make an on-screen character jump in a realistic way. Eventually this led to a concrete experience with, and an introductory understanding of, the important but generally abstract concept of the decomposition of velocities. The great thing about learning this way is that the learning is reinforced every time the situation is revisited (i.e., every time the story is retold).

Schooling through storytelling is a simple idea, but educationally powerful enough for a big-league academic label.   (LX)

About the Author

Daniel E. Kinnaman, a contributing editor to *Logo Exchange,* has more than 15 years' experience as a classroom teacher and district-wide director of education technology. He also has taught graduate teacher education courses in conjunction with colleges and universities nationwide. He is executive editor of *Curriculum Administrator* magazine and serves as a consultant to Compaq Computer Corp., Safari Technologies, and school districts and education service centers throughout the United States.

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that allows the student to produce a product that can be related to many subject areas in the school curriculum. I use MicroWorlds because it is easy to get started on many projects that can be related to many subjects. I especially like how MicroWorlds produces very nice looking animated stories.

I would love to see the 3-D features and animated GIFS of MSW Logo added to MicroWorlds. When you spend so much time working with technology, you always want more. From the student's point of view, MicroWorlds already has plenty of features to keep them busy.

                              (LX)

About the Author

Jim Muller is a engineer and Logo pioneer. In the early 1980s, Jim founded the Young People's Logo Association. Since then he has written several Logo books and acted as the long-time Moderator of the Compuserve Logoforum.

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