

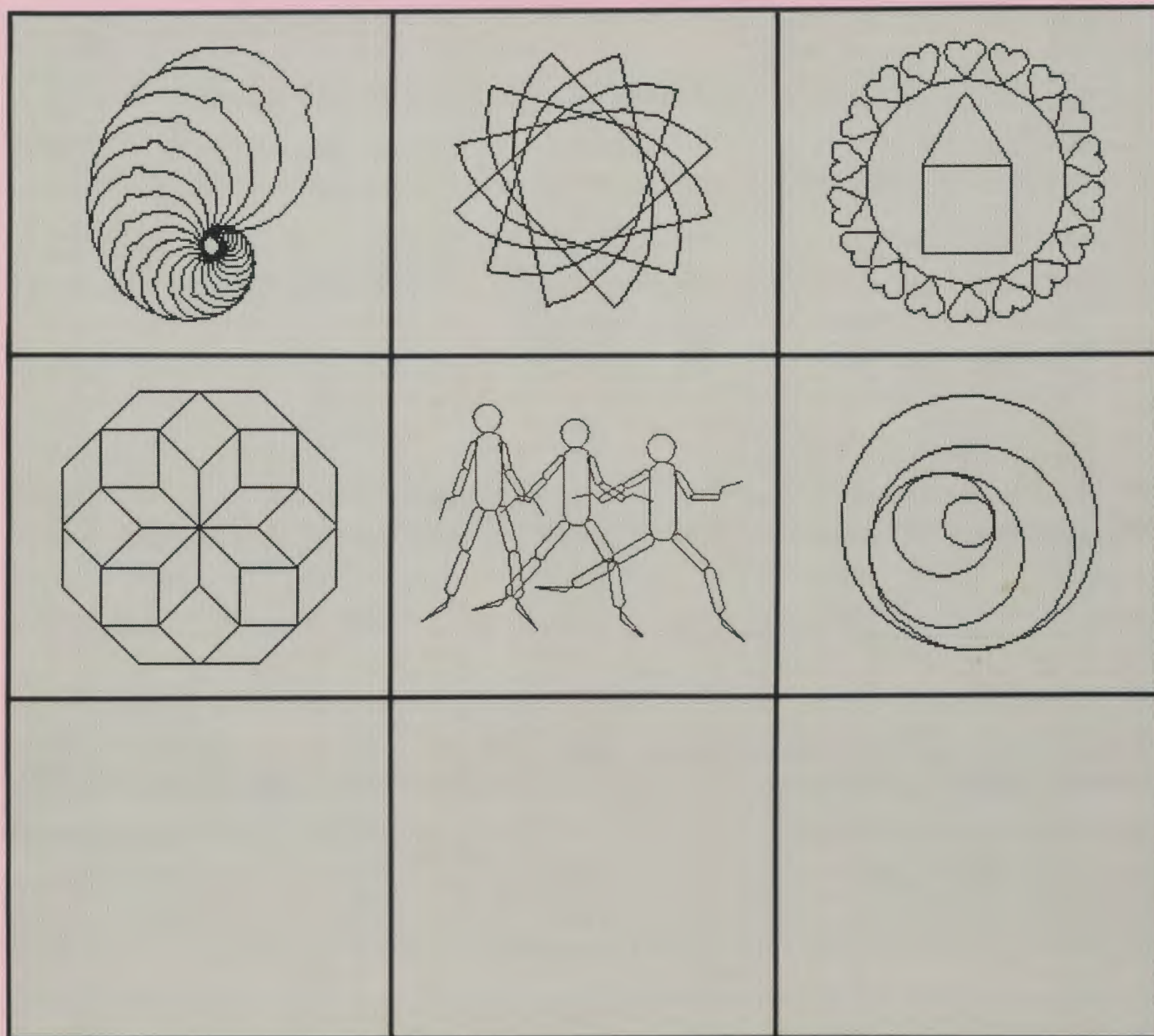
# LOGO EXCHANGE

*The Magazine for LOGO Activities Worldwide*

ISSN 0888-6970

VOLUME 5 NUMBER 6

FEBRUARY 1987



Second Class  
Pending  
Westport, CT and  
Add'l Mailing Offices

Meckler Publishing Corporation

**Two conferences in one!**

# 2nd West Coast Logo Conference and Telecommunications Symposium

**Learn about Model Curriculum Standards—using technology as a tool** **Telecommunications in the language arts curriculum** *Using technology in your classroom* **LogoWriter in the language arts curriculum** *Logo as a problem-solving tool* **Telecommunications and data bases in the social science classroom** *Using Logo within the math framework* **Integrating technology and the curriculum** *Logo in the high school classroom* **Telecommunications in the secondary school curriculum**

