

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

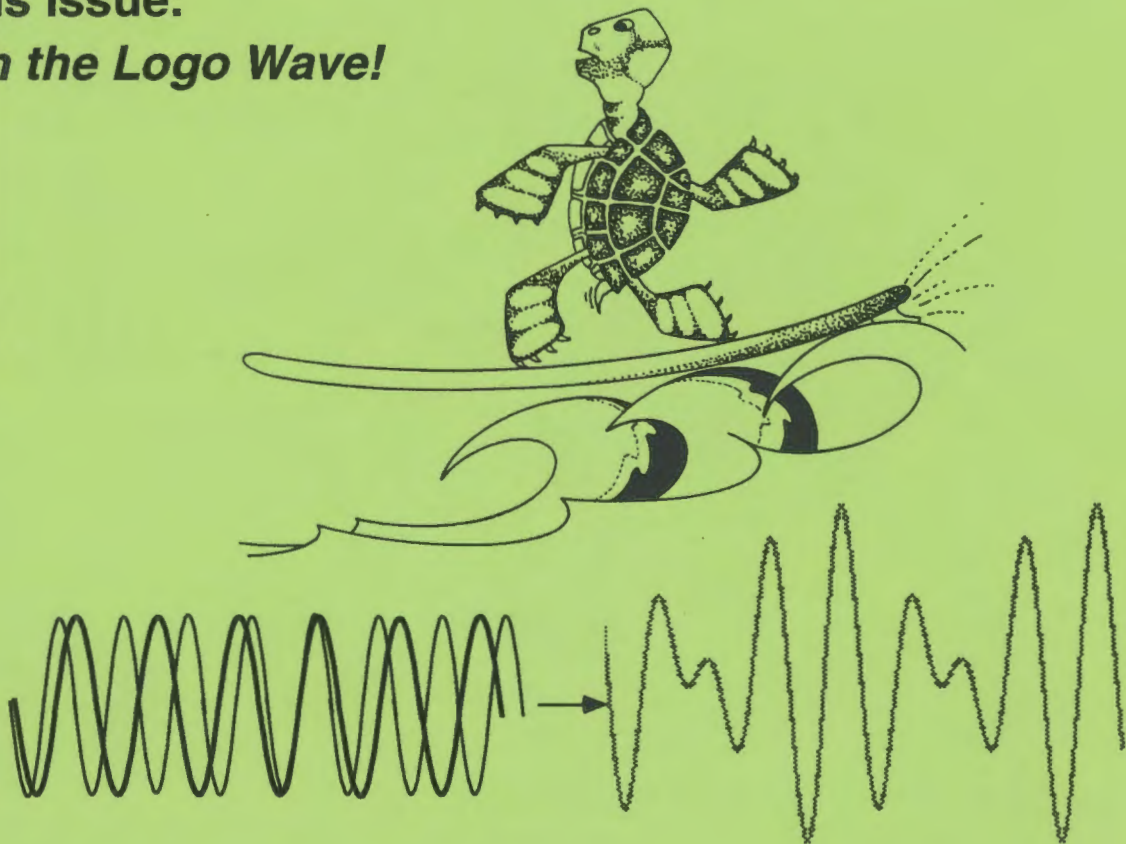


# LOGO EXCHANGE

Fall 1992

Volume 11 Number 1

**In this issue:**  
***Catch the Logo Wave!***



International Society for Technology in Education



## Logo Exchange

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Logo Exchange solicits articles on all topics of interest to Logo-using educators. Contact ISTE for submission guidelines. Opinions expressed in this publication are those of the authors and do not necessarily represent or reflect the official policy of ISTE.

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# LOGO EXCHANGE

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Volume 11 Number 1    Journal of the ISTE Special Interest Group for Logo-Using Educators    Fall 1992

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# From the (Guest) Editor: Logo Across the Curriculum

by Mark Horney

I had an interesting exchange with a district technology coordinator the other day that set me off on a long train of thought about how Logo fits in with the rest of a school's curriculum. I was meeting with the coordinator to settle some details about a *HyperCard* inservice I was preparing for some of his middle school teachers. When I asked why these particular teachers needed to learn *HyperCard*, he said it was so they could teach their students something about computer programming. I immediately suggested that Logo would be a better environment for learning programming. I pointed out that while *HyperCard* was useful for presentations and for multimedia projects, it was an awful environment for learning "real programming" (i.e. "If you thought BASIC was unstructured, wait until..."). The coordinator responded that yes, Logo is good, but Logo is something done at the elementary level and therefore something else was needed for the middle schools. I countered with the argument that if Logo was continued in the middle schools, teachers and students could capitalize on the programming skills the students brought with them and so advance quite a bit further than if they were forced to relearn basic computing concepts in a different (and in my view, flawed) language.

My argument made no headway with the coordinator, and I left our meeting frustrated and confused. How on earth, I wondered, are we ever going to convince people that Logo is not just some elementary plaything. Later I realized that this was not quite what the coordinator was suggesting. I think his belief was not so much that Logo is elementary, but that since Logo was *done* in the elementary school, students were *done* learning it and should move on. This is a different attitude, one that is held about many topics of the curriculum, not just Logo. I've heard it called the "Inoculation Theory of Education." That is, once students have been inoculated (by taking a class), they will be resistant to ignorance, and so don't have to study that topic anymore.

(Before going any further, I think it is important to note two caveats. First, the conversation described above was brief and buried among several other topics. It's quite possible that from such a shallow exchange, I have misinterpreted the thoughts of the technology coordinator or didn't understand the exact reasons for the district's *HyperCard* decision. Second, the somewhat anti-*HyperCard* flavor to this story is related directly to the use of *HyperCard* as a language for pro-

gramming instruction and not to its utility for other purposes. So, although I think the issues discussed here are germane in general, it may be an error to situate them directly in this school district, or this particular technology coordinator.)

Later, when trying to strengthen my argument that Logo should not be abandoned after elementary school (or at any level for that matter), I asked myself just exactly what skills the Logo-experienced 11-year-old can bring to a middle school computer science curriculum. I came up with a list of five general items:

- Top/down and bottom/up problem-solving skills
- A process vs. product orientation in problem solving
- A predilection to look for creative, divergent solutions
- The ability to write programs involving calculations, graphics, and text manipulations, *and* the ability to set up an interplay among these three modalities
- General computer-literacy skills involving keyboarding and hardware/software operations.

It certainly can be argued that any reasonable computer curriculum should promote these five characteristics, but they are, I think, intrinsic to our expectations of a Logo classroom, particularly the first four. These characteristics we expect of Logo-trained students derive, I think, from the emphases in Logo on learning computer "science" as opposed to learning computer "programming." Programming I define as the lower-order skill of converting algorithms into functioning computer code. Computer science is more concerned with the higher-order problems of creating and analyzing algorithms in the first place. My argument to the district technology coordinator was that by continuing with Logo instead of switching to some other programming language, students need not be retrained on lower-order programming skills, and the time thus saved could be used to increase the more important computer science skills.<sup>1</sup>

<sup>1</sup> I've been through this argument before. In 1983, my old school district decided to include BASIC, Pascal, and Logo in its computer science sequence for college-bound, technically oriented students. I argued then that a choice of any single language would be better than such a mixture, requiring, as it did, much duplicate instruction. I lost.





This is, of course, just one more round in the classical debate of the relative merits of teaching students deeply or teaching them broadly. My opinion (prejudice?) in the matter is clear: I always prefer to teach *more* about *less*.<sup>2</sup> I have two reasons for this preference. The first is built on the observation that, as it has been put in by my friend Catherine Taylor, "Learning takes an object." That is, students don't just "learn," they learn *something*. Similarly, programs take an object. Students don't just write programs, they write programs about something, *something that can come from anywhere in the curriculum*. So, by carefully selecting computer activities with some content-area orientation, it is possible to establish a synergistic relationship between the two that furthers both. However, this synergy requires that students be sufficiently advanced in their Logo skills to be able to accomplish something of significance in the content area, and that they be sufficiently advanced in the content to face questions requiring powerful programming tools.

A second reason for preferring deep instruction is that a deep understanding of one topic may reduce the difficulty of learning related topics; for example, if you

know a lot about turning right, learning to turn left is easy. If students understand a process is thoroughly—that is, if they understand its advantages *and* its disadvantages—then they are primed to quickly accept extensions to the process. Students signal their readiness for more advanced concepts when they start making statements like, "Gee, if Logo only had a command to ..." or "This primitive is dumb because it won't ...."<sup>3</sup> If the teacher can step in at just that moment and introduce the needed ideas or, even better, if students have learned to monitor themselves and know that this is the

---

<sup>2</sup> Always hoping to avoid, however, the extreme situation described by one pundit as "knowing everything about nothing."

<sup>3</sup> For me, this always happens when I'm running my word processor. After struggling with some complicated or repetitive task I find myself saying "If there's a God, there must be some easier way to ..." By that time, I understand enough about what I'm trying to do that I can effectively speculate about how my software might perform the task, and, more importantly, where in the manual the critical explanation might be. I then have a good chance of finding the appropriate information, assuming, of course, that a solution does exist. When these searches begin to fail repeatedly, I know it's time to buy new software.

## NEW Terrapin Logo for Mac UPGRADE!

Now you can upgrade to new Version 1.2 of Terrapin Logo for Macintosh. With it, you'll get:

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- **Automatic window refresh** when windows overlap
- **Print more easily** using menu options
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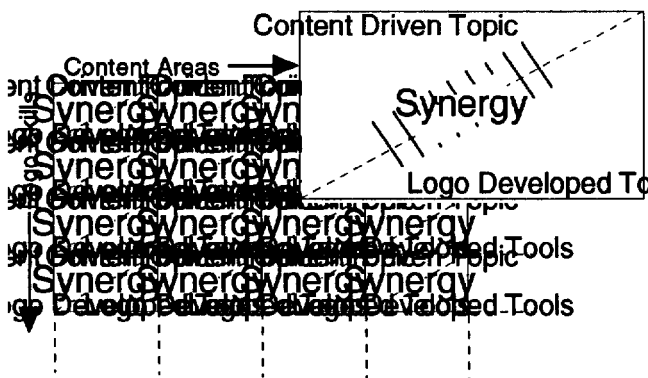
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207-878-8200 ♦ Fax: 207-797-9235



time to refer to the Logo manual, then learning new concepts is quick and easy.

The IF...THEN...ELSE construction provides an example of how this might work. I think a common technique for teaching these conditionals is to lead students through several projects involving IF/THEN constructions only, and then to continue with several more activities introducing IF/THEN/ELSE. Instead, I suggest the use of a sustained sequence of authentic activities involving IF/THEN constructions only, but which include situations where ELSE clauses would be useful. Then, as students develop an appreciation for the limitations of using IF/THEN conditionals only, the ELSE cause can be presented and accommodated within their skills with little difficulty.

My new and improved argument for the technology coordinator, then, is this: if middle school students are allowed to build upon their elementary school Logo experience, they will not only more easily expand their Logo/programming expertise, but will also be able to apply their programming skills throughout the curriculum to the benefit of both programming and the content curriculum.<sup>4</sup> This argument depends, though, on a careful examination of precisely what cognitive skills Logo students have (such as those listed above), and on how to interrelate those skills with the requirements of the broad range of content-area curricula so as to support the previously described synergy. These projects can be organized in a chart like the one shown here.



I think the development of these activities is an important task for the Logo community to undertake. It diverges somewhat from the common Logo-as-philosophy view, with its emphasis on student-driven, open-ended, discovery learning. However, I think that this is justified since whatever Logo is, it is implemented within the larger context of an educational system, a system that today is undergoing stresses and

strains, where every curriculum, activity, objective, and philosophy must compete with every other for attention, resources, legitimacy, and acceptance. I believe that if Logo is to survive as a deeply influential part of children's education, it must be deeply experienced and that can not happen if it is constrained to some "computer period" isolated between reading and arithmetic in the elementary school schedule. Rather, Logo must become deeply embedded at all levels and in all curricula.

Now, if I only had some real evidence to support all this editorializing!

Mark Horney is a research associate at the University of Oregon, where he is involved in a variety of projects in the areas of electronic studying and the applications of hypertext. Before that, he spent 13 years as a middle and high school teacher in Colorado.

Mark Horney

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<sup>4</sup> And I'll bet they can learn *HyperCard* in a flash.

# Election Information

It's time for the election of officers for the Special Interest Group for Logo- using Educators...here's what you do:

- ❖ **Read the candidate statements on the next page and choose or write-in your choices using the ballot below...**

...then photocopy this page and...

- ❖ **...mail your ballot to ISTE, c/o SIG Coordinator, 1787 Agate St., Eugene, OR 97403, by October 30, 1992.**

## SIGLOGO ELECTION BALLOT '92

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### ***President (vote for one):***

Marian Rosen ☐

write-in

\_\_\_\_\_ ☐

### ***Vice-president (vote for one):***

Chuck Friesen ☐

write-in

\_\_\_\_\_ ☐

### ***Secretary***

JoAnn Karraffa ☐

write-in

\_\_\_\_\_ ☐

Please mail your completed ballot to:

**ISTE/SIG Coordinator  
1987 Agate Street  
Eugene, OR 97403**

# SIGLogo Election ❖ Candidate Statements

## Candidate for President

### *Marian Rosen*

Since 1983, Marian Rosen has been a teacher and instructional technology coordinator for Ladue Public Schools in St. Louis, Mo. She has created Logo environments with thousands of children (K-7) and their teachers. She also teaches Logo at the college level, conducts workshops and has written articles for *Technology and Learning*. Marian has worked with Seymour Papert on the video series *Seymour Papert: On LOGO* and more recently was a leader of one of nine sites of the Logo Action Research Collaborative (LARC). LARC was a project funded by NSF and under the leadership of Dan and Molly Watt.

Marian believes that beyond technology lies teaching—an action in which adults and children work on meaningful problems of their own choosing. She hopes that SIGLogo can support teachers to do this in the following ways:

1. Have input at NECC and ISTE conventions on Logo speakers, panels and workshops.
2. Provide a friendly meeting place at conferences for Logo users and lovers to meet and share ideas.
3. Encourage and support teachers to research their own classrooms and to analyze and write about their situations and successes.

Marian never met a Logo person she didn't like. She hopes that by taking this job she meets a lot more of them.

## Candidate for Vice President

### *Chuck Friesen*

Chuck is the director of the Lincoln Nebraska Public Schools Instructional Technology Department. In addition to district-wide technology responsibilities, he directs an elementary school Logo project in which 15,000 elementary school students participate. As a part of this project the Lincoln Public Schools have developed Logo curriculum materials, including student activity cards and a Logo utilities disk.

Chuck believes Logo can enhance the educational experience of learners of all ages. He believes all students, ranging from students with special learning needs to gifted students, can benefit from working in Logo. The problem solving experiences available in this environment are of particular interest to him.