**March 6-7, 1987**

**Hilton Hotel & Towers, Los Angeles Airport**

## Limited Registration

- Hands-on workshops
- Guest speakers  
*David Thornburg*  
*Seymour Papert*  
*Dan and Molly Watt*  
*Al Rogers*  
*Bernie and June Dodge*  
*and many more*
- Teacher presentations
- Panel discussions
- Meet-the-leader sessions

### For further details:

West Coast Logo Conference  
Telecommunications Symposium  
Pepperdine University  
3415 Sepulveda Boulevard  
Los Angeles, CA 90034

# **LOGO EXCHANGE**

**The Magazine for LOGO Activities Worldwide**

ISSN 0888-6970

VOLUME 5 NUMBER 6

FEBRUARY 1987

**Editor-in-Chief**

Tom Lough

**International Editor**

Dennis Harper

**Senior Editors**

Glen Bull

Steve Tipps

**Field Editors**

Eduardo Cavallo

Patricia Dowling

Michael Friendly

Anne McDougall

Richard Noss

Fatimata Seye Sylla

**Senior Contributing Editor**

Robb Muir

**Contributing Editors**

Elaine Blitman

Regina Bowden

Doug Clements

Paula Cochran

Bill Craig

A. J. (Sandy) Dawson

Barbara Elias

Anne Cairnes Federlein

James Fry

Judi Harris

Barbara Jamile

Jim McCauley

Rebecca Poplin

Barbara Randolph

Linda Sherman

**Managing Editor**

Anthony Abbott

**Advertising Director**

Jean-Paul Emard

**Publisher**

Alan M. Meckler

*Logo Exchange* (ISSN 0888-6970) combines *National Logo Exchange* and *International Logo Exchange* and is published monthly September through May by Meckler Publishing Corporation, 11 Ferry Lane West, Westport, CT 06880, (203) 226-6967.

Copyright © 1987 by Meckler Publishing Corporation. All rights reserved. No part of this publication may be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage retrieval system, without permission in writing from the publisher.

Application to mail at Second Class postage rates is pending in Westport, CT and additional mailing offices. POSTMASTER: Send all address changes to *Logo Exchange*, Dept. VV, P.O. Box 3000, Denville, NJ 07834

## CONTENTS

From the Editor	2
Listen, My Children, and You Shall Hear	3
Tipps for Teachers	4
Teacher Feature	7
Teaching Tools	9
TO BEGIN :CIRCLES	13
Logo LinX	15
MathWorlds	17
Testudinal Testimony	20
Logo Disserts	22
Teacher to Teacher	22
The Adventures of Jacques and Elsie	24
IntLXual Challenges	25

## International Logo News

Global Comments	27
Asia	28
Europe	30
Latin America	31
LogoPals	32



**Cover:** The spiral design on this month's cover was contributed by David Miner, a 7th grade student at Barwise Junior High School in Wichita Falls, Texas.

Subscription: \$29.95 per year. Subscribers outside the USA please add \$15.00 for surface mail or \$50.00 for airmail. Orders from North and South America should be sent to *Logo Exchange*, Dept. VV, P.O. Box 3000, Denville, NJ 07834; elsewhere to Meckler Publishing, 3 Henrietta Street, London WC2E 8LU, UK, (tel.) 01-240-0856.

## From the Editor

by Tom Lough  
Good Enough?

"Didja winna medal?"

I was a member of the 1968 US Olympic Team which competed in Mexico City, and am often invited to speak to students in local schools. Almost without exception, the question above is the first one the students ask after my talk. My answer is always the same, and is always somewhat disappointing to them.

"No, but I did my best and really came close to winning a medal."

When I first began giving these talks, I, too, was disappointed in my answer. Why hadn't I won a medal? After all, many other athletes did. Later, when I had the opportunity to reflect, it occurred to me that there were hundreds of millions of people who did not even have the opportunity to participate in the Olympics that year. Of the five thousand or so who did, only a few hundred won medals. Wasn't just being on the Olympic team and competing with the world's best athletes good enough?

I realized that the students (and I myself) were measuring my performance against the standards set by the television sports commentators who interview only the gold medalists and broadcast only the winning performances. The students had been exposed to the hype of excellence for so long that it was nearly taken for granted.

.....

When I first started teaching with Logo, I had been exposed to the great ideas in *Mindstorms*. I was filled with visions of unbelievable accomplishments in education. When my early efforts met with less than spectacular success, I was taken aback. What happened? It occurred to me that there were hundreds of millions of people who did not even have the opportunity to learn with Logo. Of the thousands who did, probably only a few hundred met with much initial success. Wasn't just having the opportunity to try to find ways to use Logo with my students good enough?

It was not until later I realized that Papert had given us a vision of what Logo could do, but that it was up to us to figure out how to use it most effectively in each of our individual teaching situations. Was it reasonable to expect to accomplish this in the first try?

.....

Although I swam in the Olympics, I was not a championship swimmer. Even though I ran in the Olympics, I was not a championship runner. My Olympic sport was the modern pentathlon, a combination event consisting of horseback riding (over jumps), fencing, pistol shooting, freestyle swimming, and cross-country running.

During the years of grueling training in preparation for the Games, I had to develop a sense of balance. If I devoted too much effort to my swimming, the running often suffered. If I fenced too long, my arm was too tired for effective pistol practice. By finding and maintaining a reasonable balance among the five activities (and becoming a champion in none of them, by the way), I was able to accumulate a total score in the Olympic trials which was good enough to make the team.

.....

Although I use Logo fairly often in my teaching, I am not a Logo "expert." Even though I have taught physics for a number of years, I am not a physics "expert." I use word processors and spreadsheet programs a lot, but not enough to qualify me to write a book about them. In addition to my teaching, I also serve on a variety of college committees, edit this magazine, take graduate courses at the University of Virginia, and am a father and husband.

As these responsibilities accumulated, I had to develop a sense of balance. If I devoted too much time to Logo, performance in other areas suffered, for example. By finding and maintaining a reasonable balance among my responsibilities, I have been able to keep their demands within manageable magnitudes. Although I am nowhere near perfect in any of these areas, I have been able to perform in a manner which has been good enough to enable me to continue.

.....


I have presented these vignettes in this month's editorial because I suspect that there are many LX readers who are feeling the pressure to perform. The pressure might come from the expectations of others, or from the responsibility to perform in several different areas. Pressure to perform is not bad in itself, for it can be a highly effective motivational agent. When it is mixed with unrealistic expectations, however, there may be trouble.

In my various experiences I have learned to identify when I have done something in a manner that is good enough. Now, I do not mean that I try to get by with the minimum effort, not at all! I just accept that, when I have done the best I can do under the circumstances, and have used reasonable judgment in balancing my responsibilities, this is good enough.

Opportunities to strive for excellence and perfection abound. But not everyone has the courage to make the attempt, for fear of falling short of the impossible standard.

Why not adopt "good enough" as your standard? Aim for excellence, do your best, keep your balance, and let that be good enough.

FD 100!



# Listen, My Children, and You Shall Hear

by Peter Rawitsch

Henry Wadsworth Longfellow, the American poet, knew the difference between hearing and listening. In his poem, "Paul Revere's Ride," he invites his audience to "listen" so they can "hear" about the famous midnight messenger. In oversimplified terms, hearing is when sounds go into your ear and there is vibration. Listening is when those sounds go into your brain and there is comprehension. These two auditory processes can be used to demonstrate how Logo controls recursive procedures.

## Historical Logofication

Imagine how history would have been rewritten if Revere's friend in the Old North Church had only "heard" those fateful instructions.

```
TO HEAR :EAR
PRINT [IF THE BRITISH MARCH]
PRINT [HANG A LANTERN FOR ME]
PRINT SENTENCE :EAR [IF BY LAND]
PRINT SENTENCE :EAR + 1 [IF BY SEA]
HEAR :EAR + 1
END
```

HEAR 1 is a model of tail-end recursion. It would "sound" like this:

```
IF THE BRITISH MARCH
HANG A LANTERN FOR ME
1 IF BY LAND
2 IF BY SEA
  IF THE BRITISH MARCH
  HANG A LANTERN FOR ME
  2 IF BY LAND
  3 IF BY SEA
    IF THE BRITISH MARCH
    HANG A LANTERN FOR ME
    3 IF BY LAND
    4 IF BY SEA
      etc.
```

Like reflections between two mirrors, HEAR will call infinite copies of itself. HEAR 1 is a level 1 (or top level) procedure. It calls HEAR 2, a level 2 procedure. HEAR 2 calls HEAR 3, a level 3 procedure, and so on. Each procedure is unfinished because its END is never reached.