## Candidate for Secretary

### *JoAnn Karaffa*

My interest in Logo began about 11 years ago when I was an elementary principal. Teachers on my staff wanted to purchase a computer. I asked what could be done with kids on the computer and Logo came to the forefront. Well, I investigated this application and then became a Logo proponent.

As the years have passed, I moved through the roles of an administrator, district computer coordinator, and then returned to the classroom. It has been these past years that I have really moved into more involvement with Logo in my classroom and within the curriculum for our school. I teach fourth grade at Spring Mill Elementary in Indianapolis, In. Within my classroom I utilize LogoWriter and LEGO/Logo extensively. I have even become the area contact when folks want to know more about Logo.

I want to become more involved at the SIGLogo level so that I can bring a focus of the needs of the elementary teacher and new comer to the Logo community. I want to foster an environment where enthusiasm for the growth of Logo and idea sharing can take place.

I want to assist the organization to become more viable and interactive with the total Logo using community.



## Great News for Logo and LEGO Users!

### New Product!

Logo Computer Systems announces the availability of the Hebrew version of *LogoWriter*. *LogoWriter* Hebrew gives Hebrew-speaking students the opportunity to use the computer as a tool for learning in their own language.

*LogoWriter* Hebrew has all of the features found in the English version of *LogoWriter* — flexibility, programming, and turtle graphics. It is designed for use with students in Grades 3 and up. Schools may choose from the same variety of purchase options available with the English-language version of *LogoWriter*. Schools that have already purchased a *LogoWriter* site license may add *LogoWriter* Hebrew as a second-language extension.

For more information, contact  
Logo Computer Systems, Inc  
1-800-321-LOGO

### Paradigm Software Announces Two New Products

The Pearl Controller is a serial device that connects the LEGO Interface Box to any Macintosh computer. Up to sixteen Pearl Controller/LEGO Box pairs can be daisy-chained from each serial port. The Pearl Controller can be driven from either *HyperCard*, with its graphic interface or *Object Logo 2.6*, with its powerful object-oriented system. In addition, *Object Logo 2.6* provides emulation of *LEGO TC Logo* for running existing LEGO Logo programs.

*Object Logo 2.6* is a new version of *Object Logo* that includes built-in support for the Pearl Controller and a set of new control structures for background task-processing. The new features include machine, motor, and light and sensor object classes, as well as primitives for delayed and conditional background execution.

For more information contact  
Paradigm Software  
P. O. Box 2995  
Cambridge, MA  
Phone: 617-576-7680  
AppleLink: Paradigm

## Letter to the Editor

Dear Gentlemen,

My friend and I made a Mother's Day card on the *LogoWriter* program. We think you might want to put it into your magazine.

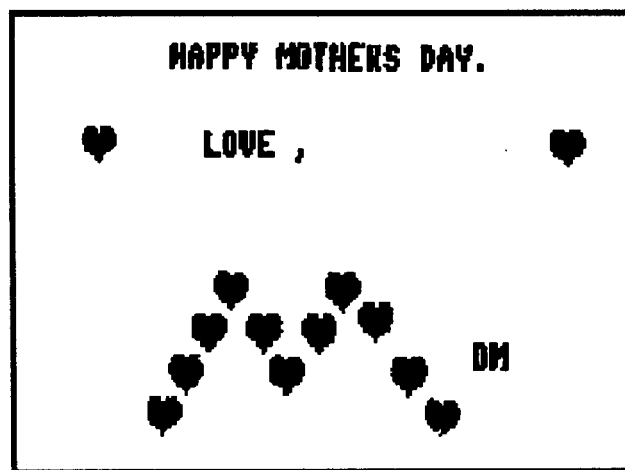
We have enclosed one copy of the card in the envelope. Thank you.

Yours truly,

*Yanni N. Mahatras  
C. Oliver Wellington*

Yanni N. Mahatras  
C. Oliver Wellington  
Grade 4

Cotuit Elementary School  
Old Oyster Road  
Cotuit, MA 02635



Thank you Yanni and Oliver!—ed.

# Back to Back

by Tom Lough

As many of you know, I have developed a moderately high (some would say excessive or even obsessive!) awareness of Logo commands when I see them in the world around me. Recently, we rented the movie, *Back to the Future X* (I can't remember which Roman numeral), in which a young man and his scientist friend embarked on a variety of adventures back and forth through time.

Naturally, this got me to thinking about the BACK command. Suddenly, I felt ashamed and concerned. I realized that over the past decade I have been preaching the virtues of the incredible Logo computer language in a discriminatory fashion. I have been touting the FORWARD command, even adopting it as my closing (as in FD 100!), and have neglected BACK. Oh, sure, I have mentioned it in an odd column every now and then, but over the long run it has been something like FD 500 BK 2. (That's supposed to be a score, not a line of code!)

As my son once remarked, "Dad, you can't rewind life," so I am not able to change how I have treated BACK in the past. (Although our erstwhile movie hero could have done so, had he desired. Maybe that will be the plot of *Back to the Future XI*. Or, maybe you and your class could write the script to such a movie!) At any rate, in this QQ, I will attempt to change the balance somewhat and focus a bit of attention on the neglected BACK command.

A philosophical vein suggests itself. Because we are coming BACK to school as this issue is mailed, we can use BACK and *Back to the Future* to help us focus on our educational work. We are coming BACK to the classroom to help our future citizens prepare for what we hope will be happy and productive lives. Not a bad thought as we prepare our first sets of instructional units and lesson plans.

From a more operational point of view, maybe we could use BACK to focus on some interesting thought processes that might have been missed. What about the following as a starter?

"OK, everyone, I have some bad news and some good news. The good news is that our computers are all still working. The bad news is that the FORWARD command is no longer available."

If this scenario were presented to your students, what do you think would happen?

Typically, students begin thinking about how to use the BACK command (aha!) to do their drawing.

Here are some possibilities they usually discover.

1. Turn the turtle around with RT 180 or LT 180. Then use BACK just like FORWARD. The turtle moves in reverse! This works OK until a turn is necessary. Then some interesting thinking has to take place. (Hint: Did you ever have to back up a car or a truck with a trailer attached?)
2. Leave the turtle facing in the desired direction and use negative numbers as input to BACK. The turtle appears to move as it does with FORWARD and the corresponding positive number. Turns pose no problem because the turtle is facing the direction in which it is traveling.
3. Create a "forward" command, such as a FWD procedure, that accepts a positive number and uses a command such as BK -DISTANCE to move the turtle.

The second and third techniques would help students become more comfortable with negative numbers. It could also become the basis for interesting discussions about adding and subtracting signed numbers. For example, after FD is "repaired" so it works once more, students might think about typing lines such as

```
FD 30 BK 10 FD -40 BK -60
```

What would you predict the turtle would do in response to this line?

If you associate "addition" with FD and "subtraction" with BK, the line could model the following series of operations:

$$+ 30 - 10 + (-40) - (-60)$$

Perhaps for the first time, students might begin to understand how subtracting a negative number is the same as adding a positive number.

Well, if you'll excuse me, I have to get BK to my reading. I see some extremely interesting articles in this issue of LX.

BK -100!

Tom Lough  
Founding Editor  
PO Box 394  
Simsbury, CT 06070



# The Great Penny Caper

by Eadie Adamson

The Summer 1992 issue of *LX* arrived just as I was working on this article. What a surprise to find that what I was planning to write about tied in so neatly with Glen and Gina Bull's article "Experiments With Language and Letters" in that issue! Read on, and you'll see why.

One day last year the following announcement appeared on the *Logo Express* BBS in New York:

## *The Great Pandemic Penny Project*

Empty your Piggy Banks!! It's time to count up your pennies! Some are new and shiny. Others are old and dull. What's the oldest penny you have? What's the newest? How many do you have from each year?

Before you start counting up, what do you expect to find? Will there be more pennies from recent years? Will there be many more pennies from some years than from others?

What if you counted up thousands and thousands of pennies? What would you get? "Very tired", you say. This sounds like a job for *LogoExpress*! If everyone counts up some pennies and pools the results, we'll end up with a huge amount of data.

Count your pennies and post your results. At the end of each week, the grand total will be posted for all to see.

This was the starting point of an interesting two-part project. One part involved on-line collaboration among Michael Tempel, Gary Stager, and me to develop series of procedures which not only added the pennies, but created a table by year and then quickly graphed the results. (Do you begin to see the connection with the Bull article?) The second part of the project was, of course, to get the weekly results of the penny counts as people sent them in. Kindergarten and third-grade classes in California worked with teacher Carol Goodman to develop their own graphing procedures. They posted their results on a special section of the *LogoExpress* host called "Pennies." Many individuals posted their "personal penny" counts. Others posted school or class counts.

## Common Cents

What a great idea this was! Students had an opportunity for inquiry that was expanded far beyond the confines of the classroom. At the time I received this message, our school was about to embark on an ambitious volunteer program. A local group had started a campaign called Common Cents. They collected unwanted pennies and had persuaded some of the local banks to help with the counting. The unwanted pennies, turned into dollars, were used to assist the homeless in New York City. Our students were about to begin collecting pennies from their apartment buildings to contribute to Common Cents. A tie-in with a national penny count sounded pretty interesting and very timely. There were certainly going to be a lot of pennies around!

## Histograms for Pennies

Michael Tempel posted some procedures adapted from a histogram program by Brian Silverman on the *Logo Express* Host. The original histogram had not used the page to store the data, but this one did. Using the page to keep your data may not always be a good idea, but in this case, taking advantage of *LogoWriter*'s word-processing primitives makes recording and graphing penny counts quite easy. Michael's histogram can read the dates and amounts from the screen. Students can simply enter their lists and then use the program to graph the results.

I downloaded the histogram procedure and tried it. I thought the graphic display of results would be more interesting if it also showed the total number of pennies graphed. Taking a cue from Brian and Michael's histogram, I proceeded to develop some tools to total the pennies on a page. I then posted this on the *Logo Express* board.

## Reading

How did the histogram procedure read a list of years and numbers? (The procedures are given at the end of this article.) I took a close look at the procedures. In this case, it depended on information stored on the screen itself. Years and numbers are recorded on the *LogoWriter* page. The histogram procedure reads each line of text and uses the information to draw the histogram. In constructing the histogram, the last two digits of the year indicate the place on the base line for the

vertical bar. The numbers for each year determine how far up the histogram draws.

### ...and Parsing

A line of text gets selected with the commands `select eol`. Select is the equivalent of the key strokes that begin selecting text. Eol stands for *end of line* and causes Logo to select text from the insertion point (in this case, the start of a line) until the end of a line.

If you have *LogoWriter* handy, try this: Type a year, a space and a number on the screen. In the Command Center, type

```
top
```

This causes the cursor to jump to the top of the page. Now watch what happens when you type

```
select eol
```

Your whole line of text should be highlighted. Now type

```
show selected
```

In the Command Center you should see the same text that is highlighted on the page.

The important part of this process is the use of `parse` to get a portion of the selected text. `Parse` makes what is selected into a Logo list. Try typing

```
show parse selected
```

Now type

```
show last parse selected
```

You should see only the last item in the selected text: the number you typed, and not the year.

The last step is the key to grabbing the number off the screen. Using the command

```
repeat last parse selected
```

the histogram procedure is able to use the last number (in this case, the amount of pennies for a given year) to control how long that year's line on the histogram should be.

### Getting a Total

It was clear to me that if you could write a program to cause Logo to read text from the page, you could write some procedures to go down a list and add up the numbers, producing the totals that I wanted to see along with the graph. I thought students involved with this project might decide to create their list of pennies

by putting a title at the top, or they might leave empty lines before beginning their list of years and numbers. Thus, I wrote a `find.start` procedure, which, with its subprocedure `check.for.number`, takes care of that problem. `Find.start` finds the beginning of a line that includes numbers. Then `addemup` can do its work, adding the last `parse` selected to the total. When `addemup` is finished, it prints a few blank lines and then prints the total it has collected.

### Taking Things a Step Further

Naturally things didn't stop with collecting a total! I posted the procedures for getting the totals on the bulletin board. A few days later, Gary Stager posted procedures that extended the totaling tools so that the computer could create a *table* of pennies, ordered by year, complete with totals. This meant that students could enter their pennies as they collected them, even over the course of several days or weeks. When they were ready to graph, they simply typed `table` first to create their table of pennies in order by year.

This seemed like an excellent class project. I passed along to the math teachers in my school a copy of the *LogoExpress* announcement along with a note of my own:

We have a *LogoWriter* program that will make a histogram of a penny count. All you need is a computer and *LogoWriter* to make a histogram of your pennies. The format in which to record them is:

Year (can use last two digits)—a space—the number of pennies

For example:           62 10

The histogram program will take it from there. There is also a procedure that will make a table and calculate the total pennies. This might be an interesting research project for some enterprising student or group of students. Why not make a personal penny count or a house penny count or a class penny count? What questions can your students add to the ones listed above?

A few of the fifth-grade math classes agreed to do the penny-counting project. One teacher researched penny information for her group. Knowing that some pennies are valuable, usually because of minting errors, she made a list of years to look for. Potentially valuable pennies were to be put into special cups for closer examination later. She reasoned that since the money was going to charity, there was a small chance that during our penny count we might turn up a rare penny. If we did, the penny could be redeemed and the extra proceeds given to Common Cents. So the students



had a double mission in their counting: first, to gather statistics for plotting distribution by year, and second, to search out pennies of value to increase the amount of money they could contribute to help the homeless.

### Things Get Going—or Counting It All

Our students began gathering their pennies. We decided to simplify the task by having each student count only a handful (about three-quarters of a cup) of the pennies they had collected. Their teachers made charts for them so that they could put ticks in a square for each year. It made the counting easy. Pairs of students helped one another count the pennies. Then each took a *LogoWriter* page of their own for storing their information.

At the same time I continued to experiment with the histogram procedures. They had been set up to read a year and a number, search for a line, move up the line while checking for a blank space before adding marks for each penny. This took a long time if the numbers were large. I realized that some of the tasks the original histograms did were unnecessary now that, thanks to Gary's extensions of my total procedures, we had a way to add up the pennies and organize our totals by year. This was all right as long as the students were adding up their own pennies where the numbers were small, but when we wanted to create a graph for a grand total, the process was far too slow!

How could we do this? Since we had a neat way of making a table in numerical order, the histogram procedure no longer needed to check whether there were lines at each year. The procedure could simply move to the place for the year, then move forward and back to draw the line. The inputs for forward and back would be the total for that year, expressed as

```
forward last parse selected
back last parse selected
```

This was so much faster I couldn't believe it. I passed the procedure along to the students. We rapidly generated a collection of individual charts like this one:



*Jenny's Pennies Total: 280*

### The Grand Total—A Little Adjustment

Now it was time to consolidate our figures. Using copy and paste, we put everyone's charts together on a single page without their totals. We used the table procedures to build one final table of the grand total.

Here is a penny table from one class :

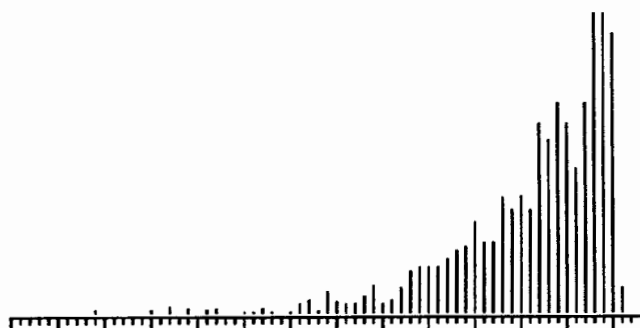
House Year	Penny Count Total # of Pennies
-----	-----
1934	2
1940	2
1942	6
1944	3
1946	2
1947	4
1950	1
1951	1
1952	3
1953	1
1955	1
1956	7
1957	12
1958	2
1959	19
1960	10
1961	9
1962	9
1963	16
1964	26
1965	8
1966	12
1967	23
1968	40
1969	44
1970	45
1971	44
1972	53
1973	60
1974	64
1975	87
1976	69
1977	67
1978	113
1979	101
1980	114
1981	100
1982	183
1983	169
1984	205
1985	184
1986	139
1987	205
1988	291
1989	293
1990	271
1991	25

Total # of Pennies Counted = 3145



Then came the surprise. We tried making a final graph. Whoa! Now the lines wrapped around the screen! I found it necessary to adjust the **forward** and **back** commands. For our purposes, multiplying by 0.5 to cut the total in half was sufficient. (Another math lesson in this: many students do not realize until they try it that multiplying by 0.5 will give the same result as dividing by 2. Nor do they realize that Logo can do these tasks for them.)

Here is our histogram of the totals from one class, displaying the distribution of 3145 pennies by year, beginning in 1925 and running until 1991:



*House Penny Count Total Pennies: 3145*

### Stepping Back and Taking a Look

Now the students had a lot of interesting information. They could look at a good sized collection of individual charts, compare them, and then look at the relationships. Transparencies could be made of each graph so that they could be superimposed on one another to look more easily for common trends. Even without the graphs, they could draw some conclusions about the relative distribution of pennies, but now they had some results in visual form to back up their conclusions. They could compare the shape of the individual graphs with the grand total and get an idea of how a small sample might relate to a larger total. In addition, they could share their information with other schools via telecommunications. Their teachers observed that it would be worth saving these graphs and running the experiment again in another year in order to have more material to compare.

### The Penny Table Procedures

```
to table
top
find.start
add.each.year
end
```

```
to add.each.year
if textpos = textlen [results stop]
select eol
if empty? selected [unselect
    results stop]
if not name? year [make year 0]
make year (thing year) + pennies
make "total :total + pennies
unselect
cf
add.each.year
end

to year
output last2 first parse selected
end

to pennies
output last parse selected
end

to last2 :thing
output word last butlast :thing
    last :thing
end

to find.start
select eol
check.for.number
clearnames
make "total 0
end

to check.for.number
if empty? selected [unselect cf
    find.start stop]
if not number? first selected
    [unselect cf find.start]
end

to results
display 25
end

to label.table
print []
print []
insert [Year]
tab
tab
print [Total # of Pennies]
insert [--]
tab
tab
print [-----]
print []
end
```



```

to display :year
if :year > 91 [print [] print sen-
  tence [Total # of Pennies Counted
    =] :total stop]
if name? :year [insert word "19
  :year tab tab tab print thing
  :year]
display :year + 1
end

```

## The Graphing Procedures

```

to pennygraph
read&graph
end

to read&graph
top
setup
r&g
end

to r&g
if textlen = textpos [stop]
find.start
select eol
go last2 first parse selected
climb
unselect
cf
r&g
end

to find.start
select eol
check.for.number
clearnames
make "total 0
end

to check.for.number

if empty? selected [unselect cf
  find.start stop]
if not number? first selected
  [unselect cf find.start]
end

to setup
rg
ht
pu
seth 90
setpos [-130 -80]
pd
line
pu
end

```

```

to line
if xcor > 139 [stop]
ifelse (last xcor) = 0 [big.tic]
  [tic]
forward 4
line
end

to tic
sety ycor - 3
sety ycor + 3
end

to big.tic
sety ycor - 6
sety ycor + 6
end

to go :year
setpos [-130 -78]
seth 90
forward 4 * (:year - 25)
seth 0
end

```

If totals are more than 200 for any date, use the following graphing procedure (climb is adjusted to fit the page). If the totals are less than 200, eliminate the \* .5.

```

to climb
pd
forward (last parse selected) * .5
back (last parse selected) * .5
pu
end

to last2 :wrđ
output word last butlast :wrđ
  last:wrđ
end

```

Eadie has been working with Logo and with LegoLogo with students and teachers. Coauthor of *LogoWriter Hypermedia Tools*, Eadie is now working as an independent computer education consultant.

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# Twice Upon a Time

by Judi Harris

"Anytwo for elevennis?"

This sentence has suffered Logo inflation. Last year, it might have read,

"Anyone for tennis?"

Next year, if things keep going up, it may read,

"Anythree for twelvenis?"

Perhaps inflation is the last thing you want to explore with Logo, especially in the midst of an economic recession. Yet it can inspire enjoyable classroom exploits with syllabication, sequencing, and homophones.

## Rising to the Occasion

Once Logo inflation hits, "I ate a tenderloin with my fork" becomes "I nined an elevenderloin with my fivek."

"Fourscore and seven years ago, our forefathers brought forth" reads, instead:

"Fivescore and eight years ago, our fivefathers brought fifth."

And so on and so fifth.

Danish comedian Victor Borge (1986) first introduced the notion of inflationary words in an effort to match language to economic trends. He reminds us that English "is your language; I'm just trying to use it." Borge suggests that we inflate words as a proactive measure, since inflation (like taxation) is inevitable.

## Getting a Rise Out of Them

This presents an interesting Logo challenge. The sound of the first step toward a solution is a homophonic one. How many different ways are there to spell the sounds of each of the number words, 1 through 10? Your students will probably be glad to list the possibilities.

one two	three	four	five...
won	to		for
	too		fore
	tu		

Now, form a list of these homonyms, output by a procedure called PREINFLATION.

```
TO PREINFLATION
  OUTPUT [ONE WON JUAN TWO TO TOO TU
    THREE FOUR FOR FORE FIVE SIX
    SICKS SICS SEVEN EIGHT ATE AIT
    NINE NEIN TEN]
END
```

An accompanying list of the same length can output correlated inflated "values" for each of the words, in order.

```
TO POSTINFLATION
  OUTPUT [TWO TWO TWO THREE THREE
    THREE THREE FOUR FIVE FIVE FIVE
    SIX SEVEN SEVEN SEVEN EIGHT NINE
    NINE NINE TEN TEN ELEVEN]
END
```

## Inflated Ergo

An INFLATE command can be written to output corresponding inflated list elements.

```
TO INFLATE :WORD.PART
  IF MEMBER? :WORD.PART PREINFLATION
    [OUTPUT ITEM ( ELEMENT :WORD.PART
      PREINFLATION) POSTINFLATION]
    [OUTPUT :WORD.PART]
END
```

INFLATE uses an adaptation of Alison Birch's (1986) ELEMENT subprocedure, which has the opposite function of the primitive ITEM.

```
TO ELEMENT :ITEM :OBJECT
  IF EQUAL? :ITEM FIRST :OBJECT [OUTPUT 1]
  OUTPUT 1 + ELEMENT :ITEM BUTFIRST :OBJECT
END
```

The superprocedure INFLATED uses these four subprocedures to output "more expensive" words.

```
TO INFLATED :LIST
  IF EMPTY? :LIST [OUTPUT " ]
  OUTPUT WORD ( INFLATE FIRST :LIST )
    INFLATED BUTFIRST :LIST
END
```



Students must supply syllabicated words as input to INFLATE. For example, if a user types

```
PRINT INFLATED [WON DER FUL]
```

the computer will return:

```
TWODERFUL .  
PRINT INFLATED [BE FORE]
```

yields

```
BEFIVE .
```

PREINFLATION and POSTINFLATION resultant lists can, of course, be adjusted to predict inflation at any rate. Who knows? Don Juan may someday be Don Eight. Why not adjust the fable now?

### Literary Lifts

Inflated words make twoderful stories. Here is an uninflated tale that Mr. Borge supplied. Your students may want to translanine it.

*Once upon a time in sunny California, there lived a young man named Bob. He was a second lieutenant in the U.S. Air Force. Bob had been fond of Anna, his half sister, ever since she saw the light of day for the first time. They were both proud of the fact that one of their forefathers had been among the creators of the U.S. Constitution. They were dining on the terrace.*

*"Anna," he said, as he took a bite of a marinated herring, "you look wonderful tonight. You never looked that lovely before. Anna looked wonderful, despite the illness from which she had not recuperated.*

*"Yes," repeated Bob, "You look wonderful tonight, but you have two of the saddest eyes I have ever seen."*

*The table was tastefully decorated with Anna's favorite flowers, tulips. They were now talking about Anna's husband, from whom she was separated, while on the radio, an Irish tenor sang "Tea for Two."*

### Elevated Elegies

Let us finish the tale in inflated terms.

*It was midnight. A clock in the distance struck thirteen. Suddenly, there in the moonlight stood her husband, Don Two, obviously intoxicnineded.*

*"Anna!" he blurted, "Fivegive me! I am only young twice, and you are my two and only!"*

*Bob jumped to his feet. "Get out of here, you three-faced triple-crosser!"*

*But Anna warned, "Watch out, Bob! He is an officer!" "Yes, he is two, but I am two, three!"*

What inflated stories will your students crenine, given these interdisciplinary tools? Until next time, dear LinXers, *three-de-loo!*

### References

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# An Electronic Logo Exchange

by Glen L. Bull, Gina L. Bull, and Graham O'Neil

Several significant events occurred in 1969:

- Neil Armstrong became the first person to walk on the moon
- The first versions of a new language called "Logo" were under development
- A national computer network known as the "ARPANET" was established.

Each of these events was a milestone. Some time would elapse before these technologies would mature and realize their potential. A technologic rule of thumb suggests that the time between the first appearance of a usable technology and its widespread infusion is likely to be measured in decades rather than years. However, last night we watched for several hours on C-SPAN as three astronauts hovered above the bay of the space shuttle Endeavour and repaired a telecommunications satellite. The earth turned beneath the space walkers as they attached to the satellite a new rocket that would boost it into a higher orbit. The fact that we could watch the entire event on a cable channel devoted to commercial-free coverage of government affairs was perhaps as remarkable as the event itself.

An observer in 1969 would perhaps have been puzzled at the motivation for development of a computer language designed for use in the public schools. At that time there were no computers in the public schools, and the idea of a chip that would be known as a "microprocessor" was just beginning to emerge at a corporation named "Intel." It would be nearly another decade before the Apple computer would be introduced. However, the developers of Logo in retrospect appear remarkably far-sighted, since there is now hardly a school in the nation that does not have multiple computers.

In 1969 the ARPANET was restricted to researchers working on defense-related projects. However, the ARPANET provided a model for development of other wide-area computer networks (WANs) as it evolved into the Internet. At last count, Internet was a collection of more than 3,000 computer networks with more than 600,000 servers in over 50 countries—the world's largest computer system (Quartermann 1990, 1991). All major universities in the United States are linked to Internet, and increasing numbers of public schools are connected.

The publication in 1980 of *Mindstorms: Computers, Children, and Powerful Ideas*, by Seymour Papert, intro-

duced Logo to the world. By that time, computers were beginning to appear in great numbers in schools, and the learner-based approach of Logo contrasted sharply with the page-turning approach of many computer-assisted instruction (CAI) programs.

## Characteristics of Print and Electronic Media

The following year, in 1981, a graduate student in physics at the University of Virginia took the first class that we offered on Logo. Tom Lough was so inspired by the potential of Logo that he decided to found a magazine that would be devoted to the language. We had extensive discussions about the appropriate name for such a magazine. Eventually Tom decided upon the title *Logo Exchange* because he wanted it to be a forum in which excitement, ideas, and classroom applications could be exchanged.

For a decade, *Logo Exchange* has served that purpose, and we hope that it will continue to serve that function for the next decade as well. However, electronic communication channels that complement print media are now becoming available. While we believe print media will continue to have an important role, the combination of print and electronic media can achieve goals beyond those achievable with print alone.

For example, an electronic article can include the code of a Logo program as well as a discussion of its use. After a decade of writing for *Logo Exchange* (the printed version), we have found that it is not practical to address some subjects because the associated code would be too lengthy—and even if it were practical to print the program, the chances that anyone could successfully type in the code of a long program without typographical errors are low. As we have worked with teachers and students who have attempted to enter Logo programs from printed copies over the years, we have often encountered high levels of frustration from typographical errors that appear in even short programs. For a longer program, it is simply not practical.

One alternative might be to include a disk with each issue of *Logo Exchange*—and, in fact, we believe that would be a good idea. However, the question immediately arises, "In what format: Apple II, IBM, or Macintosh?" In addition, there are practical problems, such as how the disks would be duplicated and how the printer would incorporate the disk into the magazine so it would not be damaged during shipping. Because of the added expense and practical difficulties, it is un-

likely that this will occur at any time in the foreseeable future.

An electronic conference also offers some opportunities that even the combination of a magazine and disk do not. For example, imagine having the opportunity to hold an electronic conversation with Seymour Papert, Dan and Molly Watt, Brian Harvey, and others about the latest article published in *Logo Exchange*. An electronic conference offers the opportunity for this type of discussion and interchange of ideas.

Printed versions of magazines and journals are still needed. As yet, no universal standard for integration and display of graphics exists, so on-screen interactions are still text-based. Also, the majority of teachers today do not have access to Internet, just as the majority of schools did not have access to computers in 1969. However, that circumstance is likely to change in the coming decade. In 1991, a bill was passed establishing a new high-speed backbone for Internet, to be known as the National Research and Education Network (NREN). Senator Albert Gore (1991), sponsor of the legislation establishing the National Research and Education Network, suggested that Internet could revolutionize public school education:

This network could revolutionize American education as well, giving teachers new tools and new ways to inspire their students. Today, hundreds of elementary and secondary schools are linked to the NSFNET, enabling students to exchange messages with other students throughout the country and enabling teachers to share new teaching ideas with one another. (p. 16)

### Proposal for a National Logo Newsgroup

The technology for establishing an electronic Logo Exchange on Internet already is in place. The highest volume forums on the Internet are the "USENET Newsgroups." Electronic discussions take place among several hundred different groups, ranging from narrow technical interests to broad societal issues. Occasional conversational threads on Logo programming or LEGO-Logo robotics appear in groups such as `comp.ai` (Computers and Artificial Intelligence) and `comp.robotics`. Because the only place for Logo discussions is in newsgroups in which Logo is tangential to the main purpose of the conference, depth and breadth of discussion have suffered.