(Ed. note: For details on how some versions of Logo handle tail-end recursion, see Jim McCauley's Q and A column in the October 1986 LX.)

In order to prevent burning down the belfry tower, a conditional or "listening" statement is needed. IF :BRAIN = 2 [STOP] will stop the tail-end recursion when it verifies that the two lanterns that are required are present.

```
TO LISTEN :BRAIN
IF :BRAIN = 2 [STOP]
PRINT [IF THE BRITISH MARCH]
PRINT [HANG A LANTERN FOR ME]
PRINT SENTENCE :BRAIN [IF BY LAND]
PRINT SENTENCE :BRAIN + 1 [IF BY SEA]
LISTEN :BRAIN + 1
END
```

When level 1 of LISTEN calls level 2, level 2 will STOP. The command STOP behaves like END in that it returns the control to the calling procedure. Now level 1 can complete its work with the END and the correct signals can be given when the British boats appear.

## Musical Recursion Excursion

Recursion can make beautiful music with a conditional statement. Here is a musical model of a different LISTEN procedure that explains what happens in the recursive "listening" process.

```
TO LISTEN :BRAIN
IF :BRAIN = 10 [STOP]
PRINT [RECURSION WITH A CONDITIONAL]
PRINT [IF YOU HEAR THE NUMBER 10 STOP]
PRINT SENTENCE [THIS IS LEVEL] :BRAIN
PRINT SENTENCE [CALLING LEVEL] :BRAIN + 1
PRINT [AT THE END WE'LL GO BACK TO THE TOP]
LISTEN :BRAIN + 1
END
```

In a classroom, ten children (or ten groups of children) can stand in a line to represent the ten levels. Each child should wear a name tag identifying his or her level, such as "Level 1." "Level 1" sings the song to "Level 2." "Level 2" sings the song to "Level 3," and so on. LISTEN is sung recursively to level 10. When "Level 9" is finished singing to "Level 10," then "Level 10" says, "STOP!"

Finally, "Level 9" can finish by saying, "END." Then "Level 8" through "Level 1" get a chance to END in succession. A total of 9 END's must be said before the whole process is officially over. That's why the song states, "At the END, we'll go back to the top." The "top" in this case is the top level procedure.

### Recursion with a Conditional

words and music  
by Peter Rawitsch



Re - cur - sion with a con - di - tion - al,



If you find the num - ber 10, STOP.



1. This is lev - el 1 call - ing lev - el 2,
2. This is lev - el 2 call - ing lev - el 3,
3. ...



At the END, we'll go back to the top.

© 1986 Peter Rawitsch. Permission is given to photocopy words and music of song for classroom use.

Paul Revere might have known something about controlling recursion as he rode through the villages outside of Boston in 1775. He called out his warning again and again until he came to Lexington (IF :VILLAGE = "LEXINGTON [STOP]).

Individuals who want to recreate that experience by "calling out" can sing every level of the song. By starting at the different times indicated above the staves, the song will become a two- or three-part round. It is recommended that the singing be done at a reasonable hour. If you sing it at midnight, your neighbors may not be in the mood to LISTEN.

(Ed. note: Peter Rawitsch will be leading the group singing activities at the East Coast Logo Conference, April 2 - 4, 1987, in Arlington, VA. He will include "Recursion with a Conditional," as well as many others.)

Peter Rawitsch uses Logo with his first grade students at the Glenmont Elementary School in Glenmont, NY. Details of his work with Logo were reported in the "Teacher Feature" column in the December 1985 NLX.

## Tipps for Teachers

by Steve Tipps

### Wheel of Fortune Logo Style

A perverse fascination sometimes comes over me in the afternoon. Between school and evening computer work and after looking at the television news for a few minutes, I begin flicking through the channels to see what else is on. The best choice is usually reruns of M\*A\*S\*H, but I sometimes find myself watching Wheel of Fortune. This game show is not as cerebral as Jeopardy, as high tech as Scrabble, or as humiliating as Let's Make a Deal; it is played a little tongue-in-cheek, a throwback in style to Groucho's You Bet Your Life.

An interesting thing about the show is the strategy which contestants use to uncover the letters in the mystery person, place, thing, or saying. They guess S, N, R, T, then go into a more random letter selection, and intermittently suggest vowels. The strategy seems to work fairly well and is apparently based on some notion of letter frequency in words. The Logo question is whether this strategy is well founded.