For several years we have worked with other colleagues in Virginia to extend Internet to K-12 schools as a means of fostering collaboration among universities, public schools, government agencies, and commercial firms. In 1990, Virginia became the first state (to our knowledge) to establish a statewide public school

telecomputing network designed to assure that all public school educators have access to Internet.

When we saw a posting on Internet by Graham O'Neil proposing establishment of an electronic newsgroup devoted to Logo, we immediately invited him to coauthor a guest column in *Logo Exchange* with us. Since this combines two of our favorite avocations (Logo and telecomputing), we thought this would be an excellent way to celebrate the beginning of the second decade of *Logo Exchange*.

By the time you read this, the electronic vote to establish a Logo newsgroup will have taken place. Preliminary voting suggests that the name of the newsgroup will be

`comp.lang.logo`

although `comp.mindstorms` is another suggested name that has received votes. The goals of the newsgroup, as developed by our guest author, are outlined below. The "Request for Discussion" (or RFD, as it is termed in USENET jargon) was developed by Graham O'Neil in response to a suggestion by James Gow, and received the benefit of review by Brian Harvey and Debora Weber-Wulff.

### Aims

The group would serve as a common ground for discussion of the Logo language and its variants [and execution platforms], questions about language syntax, constructs, and "How do you do the following?" Exchange of Logo programs would be facilitated. Experiences, lessons learned, and "What worked for me" stories posted on this common newsgroup would allow a broad range of distribution as well as provide a knowledgeable group of contributors for answering questions.

### Focus

The proposed newsgroup is focused on the Logo approach to education, exploration, and programming in Logo. This focus encompasses these facets:

1. The Logo language itself, including how to get started, programming questions, resources, and reference materials.
2. Logo applications and development information, including design issues, utilities, experiences with Logo use, new features or capabilities [e.g., LEGO-Logo], and implementation issues for interpreter developers. This area would also serve as a focal point for software trading, reviews, and requests for available packages.

3. Logo for educational, pedagogical, developmental, or cognitive discipline support.
4. General discussion on the uses of the Logo language for education, prototyping, exploratory programming, microworld development, tooling, AI education topics, classroom experiences, and research results.

### Scope

In addition to topics and discussion areas already listed, other types of questions that might arise include some of the following:

1. Why does my school system insist on teaching Logo only to advanced students when that was clearly not the goal of the language designers and developers?
2. How can I get my school system to use Logo to replace the electronic worksheets they are using now?
3. Does anyone want to get a group-buy together for LEGO-Logo and see if LEGO-Dacta will give us a group discount?
4. When and where are the good Logo conferences this year?
5. Has anyone read the book Logo's Good Gnus? Is it any good?
6. Why are there so few microworlds outside the realm of mathematics?
7. How do I get started with Logo for my children at home?

Those who wish to discuss the Logo newsgroup can contact Graham O'Neil at the following Internet address:

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### Anticipating the Future

Increasing numbers of teachers are gaining access to Internet. Any public school educator in Virginia or Texas can obtain an Internet account by requesting one from the respective departments of education in those states. The Virginia K-12 network linked to Internet is known as the Virginia Public Education Network (PEN), while the Texas equivalent is the Texas Education Network (TENET). There is no charge for an account on

Virginia's PEN, while in Texas the fee for an account is five dollars per year. In Florida teachers can obtain Internet accounts through Florida's Information Research Network (FIRN), while Internet accounts can be obtained through NYSERNET in New York and CSU-Net in California. In Colorado and three nearby states, teachers can obtain Internet access through Westnet, while the Big Sky Telegraph provides access in other areas of the West. In Cleveland any citizen can obtain an account with Internet access through the Cleveland FreeNet, and similar community-based systems have been established in several other cities as well. Even in states where there is no formal mechanism for provision of K-12 Internet access, universities will sometimes establish informal university-public school partnerships providing Internet access to teachers. As this trend accelerates, access to Internet may some day be as universal as it is in higher education today.

That day may be some years off. However, just as Logo researchers worked on development of the Logo language years before computers would be widely available in the public schools, teachers, parents, and others who currently have access to Internet can develop an electronic Logo exchange now in anticipation of the day when every teacher will have Internet access.

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- Quartermann, John S. (1990). The matrix: Computer networks and conferencing systems worldwide. Bedford, MA: Digital Press.
- Glen Bull is an associate professor in the Instructional Technology Program of the Curry School of Education at the University of Virginia. Gina Bull is a system administrator in the Department of Computer Science at the University of Virginia. By day she works in a Unix environment, by night in a Logo environment.

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# Poetry—To Cinquain Randomly

by Robert Macdonald

Boating  
Floating, easily pacing  
We paddle evenly  
Catching the tide  
Swimming  
—William Sells

If you find having children write via a computer a wonderful way to get much writing with a minimum of typing, then perhaps using *LogoWriter* to reproduce randomly selected lines of a cinquain poem is for you.

Writing takes thought. It has to be planned. To write well-conceived but randomly selected poetry that makes sense is an achievement in which any child should take pleasure. It is always the final presentation that poses the greatest difficulty. Why not have the computer do that part of the job for you?

## Planning a Poem

A cinquain has been described as "originally a five-line French stanza with any rhyme scheme or none and of uncertain line length" (Williams, 1986). What a delightfully free form for creative purposes. To get children started, I like to formalize the cinquain a bit as follows:

- The first and fifth line of the cinquain should be constructed of single words that define the same sort of topic or concept, for example, Night, Evening, Darkness, Evil.
- The second line may be made up of two descriptive words which expand and elucidate lines one and five, for example, Dark, foreboding; Peaceful, calming; Intransigent, opaque.
- The third and fourth lines may be built up of short sentences or phrases that continue to build on the feeling or concepts of lines one, two, and five, for example, I sit shivering, Hoping for light, Abandoning to despair, I fear the night, I cherish the quiet.

To help children organize their work, I have them fold a large sheet of paper vertically into five columns. The children place the lines of the interrelated cinquains in each of the respective columns. From this worksheet, it is an easy task to prepare the material for entry into the computer. Of course, a number of dictionaries and

thesauri should be readily available since this microworld is built around vocabulary development.

Backstroke  
Kicking, pulling  
I sense flotation  
Exhaustion, activity  
Butterfly  
—Kristi McGuire

## Using Logo

Let's randomly select a cinquain.

Darkness  
Intransigent, opaque  
I sit shivering  
Abandoning to despair  
Night

Not very cheery, but then we can produce a happier tone in other cinquains. As a freebie, let's write a *LogoWriter* startup procedure that will initialize some variables for us, from which we may produce some poems.

```
to startup
make "first.line [Brightness
  Luminosity Floridity Geniality]
make "second.line [[Effulgent
  lustrous][Shimmering
  dazzling][Glaring
  flaring][Vivid shining]]
make "third.line [[Scintillating
  experiences inspire][I envision
  splendor][A many hued rainbow]
  [A divertissement of joy]]
make "fourth.line [[Flashing light
  dazzles][The radiation of
  confidence][Irridescence
  throughout life][The invisibility
  of health]]
make "fifth.line [Sunshine Promises
  Cheer Wholesomeness]
end
```

The startup procedure will be run if you select the program, which I name *cinquain*, from the Contents Page. You can also run it by typing *startup* in the Command Center.



The following four procedures will produce some randomly selected cinquains. You will note the classically indispensable **random.pick** procedure that we all would find difficult to do without. The formatting will be done in the **build.up** procedure.

```
to cinquain :number.of.poems
  if not front? [flip]
  clearpage
  build.up :number.of.poems
end

to clearpage
  if not front? [flip]
  rg
  ct
  ht
  cc
end

to random.pick :list
  output item (1 + random count :list)
  :list
end

to build.up :number.of.poems
  if :number.of.poems = 0 [stop]
  (print random.pick :first.line)
  (print " random.pick :second.line)
  (print " " random.pick :third.line)
  (print " " " random.pick
    :fourth.line)
  (print random.pick :fifth.line)
  print []
  print []
  build.up :number.of.poems - 1
end
```

The command to reproduce five selections would be:

```
cinquain 5
```

Since I like to input each newly written cinquain on the front of the *LogoWriter* page, I incorporate a **cancel** procedure to remove my startup variables or any other additions that may be made along the way.

```
to cancel
  make "first.line []
  make "second.line []
  make "third.line []
  make "fourth.line []
  make "fifth.line []
end
```

To clear the variables, simply type

```
cancel
```

Now I am ready to enter new lines of poetry. Consequently, I use a procedure to enter the lines.

```
to enter.lines
  clearpage
  print [Enter your first line with
    the necessary brackets:]
  make "first.line readlist
  print []
  print [Enter your second line with
    the necessary brackets:]
  make "second.line readlist
  print []
  print [Enter your third line with
    the necessary brackets:]
  make "third.line readlist
  print []
  print [Enter your fourth line with
    the necessary brackets:]
  make "fourth.line readlist
  print []
  print [Enter your fifth line with
    the necessary brackets:]
  make "fifth.line readlist
end
```

To begin, type

```
enter.lines
```

Here is a sample of what is on the screen for a new cinquain:

```
Enter your first line with the nec-
  essary brackets:
[Night][Evening]
Enter your second line with the
  necessary brackets:
[Peaceful, tranquil][Opaque
  disappearing][Intransigent murky]
Enter your third line with the nec-
  essary brackets:
[I brood incessantly][Rejecting all
  pity][Praying for hope]
Enter your fourth line with the
  necessary brackets:
[I long for quiet][I fear the
  unknown][I sense forgiveness][I
  despair for release]
Enter your fifth line with the nec-
  essary brackets:
[Death][Solemnity]
```

## Using the Program

I have found this an easy set of procedures to use with fourth graders. The procedures are easily adaptable to other poetic forms.

Baseball  
Lunging, running  
I see the ball  
Heading for a goal  
Soccer  
—Andy Giancamalli

Much of the work for this activity should be done with pencil and paper away from the computer. There are any number of ways to stimulate children in preparing suitable samples.

Children are perfectly capable of entering the lists at the keyboard. You might wish to check the use of brackets before they enter the material in `enter.lines`. This provides a wonderful opportunity to do a brief lesson or two on lists (Birch, 1986).

To double check what children have entered, you might like a print of the screen after running the `enter.lines` procedure. Use the commands:

```
sspace  
printtext
```

You can easily have the children correct any errors to their input by entering such commands as the one given below in the Command Center.

```
Make "third.line [[ I sit quietly]  
[I run excitedly] [Hoping for a  
sandwich]]
```

Note carefully the use of brackets. Error messages will result from faulty bracketing. Using a statement such as this will save them from having to enter everything again with `enter.lines`.

Reading  
Words, phrases  
Seek peaceful contemplation  
Poetry, Novella  
Writing  
—Heather Westrick

After all the necessary editing on a new set of poems, you are ready to produce output. How about producing eight variations?

```
cinquain 8
```

To get a printout of the screen suitable for display, again use the commands:

```
sspace  
printtext
```

Children enjoy looking over their own poems and the poems of others. Critical commentary abounds. Circulating prints of randomly generated cinquains adds to the literary excitement. Carefully prepared mountings of these poems prominently displayed in hallways adds more appeal to the writing process and gives other classes the opportunity to become aware of Logo activities.

If you try this activity and have ideas for enhancement, please forward them to me at the address given at the end of this article.

PS: In the summer QQ column, I invited readers to send in any Logo rhymes and what-have-you. Thanks to LX subscriber Jandy Bird from Colts Neck, New Jersey, for this delightful contribution.

There was a young lady from Togo  
Who tried to rhyme something with Logo.  
After ten paradigms  
Of unsuitable rhymes, She exclaimed,  
"Well, I guess it's a no-go!"

## References

- Williams, M. (1986). *Patterns of poetry. An encyclopedia of forms*. Baton Rouge: Louisiana State University Press.  
Birch, A. (1986). *The Logo project book. Exploring words and lists*. Terrapin, Inc.: Cambridge, MA.

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# We've Come a Long Way, Folks!

by A. J. (Sandy) Dawson

## A Look Back

I began preparation of this column on the 12th anniversary of the eruption of Mount St. Helens, a mountain not far from the home of *Logo Exchange* in Eugene, Oregon. As with many folks, I too can remember what I was doing on that fateful day. As I contemplated events since then, particularly those associated with mathematics education and computers in education, it came clear to me that much had happened in the intervening years.

For example, on May 18, 1980, very few people were aware of the possibility of—let alone had any experience with—teaching a course or carrying on a discussion via computer-mediated communication. Yet I, like many others, have now taught at least half a dozen such courses. Most recently, I worked with a group of 12 classroom teachers as they struggled to make use of computers in intellectually honest, educationally sound, and pedagogically valid ways.

Twelve years ago, in educational research circles, the debate was just beginning in earnest about the validity of using nonquantitative methods for doing research. This debate was not, however, current among mathematics educators. About 1985, papers and books began to appear that started the move towards alternate views of how one might go about researching mathematics teaching and learning in schools. Case-study methods, in-depth interviews, and videotaping of students and teachers are now standard ways of trying to figure out what learners are thinking about when doing mathematics. Of course, work by Papert and his colleagues with *Logo* foreshadowed much of this more recent work in mathematics education.

Even a quick perusal of the NCTM standards causes one to marvel at the ideas that are being advocated now. Concepts and approaches only whispered about 12 years ago about what mathematics is, how it should be taught, and how one might go about research in mathematics education are now commonly discussed.

## And a Look Forward

For me, this makes it all the more exciting to contemplate this coming fall. I will be working with a group of 12 secondary school mathematics teachers, all of whom are enrolled in a master's degree program at Simon Fraser University. The focal point of the course is the foundations of mathematics education, and the application of these foundational ideas to the class-

room situations in which these masters students work. In preparation for teaching this course, I went looking for reading material that would might help my students and me in a variety of ways. A single book would be nice, I thought—one that would

1. Discuss alternate ways of conceptualizing mathematics that have arisen in the past decade and a half.
2. Convey something of the flavor of doing research (preferably action research involving classroom teachers) in mathematics education using the now acceptable qualitative methods.
3. Give practical advice about how real teachers in real classrooms with real learners might realistically make some changes in their classroom practices, if they wish to do so.

To find one such book is no doubt asking too much, I mused, but to my delight I think I have come close to finding it.

## Mathematics Through Inquiry

In October, 1991, I heard Raffaella Borasi speak, at the conference of the Psychology of Mathematics Education North America Group (PMENA), about her research, which involves a case study of two secondary school, female mathematics students. At the conference, Raffaella mentioned that a book reporting on this research would be forthcoming in the spring of 1992. I received her book in March, and even a quick once-over convinced me that here was just the sort of material that came very close to satisfying my needs for my fall course. The title of her book is *Learning Mathematics Through Inquiry* (Borasi, 1992).