#### Alphabet Tools

Few tools are needed to proceed on this investigation of letter frequency. You need a tool for going letter-by-letter through the words in the phrase or list and counting the letters. This counting necessitates an initialization of the letter counts to 0 and later a printing routine for the count. An easy way to feed the procedures a variety of phrases or lists of people, places, or things is desirable.

I worked out procedures in the sequence listed. Beginning with the core procedure and gradually adding the surrounding necessities programming is a programming strategy I call "inside out". A top down programmer would begin with the initialization procedure, work out the functional counting procedures, then finish off with the printing. My method gets the important procedures working straight off with the embellishments to be added later. Hunting through the words is the core.

(Note: Terrapin Logo users should delete the brackets around [STOP] and the brackets in the IFTRUE lines of the procedures which follow.)

```
TO HUNT.FOR :LETTER :WORD.GROUP
IF :WORD.GROUP = [ ] [ STOP ]
COUNT.LETTERS FIRST :WORD.GROUP
HUNT.FOR :LETTER BUTFIRST :WORD.GROUP
END
```

```
TO COUNT.LETTERS :NEXT.WORD
IF :NEXT.WORD = " [ STOP ]
TEST FIRST :NEXT.WORD = :LETTER
IFTRUE [ MAKE WORD :LETTER "COUNT 1 +
THING (WORD :LETTER "COUNT) ]
COUNT.LETTERS BUTFIRST :NEXT.WORD
END
```



## The best way to introduce students to Logo is to

# == SEELOGO ==

One reviewer said: As I proceeded, I kept thinking "What a great idea!" or "Why hasn't someone put this in before?"

Well now someone has. And the result is SeeLogo — a friendlier yet more powerful Logo graphics language that lets kids do more sooner. SeeLogo is not a full-featured Logo, but what it does it does well. For many children, the enjoyment of building Logo graphics is all too often impeded by the tedious typing and editing of commands and procedures. SeeLogo minimizes this, making it especially appropriate for beginning students (and teachers!) who can more quickly become involved in intriguing problem-solving & graphics challenges after relatively little instruction. But even if your students already know Logo, you'll still want to benefit from SeeLogo's many new features. And, because SeeLogo's other commands are 100% Apple and Terrapin Logo compatible, almost no relearning is required.

- FRIENDLIER ERROR MESSAGES PROVIDE MORE CONSTRUCTIVE HELP.
- EDITING IN THE DIRECT MODE IS FASTER, EASIER.
- GRID SYSTEM COMMAND ALLOWS THE USER TO SEE THE ON-GRAPH LOCATION AND X, Y COORDINATES OF THE TURTLE AT ANY TIME.
- PLACING TEXT ANYWHERE ON-SCREEN MAKES SEELOGO BETTER FOR STORY WRITING
- HOW MANY TIMES HAVE YOU WANTED TO UNDO YOUR LAST STEP? 'UNDO' DOES IT!
- GRAPHICS CAN BE DEFINED AS PROCEDURES BY SIMPLY NAMING THEM.
- UNLIMITED BACKUPS AT \$8.00 EACH MAKE SEELOGO EXTREMELY AFFORDABLE TO ADOPT.

Best of all, all this "more" is available for less. SeeLogo costs just \$59.95 and is available for free, no-risk 30-day examination. We'd like you to see for yourself just how good SeeLogo can be in your classroom. Call 800-922-0401 to order today!

**K-12 MicroMedia Publishing**  
6 Arrow Rd., Ramsey, NJ 07446



"Hi, I'm Cecil, the new turtle in town. I'm 100% Apple and Terrapin Logo compatible and a whole lot more to boot!"

### NEW PRIMITIVES

**CREATE/SET** Changes the shape of the turtle.  
**GROWBY** Increases the size of the graphic by any percent.  
**HALF/QUARTER/THIRD** Reduces the size of the graphic.  
**TIME** Times the intervals of action procedures.  
**SPIN** Allows for rotation.  
**STAMP** Replicates the turtle anywhere on the screen.  
**MIRROR** Creates the mirror image of the graphic.

*Logo graphics for the rest of us.*

These two procedures do the job of hunting through a word group for a designated letter. For example, a word group might be the first presidents.