I don't wish to write a review of the book here. Rather, I would like to draw attention to one section of the book—the one devoted to the topic of how to go about creating a conducive mathematical environment. The section includes strategies to initiate and support students' mathematical inquiry (pp. 190-201). In this section, there are nine items listed that I am sure will be central to the discussions I will have with the graduate students in my course. But I should let Raffaella speak about these items and their intent before I go any further:

The first group of strategies described here will focus on helping students appreciate "what there is

to inquire about in mathematics.” In the previous chapter, I argued that anomalies are the seed for generating doubt and, thus, genuine inquiry. The first six strategies (A to F) will propose complementary ways of making students aware of the presence of ambiguity, conflict, and limitation in mathematics and also suggest how such elements can be exploited to stimulate questions for reflection and exploration. The remaining three strategies (G to I) will suggest a number of instructional activities that can support students while they engage in mathematical inquiries and make them more meaningful and productive. (p. 190)

I want to examine in turn each of Raffaella’s nine points as they relate to mathematics education, and then comment on how reminiscent these points are to the still on-going discussion about the use of Logo and Logo-like environments in education.

*A. Exploiting the Complexity of Real-Life Problematic Situations (p. 191).*

I am sure you are all aware of the typical word problems one finds in traditional mathematics textbooks and exercise sets. How long have we realized that though these problems allegedly have to do with real situations (trains traveling toward each other leaving from stations many kilometers apart, etc.), the learners know the problems are not really about their lives. This item is not another call for relevance in the curriculum. It is a recognition that the real problems in the world that require mathematics for their solution are very complex, often give rise to conflicting results, and call for interpretative thinking in order to put meaning to the calculations or manipulations carried out in “solving” (whatever that means) the problem. Of course, computer simulation of real-life situations, ones that can be mathematized, are fertile ground for student explorations.

*B. Focusing on Nontraditional Mathematical Topics Where Uncertainty and Limitations Are Most Evident (pp. 191-192)*

Even in the esoteric world of pure mathematics, many opportunities exist for students to confront, grapple with, and explore the uncertainty and limitations of mathematics. As Borasi points out, the concepts of mathematical proof, of infinity, of probability, and of analysis are all ripe for students to explore this nontraditional view of mathematics. I once had the pleasure of being part of a group of 20 mathematicians and mathematics educators who, when asked to say what they thought the concept of limit meant, produced at least 12 distinctly different answers. We then argued for two hours about which

answer was best. We never did settle the matter. This anecdote points out the richness that is there in the mathematical realm if we have the courage to mine it with our students.

*C. Uncovering Humanistic Elements Within the Traditional Mathematical Curriculum (pp. 192-193)*

The anecdote about “limits” can be viewed in another light, namely, the human aspect of mathematics. Mathematics is not written in the stars or on stone tablets. Rather it is generated in the minds of women and men, and they put their own particular meanings of what to outsiders might seem like identical concepts. A colleague in the mathematics department at Simon Fraser University recently told me that by today’s standards, Newton’s proofs would not be acceptable if they had been brought forth in an undergraduate class. Regardless of whether this belief is valid, it points out the fact that even the standards of proof used in mathematics are subject to the human beings using them. Mathematics is a very human enterprise!

*D. Using Errors as “Springboards for Inquiry” (pp. 193-195)*

When I first read, some 20-odd years ago, what was to become Lakatos’ *Proofs and Refutations*, I wrote an article, called “Guessing and Testing,” in which I suggested, following Lakatos, that a fundamental aspect of mathematics was guessing at solutions to problems and then checking to see if the guess was at all viable. Derivatively, I suggested that student errors should be treated much more humanely and creatively, because for the student, what an error represents is a guess that didn’t work. It was with gladness in my heart, then, that I read the following passage in Borasi’s book:

Although mathematics educators have long been interested in student errors, their focus has essentially been on how these errors can be eradicated. Thus, researchers, as well as teachers have used errors as a tool for diagnosing learning difficulties and directing their remediation. However valuable for mathematics education, this approach does not invite students to view errors as learning opportunities or to engage in their own analysis of errors.

...a mathematical error [can provide] the stimulus for the students to ask “What went wrong?” “How can it be fixed?” “What are the implications of what we have done?” (p. 194)

Hooray for Raffaella! And hooray for her students who asked just these sorts of questions. And doesn’t this remind you Logophiles out there of Papert’s exhorta-

tion to treat errors as bugs, and to debug programs?

*E. Exploiting the Surprises Elicited by Working in New Domains (pp. 195-196)*

When working on mathematics with elementary teachers, I seek ways of putting teachers into new situations that are close to what they are used to but that are different enough to cause them to be surprised by the results they obtain in this new area. For example, I invite teachers to journey with me to the "yellow planet," where all inhabitants have one arm and one leg. When these yellow-planet people count the fingers on their hand, they chant "One, two, three, four, ten," and hence they have ten fingers and ten toes. I then ask the teachers to become citizens of the yellow planet and to generate a mathematics curriculum comparable to the one they are familiar with on their home planet earth (the "orange planet"). Thus, these teachers learn to add, subtract, multiply, and divide whole numbers and fractions on the yellow planet. In the process they experience many surprises, some with delight and some with frustration, and thereby come to have a sense of what it is to create a mathematical experience. They also learn, incidentally, a lot about multiculturalism, and a lot about how difficult it might be for their own young students to learn what is so familiar to us, but which is brand-new and as foreign to them as yellow planet mathematics is to this group of adult teachers.

*F. Creating Ambiguity and Conflict by Proposing Alternatives to the Status Quo (pp. 196-197)*

A simple example will illustrate how this can work. The area of inquiry is the addition of fractions. Suppose that at the start of the basketball season, Portland wins 4 of its first 5 home games (4 fifths of the games were wins), and then goes on the road and wins 3 of its first 4 away games (3 fourths of the games were wins). Is it not true that they have won 7 of their first 9 games (7 ninths of their games thus far in the season)? Hence, 4 fifths plus 3 fourths is 7 ninths, and adding fractions is simply a matter of adding the numerators and the denominators! Now that really is an alternative to the status quo! It certainly creates ambiguity and conflict (usually addressed at me, the teacher) when I present it to student or practicing classroom teachers. So, tell me, is it not valid?

*G. Generative Reading Activities as a Means of Sustaining Inquiry (pp. 197-199)*

The point here is that the teacher should not be the primary or only source of authority and knowledge in the classroom. When reading this, I was reminded of the first time I heard Molly Watt say, "Ask three

others before you ask me" in response to a woman who couldn't figure something out in a Logo program she was writing. Even if students and adults other than the teacher are used as resources in the classroom, reading, as Borasi notes, has not been part of mathematics instruction in schools. Appropriate reading material for school-age learners has been around for quite some time, but it is only recently that teachers are beginning to use it.

*H. Providing Occasions for Reflecting on the Significance of One's Inquiry (pp. 199-200)*

Borasi suggests that students should reflect on the significance of their inquiries both while engaged in the investigation and after it has been completed. In my view, the latter is much more readily accomplished than is the former. Regardless, I do agree that being aware of what one is doing is the only way in which learning will occur. The additional step of being aware of oneself as one is learning is a challenge that requires working with students to help them develop tools for accomplishing this task. Borasi notes:

There are good pedagogical as well as logistical reasons for students to do this [reflection] as soon as possible, since evaluating the results of one's inquiry is a crucial element to becoming independent learners and critical thinkers. (p. 199)

*I. Promoting Exchanges Among Students (pp. 200-201)*

No student learns in a vacuum, except perhaps in the traditional mathematics classroom! The concepts and ideas generated by students need to be tested for viability, and one sure way to do that is to bounce those ideas and concepts off of one's colleagues. This can be done by discussion, by writing stories or keeping diaries, by large- and small-group presentations, or by quiet, one-on-one dialogue. But whatever the means, the important thing is for students to communicate with each other regarding the outcomes of their mathematical investigations.

I can hardly wait till the fall when the teachers and I can get into a discussion about each of these points, explore their application in the teachers' classrooms, and reformulate or give illustrations for each item. It promises to be an exciting time for those teachers and me.

Many of the points raised and discussed here will not be new to those of you experienced in working with Logo and Logo-like environments. However, most of the points are not ones typically found in mathematics classrooms in North America. Perhaps Raffaella Borasi's book will help in giving the necessary permission to mathematics teachers to extrapolate from the work



done with Logo and computers to the environments they create for the learning of mathematics.

#### References

Borasi, R. (1992). *Learning mathematics through inquiry*. Portsmouth, NH: Heinemann Educational Books, Inc.

Sandy Dawson is an associate professor of mathematics education at Simon Fraser University, and is director of that institution's teacher education

program. His most research interests centre on the areas of LEGO/Logo and the exploration of what mathematics lessons with a constructivist or humanistic focus might look like.

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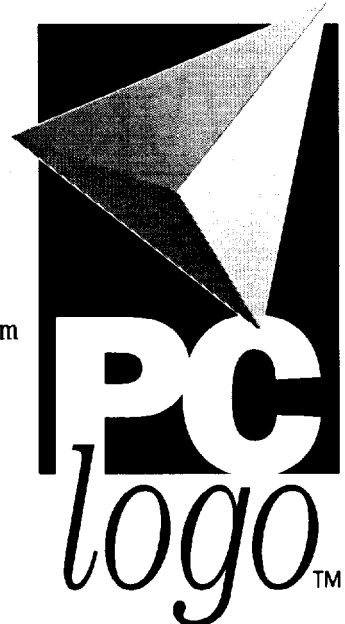
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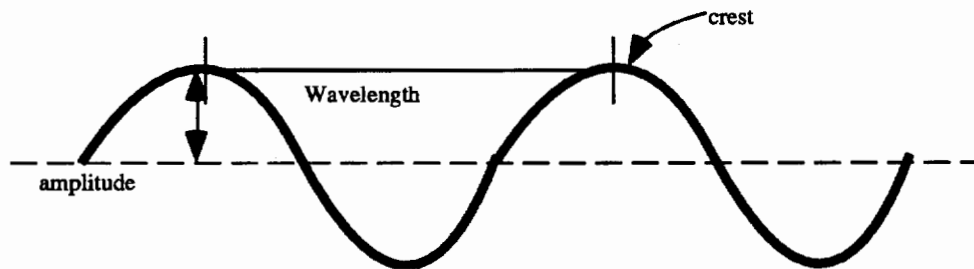
# A Logo Wave World

by Dan Robinette

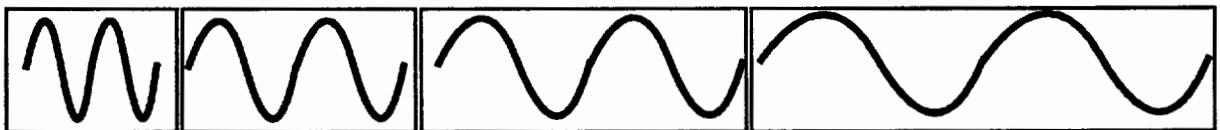
As a series of waves strikes the shore, how would they be different if they were going twice as fast? Why do some large rooms have "dead spots" where sounds can't be heard from other locations in the room? What makes one color of light different from another? All of these concepts are related to an important topic in physics: waves.

As a classroom teacher, the problem I have faced is that I cannot show my classes how waves interact in a dynamic way. I can't take my class down to the ocean and make the waves go a different speed. It is impossible to really "see" the difference between light waves.

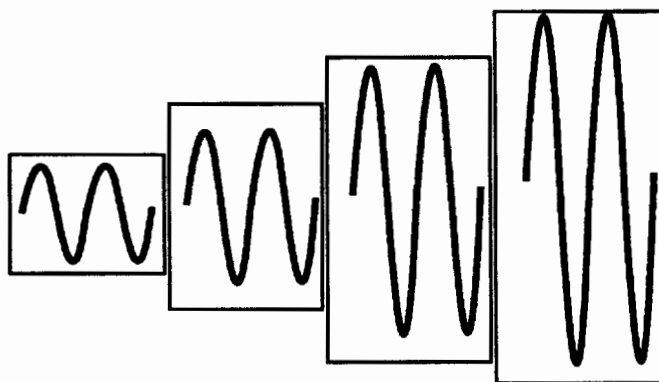
Ever since I began using computers as a learning tool, I have wanted to provide students a way to really *experiment* with waves. I wanted to give them a way to change how many wave crests they get every second (the frequency), how fast the waves go (the velocity), and how tall the waves are (the amplitude) so that they can see how the shapes of the waves change (the distance between the wave crests is called the wavelength).



For the introductory week of my waves unit in physics, I developed a Logo "microworld" called Wave World, which allows students to alter the frequency, velocity, and amplitude of the wave to see how the wave changes. Students can experiment with different values and quickly see the result as the waves are drawn. For example, they can experiment with the effect of speeding up the wave or making the amplitude bigger.

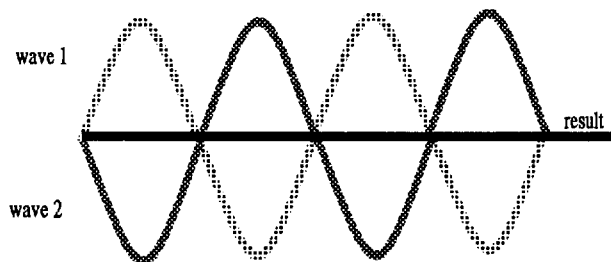


increasing the speed of the wave



increasing the amplitude

In addition, the microworld gives students a chance to see how two waves mix together to cancel each other out or make interesting patterns. If students come up with the right combination, Wave World draws two waves whose crests cancel with the other waves' troughs:



## Overview

My fundamental goal was to establish a foundation of understanding in class and then allow students to experiment with Wave World.

The general format of the wave unit is to introduce students to the concept of waves through demonstrations, cooperative learning exercises, and film. After a few days of introduction, students go to the lab to try out some concepts with which they are already familiar (wavelength, amplitude, frequency, velocity). In addition, they learn several new concepts through the microworld, such as "beats." Beats are fluctuating waves that arise when two closely related waves add together. After each visit to the computer lab, we debrief and share problems and new ideas for using the program.

### Day One

The integration of classroom lessons with the computer lesson goes smoothly. In the computer lab students seem involved with the lesson as they experiment with wave ideas. Learning with Wave World is structured at this point. I provide specific questions and tasks that students are to address.

### Day Two

During the debriefing session the next day, I tend to focus on three issues. First, we discuss some waves that students have printed using Wave World. As a group, we interpret how each set of waves could be produced. Next, students qualitatively describe how amplitude, frequency, and wavelength are related for a wave. This is one of the most successful aspects of the lab. For example, students can indicate with confidence that as the velocity increases, the wavelength increases. For the third aspect of this debriefing, students suggest ways to improve Wave World, focusing both on my goals and on technical aspects of the program. They always have some very important contributions to make.

### Day Three

Students go into even more depth during this session and begin immediately to develop an even more sophisticated idea of the nature of waves. They experiment freely with all the aspects of the microworld. Even though most are just trying to "make pretty pictures," they must create them by correctly relating various wave concepts. Every student also delves into wave addition, and most discover some essential aspect of what happens when waves add together.

### Day Four

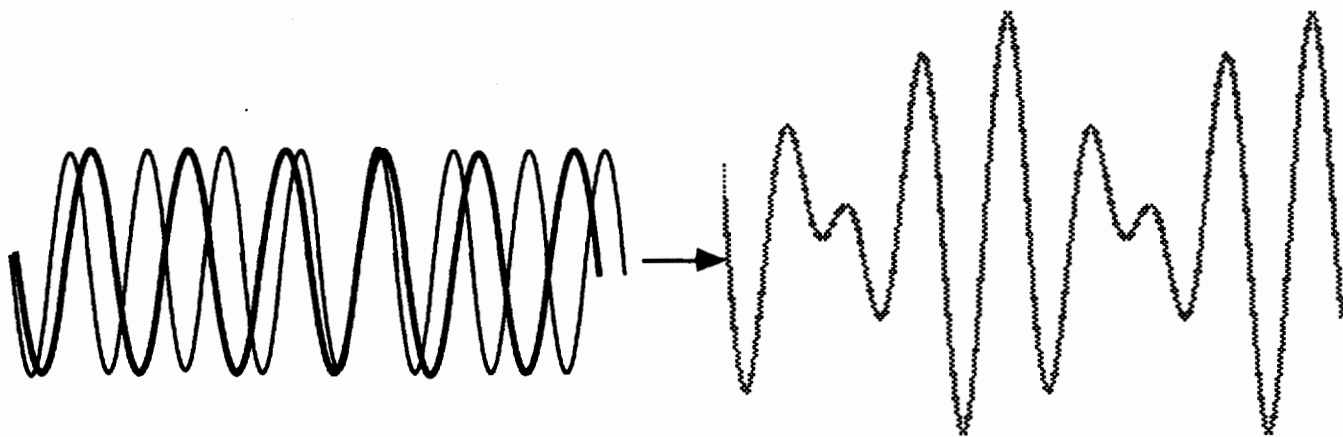
During our next debriefing, we identify other wave properties we could investigate using Wave World. We analyze several interesting waves and try to figure out how they could be created.

### Day Five

For the final session, we return to a more structured format in which students have some specific goals to achieve. In addition, they create scenarios that demonstrate new ideas about waves.

Throughout the lessons, the students seem comfortable relating the computer with new wave concepts. I even suggest that they try out their questions on the computer. I try to facilitate this linkage between class and the lab by using the computer to demonstrate some ideas. On the homework assignment for that first week, for example, I ask students to add some waves graphically. When discussing the answers to the homework, I create a similar addition scenario with Wave World to show them how the program could help visualize a particularly nasty addition. Students can manually add waves with ease that exactly cancel or that line up exactly "crest to crest." Waves that are similar but out of synch offer students a real challenge. By using Wave World, students can add these difficult cases, as shown at top of page 28.





## Conclusions

I am very happy with the way that students received the experiment. Most seemed to be adequately challenged and interested, and they seemed to learn some important lessons about waves. Some students even asked for the program disk so that they could experiment on their own time. Several other students used their graphing calculators to create their own wave simulators. This extra effort assures me that many students became excited about the idea of waves. As a teacher, I feel as if a blank space in my wave unit has been filled.

Dan Robinette has taught physics and chemistry at Clackamas High School in Milwaukie, Oregon, for four years. A native of Oregon, he received his B.A. in chemistry at the University of Oregon in 1988. He is currently completing graduate studies in computers in education at the University of Oregon.

If you would like a copy of the code for "Wave World," send a self-addressed, stamped mailer and \$5.00 to:

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8040 S.E. Jennings Avenue  
Milwaukie, OR 97267

# Squares and Rectangles

by Douglas H. Clements, Michael T. Battista, and Julie S. Meredith

- Teacher: How do you know it's a square for sure?
- Mary: It's in a tilt. But it's a square because if you turned it this way it would be a square.
- Teacher: Is it a square?
- Adam: Yes, a sideways square.
- Teacher: How do you know?
- Barb: It has equal edges and equal turns.

About two years later than we planned, we're figuring out what we've learned from our *Logo Geometry* project (Battista & Clements, 1991; Clements & Battista, 1991). We argued that *Logo Geometry* activities help students analyze visual aspects of shapes and how their parts are put together. We predicted that this would aid students in moving from thinking of figures as visual wholes to thinking of them in terms of their properties. Mary, a second grader, made a completely visual response. A figure was a square if you could make to "look like" one. But fifth graders Adam and Barb used the properties of a square to decide.

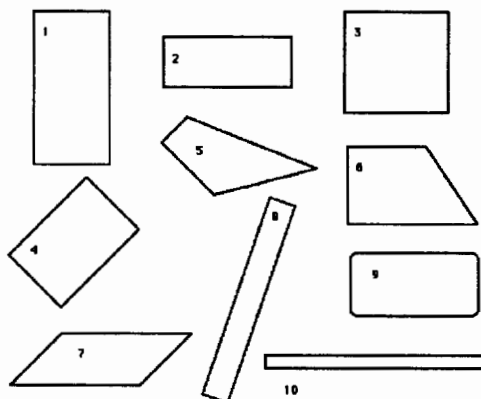
## Squares and Rectangles

How did most of the students think about rectangles and squares, and the relationship between these two classes of shapes? Did *Logo Geometry* change their thinking?

We worked with 656 students on *Logo Geometry* activities designed to help students construct geometric ideas from their spatial intuitions (Battista & Clements, 1988; Battista & Clements, 1991; Clements & Battista, 1991; Clements & Battista, 1992). Control students (644) worked with their regular geometry curriculum. After introductory path activities (e.g., walking paths, creating Logo paths), students engaged in off- and on-computer activities exploring squares and rectangles, including identifying these shapes in the environment, writing Logo procedures to draw them, and drawing figures with these procedures.

"Rectangle: What can you draw?" Directions: Which figures can you draw using a rectangle procedure with two inputs? You may turn before you draw a figure using RT or LT. Explain your reasoning.

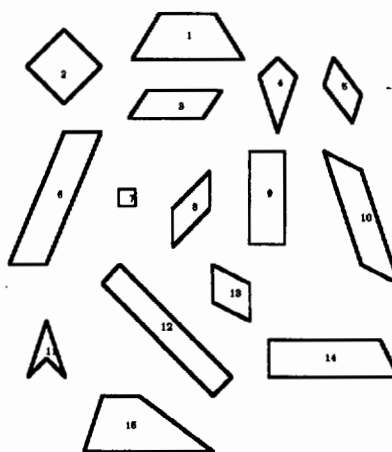
We conducted case studies and paper and pencil testing to see what students were thinking. We'll discuss some examples here.



## Paper-and-Pencil Items

The first item asked students to identify rectangles. Good performance on this item requires knowledge not only of the properties of rectangles, but of the fact that squares are rectangles.

Directions: Write the numbers of all the figures below that are rectangles.



Logo students performed better overall. They showed dramatic growth on the squares (shapes 2 & 7). The Logo group outperformed the control group on the parallelogram items, so they weren't overgeneralizing, that is, believing that all parallelograms are rectangles.

Logo students' increased attention to properties did not always lead to higher scores, however. They more frequently agreed with the statement that rectangles have two long sides and two short sides. In

another item, they also agreed that rectangles had "four equal sides." They have misinterpreted quantifiers such as all and some. For example, they might have read *rectangles have four equal sides* and thought, "sometimes—when they're squares—rectangles *do* have four equal sides."

Logo students did learn to apply the property "opposite sides equal" to the class of squares. They understood that the property "opposite sides equal" is not inconsistent with the property "all sides equal in length." Most students could apply both properties to the class of squares, demonstrating flexible consideration of multiple properties that may help lay the groundwork for hierarchical classification.

In conclusion, Logo explorations helped students move toward higher levels of geometric thinking by focusing their attention on properties of figures. They identified squares as rectangles as well. Why? They may have asked themselves if a "Rectangle" procedure could have drawn each of the given shapes. They may have seen that squares as rectangles because squares have all the properties of rectangles. As we will see below, others made sense of this notion by using visual transformations.

### Case Studies

Students dealt with the relationship between squares and rectangles in different ways. Kindergartner Chris is using the *Logo Geometry* "Shape" command to draw figures of various sizes. He types S (for Shape), then types the first letter of the shape he wants (e.g., S for Square, from a menu), and finally receives a prompt to type a number for the length of each side of the shape. After first being puzzled that pressing R for rectangle required two numbers as inputs, Chris enters two 5s.

Teacher: Now what do the two 5s mean for the rectangle?

Chris: I don't know, now! Maybe I'll name this a square rectangle!

Teacher: That looks like a square.

Chris: It's both.

Teacher: How can it be both?

Chris: 'Cause 5 and 5 will make a square.

Teacher: But how do you know it is still a rectangle then?

Chris: 'Cause these look a little longer and these look a little shorter.

Teacher: Would this square [drawing a square with Logo] also be a rectangle, or not?

Chris: No.

Teacher: Even though I made it with the rectangle command?

Chris: It would be a square rectangle.

Even though Chris creates a phrase ("square rectangle") that suggests that he might be thinking of a square as a special kind of rectangle, his response of "No" indicates that he is not making a hierarchical classification. He also judges the figure to be a rectangle, not because it was made by the rectangle procedure, but because of the way the sides "look."

Teacher: So is a square a special kind of rectangle?

Chris: Yeah, if you pushed both numbers the same.

Teacher: How about 10 on two sides and 9 on the other two? Would that make a square? Or a rectangle? Or both?

Chris: It's both [a square and a rectangle].

Teacher: Is it a square?

Chris: Yes.

Teacher: How come it's a square?

Chris: 'Cause 9 is close to 10.

Again, we see the strength of visual thinking in Chris' judgments. He is willing to call the rectangle with side lengths of 9 and 10 a square, presumably because his visual thinking causes him to judge 9 close enough to 10 as side lengths. Contrast this with the second grader Mary's thinking about squares (at the beginning of this article). It too was visual, but it was more sophisticated because of her use of visual transformations.

Robbie, another kindergartner, already indicated that he understood why he must enter two numbers for a rectangle but only one for a square.

Teacher: What about this? What if I put in S R 5 5.

Robbie: That would be a rectangle for R.

Teacher: Right, and then I tell it 5 and 5.

Robbie: R draws on paper what he thinks it would be (a square) and calls it a square.

Teacher: How did that happen?

Robbie: Because if I goofed...and I think I put some number the same, I got a square, and I wanted a rectangle.

Teacher: Why is that?

Robbie: I can go wrong on the rectangles. Because the rectangle is like a square, except that squares aren't long.



Teacher: What else do you know about a rectangle? What does a shape need to be to be a rectangle?

Robbie: All of the sides aren't equal. These two [opposite] and these two [other opposite] sides have to be equal.

Teacher: How about 10 on two sides and 9 on the other two? Would that make a square?

Robbie: Kind of like a rectangle.

Teacher: Would it be a square too?

Robbie: [Pause.] I think may... . [Shaking head negatively.] It's not a square. 'Cause if you make a square, you wouldn't go 10 up, then you turn and it would be 9 this way, and turn and 10 this way. That's not a square.

Robbie also is not using hierarchical classification. He thinks of squares and rectangles in terms of visual prototypes—"the rectangle is like a square, except that squares aren't long." And according to his experiences, he, like most students, decides that rectangles have opposite sides equal, but not all sides equal.

In conclusion, the Logo microworlds proved to be evocative in generating thinking about squares and rectangles for these kindergartners. Their work was strongly visual in nature, and we should not conclude that they understand logical classification, such as class inclusion. Squares were squares, and rectangles—unless you make a square with a Logo rectangle procedure or you intend to sketch a rectangle, but draw a square instead. In such cases, you might describe the shape as a "square rectangle."

Even though these young children were still thinking visually, the Logo microworlds started them thinking about the properties of shapes. As we'll see, after further experience with Logo, they increasingly attended not only to the holistic visual aspects of shapes but also to their properties. This is the first step on the path to more sophisticated geometric thinking.

In the next installment, we'll look at older students struggling with similar issues.

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Douglas H. Clements, associate 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. His book *Computers in Elementary Mathematics Education* emphasized Logo (Prentice-Hall, 1989). Through a National Science Foundation (NSF) grant, Michael Battista and he co-developed a K-6 elementary geometry curriculum, *Logo Geometry* (published by Silver Burdett, & Ginn, 1991). He is currently working with several colleagues on a second NSF-funded project, *Investigations in Number, Data, and Space*, to develop a full K-6 mathematics curriculum featuring Logo.

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  - c. Description of technology presently in use. (Network readiness.)
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6. ISTE Organizational Affiliate members will judge entries and select semi-finalists from the East, Central, and Western United States in each of the three prize categories.
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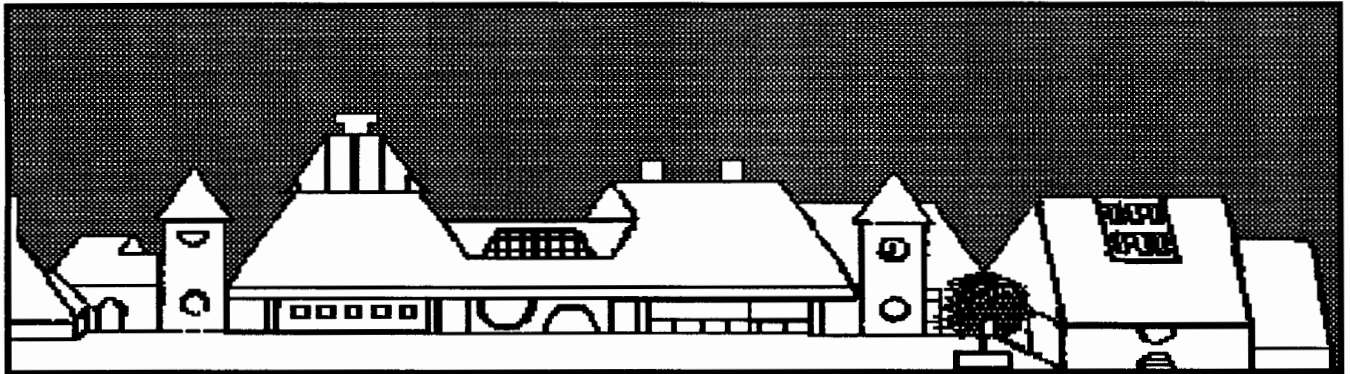


# Back to School

by Dorothy Fitch

At Terrapin, we frequently receive printouts of Logo designs created by students (and sometimes by adults). We like to include these pictures in our newsletter. It's great to see and to share what people can do with Logo.

A while back, we received this picture drawn by Mark Champion, then a fourth grader at the Bancroft School in Andover, Massachusetts.



## Project Idea

What a great picture, and what a lot of work it represents! Just think of all the mathematical ideas and problem-solving skills that are used to draw a school in Logo: estimation, measurement, scale, ratio, planning, organization, breaking down a problem, and so on. This project presents a wonderful opportunity to integrate Logo into your math and problem-solving curriculum.

There are several ways to approach this project. I asked Mark how he did it. He replied:

Dear Ms. Fitch,

Thank you for your interest about my drawing of my school. I did it from a sketch and didn't actually measure the building. I forget how long it took me. I am now in the fifth grade and was in the fourth when I did the drawing. I have Logo at home and at school. I just looked at the sketch of my school and worked up the procedures. The building was too long to fit on one screen, so I used two and taped the paper together. I really like using Logo.

Sincerely,

Mark Champion

As you can see, in addition to the general problems of recreating a larger-than-life design on screen, addi-

tional problems crop up along the way. For example, how do you fit the entire school on one screen! Mark solved the problem by drawing the design in two halves and reassembling the design after it was printed. Imagine the added difficulties of working with a design that is in two different pieces!

The results can be very impressive, but this project focuses on mathematics and problem solving, not on Logo skills. All students need to know is a handful of turtle commands (FORWARD, BACK, RIGHT, LEFT, PENUP, and PENDOWN) and how to write and edit procedures. Clearly, this fourth grader was capable of completing the project, yet it is a challenging activity for students through junior high school grades.

How much guidance you give your students will probably depend on their age. You could divide a class of older students into groups and simply give them the challenge: Write a Logo program that draws the school. Each group would then have to solve the entire problem from scratch. You will need to help younger students identify the tasks and talk with them about how to tackle the project.

## Meeting the Challenge

Each group (or the entire class) needs to figure out, and then complete, the major tasks for the project. Here are some ideas to help you and your class get started.

- Choose which side of the school to draw.

Generally, you would want to show the side with the front entrance. However, more than one view of a school may be desired. Different groups could work on different sides. (Make sure that they all agree on the same scale!)

- Make a sketch of the school.

Perhaps the art teacher could get involved in this part of the project. Drawing a sketch makes students more aware of detail, proportion, roof angles, and even shadows. Artistic talent is not a prerequisite. The goal is to have a place to write down measurements and a way to refer to details that doesn't involve lots of running outside to look at the real thing!

- Mark down the location and dimensions of other features of the school grounds.

A plot plan showing shrubs, trees, the flagpole, and so on will provide ideas for later enhancements to the picture.

- Measure the school section by section and write down the dimensions on the sketch. Students will no doubt become quite creative (and have lots of fun) as they figure out the best way to measure the building. Those looking for an added challenge can measure all distances in meters rather than feet. Students can use a tool such as a yardstick, a long tape measure, or a rope that has been measured and perhaps marked. They might decide to use their own bodies to measure distances by taking baby steps, counting off measured paces, or even lying down end to end! Measuring the horizontal distance is easier than the vertical distance. To measure height, students can count bricks, hang a rope from a window, or estimate from inside measurements. They will probably come up with methods of their own!

- Determine a scale of measurement to use.

Obviously you can't draw the school using its actual dimensions. Students will have to figure out a scale to use. Will one foot = 10 turtle steps? One inch = 1 turtle step? One meter = 20 turtle steps? The answer depends

on the size of the school. Will this scale make the picture smaller than you want? You could choose a larger scale and draw it in sections, as Mark did. That complicates the process but may provide you with the results you want. Will the scale you choose be suitable for both the vertical and horizontal dimensions? Where on the screen will you need to start the picture? There are many questions to resolve here.

You could write the entire program using a variable to represent one unit of measure. For example, the variable UNIT might be the actual number of feet. These instructions would move the turtle forward 9.4 "feet," and then cause it to turn right and draw a line 20 "feet" long.

```
FORWARD :UNIT * 9.4
RIGHT 90
FORWARD :UNIT * 20
```

Later, you could experiment with the value of UNIT to make the design fit on the screen.

```
MAKE "UNIT 5
```

- Determine the names of the subprocedures for the program.

You certainly don't want to have one procedure that draws the entire school. Debugging would be a nightmare! So, you will need to decide how to break the design for the school into smaller chunks. If the school has wings or parts of the building for the gym or cafeteria, those will be clear segments of your program. If your school is an older building with several floors and regularly recurring patterns of windows, you will need to determine how best to organize the program. You will probably want a procedure for a window, perhaps one for a series of windows, a procedure for the roof, a procedure for the door, and for any distinct part of the building. Be sure to give them meaningful names.

- Write instructions for each of the sub-procedures.

Even before you have written the main procedure, you can begin to write the subprocedures. If you are using a variable for the measurement unit, you don't even



need to know the scale for the drawing at this point. Make each procedure so that it can stand alone. The turtle should begin and end each procedure in the same place and pointing in the same direction. This will make it easier to combine the procedures later. When you type WINDOW, you should see something that looks like a window. You should see a roof when you type ROOF. Make sure that the GYM procedure looks like the gym. If it doesn't look like the gym at first, it won't look any more like the gym when you combine the procedures!

- Write the main program.

After having written all the subprocedures, it should be fairly simple to write the main program. All you need to do is link the procedures together, moving the turtle from place to place as necessary. It will make your program easier to debug later if you add a few procedures with names like MOVE.TO.ROOF or MOVE.TO.START rather than have a lot of FD, RT, and LT commands in the main procedure.

- Enhance the program with color and other details.

Once you are happy with your completed design, add trees, a flagpole, a sign, a school bus, the sun, or a few clouds, as time permits.

- "Publish" the design.

Now that you have finished your masterpiece, you need to show everyone! Print it out and display it on a bulletin board. Include it in your school newspaper. You could even make it part of your school letterhead! Get the local newspaper to publish it. Send it to the *Logo Exchange* or to the publisher of your Logo language. If you have a pen-pal school, send the school a copy. Maybe the students there will send you a design of their school!

Note that members of the group, or different groups in the class, can work on different tasks at the same time. One group can sketch the school while others provide the actual measurements. After a few main measurements have been made, students can compute the best scale. Meanwhile, others can figure out the best way to divide the program into smaller units and give

them names. In other words, the list of tasks does not have to necessarily be completed in order. A small amount of measuring can provide enough information for a large amount of work to begin in different areas.

As much as possible, let your students encounter and resolve problems on their own. Resist the temptation to stop them from pursuing what you consider to be the wrong path to a solution. They will find out themselves that it won't work (a powerful lesson learned), or they might actually stumble upon a better solution than you could have imagined! However, this doesn't mean that you should allow them to bungee-jump off the roof to measure the distance!

Why not try this project with your class this fall. Happy Logo adventures!

By the time you read this, Mark Champion will be in the sixth grade. When he created the picture in the fourth grade, his teacher was Claire Touseall. His original design has a blue background and a green tree.

Dorothy Fitch has been director of product development at Terrapin since 1987. A former music educator, she has also directed a computer education classroom for teachers and students and provided inservice training and curriculum development for schools. She is the author of *Logo Data Toolkit* and coauthor of *Kinderlogo*, a single-keystroke Logo curriculum for young learners. At Terrapin, she coordinates software development, edits curriculum materials, writes documentation, and presents sessions at regional and national conferences.

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# LEGO/Logo: Using Cooperative Learning Strategies

by JoAnn Karaffa

During the last three years, I have had the opportunity to take workshops to assist me in bringing cooperative learning into my classroom. I have found these strategies easily applied to the many subjects and topics that I teach in my fourth grade classroom, including my LEGO/Logo activities. Thus, I have created several lesson plans that incorporate these strategies. But first, let's recap what cooperative learning is, according to Johnson, Johnson, and Holubec (1988).

The basic elements of cooperative learning they identify include:

- positive interdependence
- face-to-face interaction
- individual accountability
- interpersonal and small-group skills
- group processing.

*Positive interdependence* means that students must rely upon each other to establish mutual goals, receive joint rewards, share information and materials, and assume roles.

*Face-to-face interaction* means that students are encouraged to interact verbally through oral summarizing, giving and receiving explanations and elaborating on experiences. Students are encouraged to utilize "12-inch voices," which foster a small buzz rather than a large roar in the classroom.

*Individual accountability* encourages each member of the group to involve himself or herself in learning as the group works. The teacher may randomly select a member to give an answer for the whole group or summarize the group's progress.

*Interpersonal and small-group skills* are skills that need to be taught. Children come to school with self-centered skills and need to establish leadership, trust, decision-making, and conflict management skills so that their group will function effectively.

*Group processing* means giving students time to analyze the group's functioning, evaluate effectiveness, and set goals for future successes.

Well, then, how do you use LEGO/Logo in this kind of environment? I begin by doing several easy activities in which I utilize the building concept cards from the LEGO Technic I 1030 and 1032 kits. My goals beyond helping students learn to work cooperatively include helping them learn the names of LEGO components and learn to program in Logo. I make use of the lesson plan outlined below.

## *Compound Machines: Making Work Easier*

### **Tasks**

Construct one compound machine  
Identify the combination of simple machines (lever, pulley, wheel and axle, gears, belts, inclined plane) used in the compound machine

### *Cooperative Activities*

Each member of the group has a role.  
Everyone must agree upon the possible uses of the machine.  
Everyone must be able to explain how the machine makes work easier for humans.

### *Positive Interdependence*

Goal: Construct one compound machine  
Task: Be prepared to tell other groups the parts of the machine and its uses  
Resources: LEGO set, LEGO building plans  
Roles: *Parts Manager*—locates needed components. *Engineer*—head builder, allows others to assist. *Reporter*—Makes sure that the group stays on task, asks group to identify simple machines used in the compound machine, tells others about the project

### *Face-to-Face Interaction Environment*

Work in a group of three members, heads together, using-12 inch voices, everyone involved

### *Individual Accountability*

All group members participate in construction and contribute ideas for the report to other groups

### *Interpersonal and Small-Group Skills*

Each member is checked for understanding.  
Each member fulfills expected roles working cooperatively with group members.

### *Intergroup Cooperation and Processing*

The members will use active listening skills as other groups report and may question or ask for clarification from others reporting

Students are divided into groups of three, given a set of building blocks, a building plan, and role cards to select from an envelope. Roles are reviewed, time limits



are set, and the groups begin to work. After a given period of time, the groups describe their product, discuss the product's value or use, and tell about their group's ability to function. I question the groups to expand upon the observations I want students to make as I have the groups report. They may be asked to explain applications to simple machines used in their daily lives and to identify simple machine components.

After the first activity or building project, I have the students change groups. We number off 1, 2, 3, with 1s moving to the group on the right and 3s moving to the group on the left in sort of a round-robin rotation. The 2s never move. The last project is disassembled, parts are returned to the kits, and I hand out new project cards. Students decide upon a role they have not previously assumed. They can draw role cards and then trade them. Then a time limit is set, and work begins.

Within a 45-minute period, we can usually accomplish two or three building sessions, depending upon the difficulty of the project. The projects from the Technic I 1030 kits go faster than the more difficult concept cards from the Technic II 1032 kits.

When we begin using the motors from the Technic 1032 kits, I begin setting the stage for programming in Logo. After the model has been tested with the battery pack, we create simple procedures and run them from the computer. I find that easing into the concepts of programming from this angle gives my students a stronger understanding of the structure of Logo, note taking, and problem solving. I have my students begin a notebook record of the procedures they write so that they begin to see the patterns in programming that they will need to use in procedure writing.

### ***Transitioning Into Computer-Controlled Building With Technic Control O Sets***

Let me give you a short overview of the difference in the LEGO/Logo set that the students will now use. The set includes eight new building cards that will create machines that can be programmed with the computer. The plans include a stop light, car, merry-go-round, conveyor belt, washing machine, race-track start-and-finish gate, and a drawing machine or turtle. Each of these projects will have specialty components such as motors, touch sensors, optic sensors, and lights.

Now that my class has successfully completed noncomputer-controlled building activities, I am ready to expand the cooperative groups to five members. The roles are redefined and modeled. A new role of "programmer" is added. I make sure I have extra copies of the programming books that go with the kits. I have all of the programmers sit down together as the projects are being built. They collect information and decide upon sample programs to try. I have all of the groups build the stop lights first. I work with all of the pro-

grammers in a group. We model how we read, record, and learn about programming the machines. The programmers maintain a group programming-notebook in which they keep a list of primitives learned, along with their meanings. They will be the teachers for the rest of their groups.

Time is then provided for the programmers to enter their procedures and demonstrate the outcomes to the rest of the class. Each of the four or five groups selects a different concept to explain for operating the stop light. The concepts they demonstrate include sequencing the light turning from red to yellow to green, flashing, using the touch sensor to change the light colors, using the light sensor to change the light colors, and setting a burglar alarm.

After we have exhausted all the ideas for the programming the stop lights, we are ready to move on to our next project. I generally follow the sequence of the LEGO books, with each group building the next project. I utilize the following five-member cooperative group model.

### ***Smart Machines: Stop Light and Car***

#### ***Tasks***

Construct a stop light and a smart car  
Learn to interface the machines with the computer to operate them

#### ***Cooperative Goals***

Each member of the group has a role.  
Everyone participates to accomplish the final results.  
Everyone must be able to explain how the machines function and how they are operated by the computer.

#### ***Positive Independence***

Goal: Have a functioning stop light and car  
Task: Be prepared to tell others how to control the light and the car  
Resources: LEGO set, LEGO building plans  
Roles: *Supervisor*—locates needed components. *Engineer*—head builder, allows others to assist, makes sure that the group stays on task. *Worker*—assists the engineer to complete the projects. *Programmers*—read the instructional books to learn how to write the procedures needed to operate the stop light and car and type the procedures into the computer, saving them to disk.

#### ***Face-to-Face Interaction Environment***

Work in a group of five members, the construction group working with heads together, using 12-inch voices, while the programmers are working at the computer



### ***Individual Accountability***

All group members participate and share information with the group.

Each member of the group can explain how the stop light and smart car work.

### ***Interpersonal and Small-Group Skills***

Each member is checked for understanding.

Each member fulfills expected roles working cooperatively with group members.

### ***Intergroup Cooperation and Processing***

The members use active listening skills as other groups report.

The groups assist each other by responding to questions and share "eurekas" with other groups.

My students are unbelievable when they do the LEGO/Logo projects. I am amazed at the knowledge and sophistication that develops as a result of using these exciting activities and this innovative model of instruction. I have seen children who are uncommunicative become outgoing and freed from inhibitions. I have seen aggressive children become group workers and supporters. Yes, there have been problems. I have had work groups go on strike, and we have then investigated, negotiated, and found solutions through contract resolutions. Learning has stimulated learning. Behaviors have created new behaviors. I am particularly impressed by the fact that my students seem to become more self-sufficient. They begin to advise me about strategies I should use, suggest improved organizational strategies for our classroom, and become independent thinkers. I have learned much more from them about how machines work, how work is made easier by machines, and how problem solving requires several heads working together.

Let me describe an experience that my students had two years ago. One day the assistant superintendent was walking by our classroom while my students were clustered around the race-track start-and-finish gate project. (I had converted this activity into a full-blown scientific study of mass and speed. Students had learned how an inclined plane and its angle impacted the rate of speed that a car would travel down the incline. We had then moved into a study of how the mass of a car related to the speed with which the car would travel down the incline that they had made from LEGOs at home.) There was a great deal of excitement and involvement that the assistant superintendent when he passed the room. He came in and watched what was going on. The children were quick to notice a visitor and began enthusiastically telling him all about the project. He was amazed at the knowledge they had acquired and was impressed with their work. Three

days later I received a call from him. He had told the superintendent about the observation and they had decided that this was an activity that the school board should see. Would we come next week and show them? We did, and they were speechless. The children were elated, and what an opportunity! I'll tell you how I structure this exciting activity sometime in the future.

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by Dennis Harper

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## Logo and Freire's Educational Paradigm

by José Valente,  
Latin American Field Editor

A major project concerning the implementation of computers in education is happening in the city of São Paulo, Brazil. This project was initiated by Paulo Freire, the city's secretary of education. In São Paulo's educational system, there are 678 schools—576 of them are elementary and middle level (first to eighth grade). The implementation of the computers-in-education project started in August 1990. About 60 elementary and middle schools had computing as part of the school activities by the end of 1991. The methodology being used is based completely upon Logo.

In this article, I describe the major points of the computer project as well as the new educational paradigms in which it is inserted. This new paradigm is based upon Paulo Freire's conception of education. Logo, as an educational methodology, fits very well in this paradigm. As a result we have the computer as part of an education project in which it is possible to contemplate Piaget's interactionist and Papert's constructivist approaches to intellectual development, as well as the socio-cultural component added by Freire.

### Freire's Educational Paradigm

Paulo Freire's ideas about education are expressed in his well-known book *Pedagogy of the Oppressed*. In this book he proposes an educational methodology and describes the results of its praxis. His goals are to create educational situations in which a student learns by acting upon and transforming his world. Freire believes that if this is done, the students can move toward the new possibilities of a richer life as an individual as well as collectively. Thus, for Freire, the world is not a given reality to be accepted and mastered through memorization; rather, it is a problem to be faced, to be

worked on, and to be solved. For example, if a school is in a community involved with the production of bricks, "brick" becomes the word around which the students learn to read and write. Counting bricks becomes a way of introducing the concept of "number," and the process of brick production is studied. Social and political issues, such as the reasons bricks are produced, the exchange value of bricks, and the groups for whom bricks are produced are also used to make the students and the community aware of their reality.

Thus, Freire wants to provide educators as well as students with the opportunity to move "from the naive consciousness to the critical consciousness" so they will not only be able to read texts but also will be able to read the world, interpret it, and act upon it. In this sense, his ideas are very much interactionist and constructivist, like Piaget's and Papert's proposals. However, there are some slight differences. For example, for Freire, the student's learning environment is the community and the student's action upon the world is not limited to interaction with the objects or people from the learning environment. Freire wants the student to transform the world through this interaction.

Freire developed his ideas while working as an educator in northeastern Brazil in the early 1960s. Since then, he has been able to practice and to polish his ideas through several educational projects in different countries. In 1989 he was appointed secretary of education of the City of São Paulo.

The city of São Paulo is one of the largest in the world. It has 14 million people, about 1.8 million of whom are students from kindergarten through the 12th grade. These students are distributed in three different educational systems: 472,000 in the city educational system; 1,036,000 in the state educational system; and 323,000 in the private system. The city educational system has 678 schools, the state system has 995 schools, and the private system has 928 schools. Thus, as the head of the city educational system, Freire is in charge of 678 schools and 472,000 students.



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Freire's goal is to change the city school structure in order to materialize his educational ideas. He established three main principles to guide the reconstruction of the city educational system: participation, decentralization, and autonomy. These principles were chosen because, as in most educational systems, education is rigidly hierarchic—policy makers at the top deciding what needs to be done, several levels of intermediaries, and the teachers who execute what has been decided at the top levels, which in general has nothing to do with the students' reality or the reality of the school. In Freire's new structure, everyone involved has to participate, decisions are decentralized, and each school has the autonomy to decide what is good or bad for it. Chaos? Not quite, but there are enough changes to create the critical consciousness that Freire wants to promote.

To implement his plan, Freire created several administrative mechanisms and educational projects. One of the key administrative mechanisms is the school committee formed by the school director, teachers' representatives, school workers' representatives (secretaries, janitors, etc.), representatives of the students, representatives of the students' parents, and members of the community. This committee has the power to decide what the school should be educationally as well as administratively. Also, this committee constitutes a good channel of communication and source of feedback between the school and the community.

In terms of educational projects Freire has proposed two main projects: the Interdisciplinary Project, which tries to implement the idea of education around the community as a generative theme (not easy for an educational system centered on the basic traditional curriculum) and the Genese Project, which involves the use of computers in education. Also, other educational projects can be initiated by the school, through the school committee.

### The Genese Project

The use of computers in education was initiated by Freire because, as he says, he "is a man of his time." According to him, computer technology is part of one's reality and has to be dealt with using the same approach as is used with other objects in one's world. It has to be studied and used critically: it is a tool to be acted upon and to be used to transform the world.

The computer plays an important role in Freire's educational goals. It is clear that in his educational vision there is no room for Computer-Aided Instruction (CAI). Also, the computer cannot be introduced into the school as an "animal in the zoo," just to be watched, or as an object to be mastered in order to become the vehicle for success in jobs. Rather, it is a tool for solving problems related to the students' immediate reality. In this case, Logo and other software, such

as word processors and spreadsheets, fit very well in this educational proposal.

In the Genese Project the computer activities developed in the schools are part of the class activities. A teacher of a particular discipline uses the computer as a tool to help the development of the class subjects. Thus, the computer is not a separate subject to be mastered.

The Genese Project started with a group of school teachers who were interested in participating in the project. Thirty teachers were enrolled as part of the first computer training course. This course was 180 hours long—90 hours of computer practice and 90 hours of theory. The computer practice consisted of 75 hours of Logo and 15 hours of word processing. The theoretical part consisted of an introduction of Piaget's and Vygotsky's theories, a discussion and examples of the use of Piaget's clinical method, Papert's theory, Turkle's ideas, a brief introduction to cognitive theory, and seminars about several existing computers-in-education projects. During the course, the participants had to develop a computer project that was presented to the group at the last day of class.

From these 30 participants, 6 were selected to form the group of experts at the education secretary level (central group), and 18 were selected to form three subgroups of 6 members each (regional groups). The central group is in charge of administrative as well as educational issues regarding the dissemination of computers in the city educational system (for example, to integrate the Genese Project with the Interdisciplinary Project, to analyze projects from the schools, to supervise the work at the school level, and to keep informed about the development of ideas in the computers-in-education area in order to disseminate them). The regional groups are in charge of the actual implementation of computers in the schools. For this purpose, São Paulo was divided into three regions, and each subgroup of experts in computers in education is responsible for the actual implementation of computers in the schools of its respective region, for example, to train the school teachers, to help them with school activities, and so forth.

Several seminars and workshops were held to disseminate the idea of using computers in education throughout the city educational system. As a result, several schools submitted project proposals.

The procedure for introducing computers in a particular school begins with the selection, by the school committee, of five teachers to participate in an 80-hour course. This course is a shortened version of the 180-hour original course and is administered by a member of the respective regional group. Also, the directors and the supervisors of these schools participate in a 40-hour training course so that they can understand what is



going on at their schools and can help the process of implementing the project at the school level. Then, 15 MSX microcomputers and two printers are installed in the school.

The five teachers trained have the responsibility of disseminating the ideas about computers in education in their respective school. They have to introduce computers as part of the activity developed in their discipline and help in the training process of their colleagues. The theoretical part of this training course is administered by the members of the regional group of experts. The computer practice is supervised by one of the five teachers already trained. Also, the regional group keeps a close relationship with the school. The regional group members supervise the teachers' and student's computer activities, help the teachers to plan their actions, and are in charge of the ongoing training of the teachers.

While participating in Project Genese, a school teacher is paid 10 for 10 extra hours of work per week. (If a teacher has 30 hours per week of class activities he or she receives payment for 40 hours of work.). These 10 extra hours are used to study (2 hours), to plan activities (4 hours), and to learn more about Logo or to train colleagues (4 hours). Extra hours are also used for courses that provide in-depth information on subjects the teacher feels are necessary to develop class activities, such as lists, animation, and so forth, or for subjects that relate to the development of the area, such as Logo-music, 3D Logo, or Lego-Logo.

The actual implementation of Genese Project at the school level started in March 1991, with six schools, one of which is for auditorily impaired children. In this first round, about 3,000 students and 150 teachers started to use computers as part of their school activities. These students have at least one hour per week of computer time in each of the disciplines (math, language, science, and art), totaling at least four hours per week of computer activities.

A second round was implemented in August. Twenty-five schools were selected. A third round started in November, with the objective of implementing the computer project in 20 other schools. By the end of 1991, it is expected that 50 schools will have implemented the computers-in-education project, providing this facility to 30,000 students and 1,500 teachers.

### **Genese Project in Action**

What does it mean to have the computer project in a school? How is the computer contributing to Freire's educational ideas? In order to answer these questions more concretely, I will describe the computer experience of the seventh-grade students of a school that participates in both the Interdisciplinary and Genese projects.

In terms of the usage of computers in a classroom, there are three different types of activities that happen simultaneously: activities originated by the interdisciplinary project, activities originated by the interest of the class as a group, and activities developed by each student according to his or her personal interest.

As part of the interdisciplinary project, the generating theme chosen by the school committee was "Living in a Community." The school teachers divided this theme into subtopics by disciplines. These subtopics have the function of providing the students of a particular grade with problems that are related to the content of the disciplines and that can be solved as part of day-to-day activities. The subtopic chosen by the seventh-grade teachers was "the role of communication media in the community." The development of this subtopic led to different ideas to find out what kind of communication media and computers existed in the community. By doing so, they found out that there were a lot of elderly people sitting in front of the TV as their only daily activity. Based upon this information, the problem to be studied became "how does the communication media convey and form our vision of elderly people?" This became the problem to be solved during the first two months of the school semester.

The science teacher used this problem to study the different phases of human development, beginning with cells, how they are formed, how they grow, and how they get old and die. Also, she introduced other subjects, such as the relation between the TV and elderly people, the reasons there are more young people than old people portrayed on TV, and the principal causes of mortality in Brazil.

The language teacher used the same thematic problem to introduce such topics as how to interview, how to analyze, and how to present the results of these interviews. The math teacher developed the quantification and representation of the data. By using Logo, the students constructed bar and circle graphs to show the different results of their field work.

The media project spun into other types of projects, such as the production of material using word processing, the use of Logo to produce logotypes to introduce the material (similar to product advertisements they see on TV), and to illustrate the subjects they studied.

The students decided to construct solid objects from cardboard and to represent these objects on the computer as part of the class computer activities. These objects were drawn by using Logo, and two or three students were responsible for a solid and its representation. The math teacher used this subject to introduce some of the geometric theory involved in the production of these objects.

In addition to these computer activities, each student had, on the side, his or her own computer project,



such as drawing a spaceman, car, or other object. These were free activities each student could develop. If the student had an idea or a project, he or she was welcome to try it, with the teacher making sure the student could do it.

### Discussion

There are several interesting aspects of this project that are worth discussing. First, it is a massive project, with respect both to quantity and quality. Introducing computers in the São Paulo educational system is a gigantic enterprise. Moreover, this has to be done with the objective of using the computer as a way of developing critical consciousness. However, the structure of the Genese Project—involving the participation of administrators, teachers, and students; the decentralization of decision-making power; and the autonomy given to the people involved in the education process—creates a working strategy that contributes to a sense of community. Participation is consistently based on the interest expressed by individual teachers and schools. Their work emerges from the need people have in acting and transforming their own world.

Second, even though the work is community-based, the project is set up in ways that leave enough room for a small group, like a class, or an individual to explore a particular interest. By maintaining the synergy between social and individual interests, the computer makes learning not only ego synthonic (in Papert's terms) but socio-cultural as well (in Freire's terms).

Third, the computer becomes a natural tool for students and teachers to carry out their activities. The computer enriches the learning environment because it is another object of the student's world to be understood and because it allows the development of activities that can be very sophisticated and interesting. Thus Logo, in addition to being totally synthonic with Freire's educational proposal, adds another dimension to his ideas.

A common criticism of Freire's educational method is that it works in "Freire's hands." In order for the community themes to be interesting as educational subjects, they have to be explored from the social, from the political, and from the cognitive points of view. However, if the teacher is not well prepared to deal with all these different aspects, one aspect can be emphasized to the detriment of the others. In general, the cognitive is the one that suffers most. This happens because either the teacher using Freire's educational ideas is too socially or politically oriented or the community themes are too weak in subjects that can lead to cognitive development. Thus, the computer activities constitute experience that can contribute to the formation of high-level cognitive mental structures.

Finally, the success of Freire's method and Logo requires well-trained teachers. The marriage of this method with the computer requires that the teacher is well informed about Freire's interdisciplinary approach as well as about the Logo methodology. It is true that they complement each other and much of the Logo way of working is similar to Freire's. However, in order to do Logo, the teachers need to know Logo language and methodology. Thus, the Genese Project has to foresee mechanisms that guarantee that the process of training teachers by other trained teachers does not dilute the most important aspects of Logo. There are several ways of doing this, but the most important is to create mechanisms that force the participants of Genese to reflect upon and to debug their actions, that is, to use Freire recursively.

This article was based upon two papers, "Projeto Genese de Informática Educativa: Histórico, Princípios e Diretrizes" and "Educação no Futuro," prepared by Sulamita Ponzo de Menezes, the Genese Project coordinator. It was also based upon a conversation with Sulamita P. de Menezes and the Genese Project central group, formed by Alayde R. Carlucci, Carlos A.O. de Carvalho, Davilson F. Bassi, Marcia Regina T. Macedo, Pompéia Del Corso de Moraes, e Regina Célia Vieira. I thank them all. For more information please write to:

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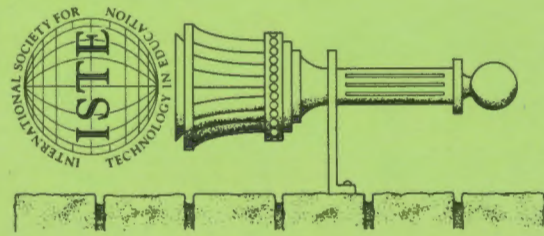
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