TO FIRST.PRESIDENTS

```
OUTPUT [GEORGE WASHINGTON JOHN ADAMS
THOMAS JEFFERSON JOHN QUINCY ADAMS JAMES
MADISON JAMES MONROE ]
END
```

If you wanted to hunt for the letter "S in the first presidents' names, you would

```
?HUNT.FOR "S FIRST.PRESIDENTS
```

An error results the first time through. The counter called "SCOUNT has to be initialized ahead of time.

```
?MAKE "SCOUNT 0
?HUNT.FOR "S FIRST.PRESIDENTS
```

Then, to discover the count of the S's, just type

```
?PRINT :SCOUNT
```

8

You can quickly verify that 8 is the correct result by counting the S's in the list yourself.

If you want to hunt for the number of N's and T's, as well as E's, A's, and O's, the process of initializing a counting variable and then using HUNT.FOR and PRINT can be done for each letter. However, the instinct that "there must be an easier way" should take over quickly. Instead of individually checking each letter, why not let Logo scan the alphabet and check each letter?

### Counting from A to Z

Begin with an alphabet procedure which outputs a list of all the letters.

```
TO ALPHABET
OUTPUT [ A B C D E F G H I J K L M N O P Q R
S T U V W X Y Z ]
END
```

Use this alphabet procedure to create and initialize all the counting variables. (Terrapin users remove the brackets from around [STOP].)

```

TO INIT.LETTER.COUNT :LIST
IF :LIST = [] [ STOP]
MAKE WORD FIRST :LIST "COUNT 0
INIT.LETTER.COUNT BUTFIRST :LIST
END

```

When you type

**?INIT.LETTER.COUNT ALPHABET**

Logo creates 26 counting variables and sets each one to 0. Check to see that this has happened by printing out the names of the currently defined variables. (Most versions of Logo do this with either PONS or PO NAMES.) You can, if you prefer, hide all the innards in a master procedure, such as INIT.

```

TO INIT
INIT.LETTER.COUNT ALPHABET
END

```

Now you need a way to hunt for each letter in the alphabet. Put a master procedure around HUNT.FOR. (Terrapin users remove the brackets from around [STOP].)

```

TO HUNT.FOR.ALL :LIST :WORD.GROUP
IF :LIST = [] [ STOP]
HUNT.FOR FIRST :LIST :WORD.GROUP
HUNT.FOR.ALL BUTFIRST :LIST :WORD.GROUP
END

```

**?HUNT.FOR.ALL ALPHABET FIRST.PRESIDENTS**

All the counting variables which are represented in the letters of the first presidents' names are now filled. You still

need some way of getting the results of all the counting. The same process can be used again.

(Note: Terrapin Logo users should delete the brackets around [STOP] and the brackets in the IF line of the PRINT.LETTER.COUNT procedure, and change TYPE [ \ \ \ ] to PRINT1 [ ' ' ] in REPORT.)

```

TO PRINT.LETTER.COUNT :LIST
IF :LIST = [] [ STOP]
IF THING WORD FIRST :LIST "COUNT > 0 [REPORT]
PRINT.LETTER.COUNT BUTFIRST :LIST
END

```

```

TO REPORT
TYPE WORD FIRST :LIST "COUNT
TYPE [ \ \ \ ]
PRINT THING WORD FIRST :LIST "COUNT
END

```

When you type

**?PRINT.LETTER.COUNT ALPHABET**

the PRINT.LETTER.COUNT procedure uses the alphabet list and prints the result of each non-zero letter count one right after the other. For the first presidents, the most frequent letters are A, E, J, M, N, O, and S.

ACOUNT	9	NCOUNT	8
ECOUNT	7	OCOUNT	9
JCOUNT	5	SCOUNT	8
MCOUNT	7		

## Key Reference Sources

### LOGO EXCHANGE RESEARCH DIRECTORY

Edited by Regina H. Sapona

Price: \$9.95 (paper)

ISBN: 0-88736-085-8 (1986)

### NATIONAL LOGO EXCHANGE INDEX (volumes 1-4 (1982-1986))

Compiled by Regina H. Sapona

Price: \$9.95 (paper)

ISBN: 0-88736-0904

### Order Form

Please enter orders for the following:

- ☐ LOGO EXCHANGE RESEARCH DIRECTORY @ \$9.95  
☐ NATIONAL LOGO EXCHANGE INDEX (1982-1986) @ \$9.95

☐ Payment enclosed (required for all personal orders, which must be prepaid by personal check or credit card).

Name \_\_\_\_\_  
 Organization \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

☐ Please bill my organization Purchase Order No. \_\_\_\_\_  
 Authorized Signature \_\_\_\_\_



Meckler Publishing  
 Corporation  
 11 Ferry Lane West  
 Westport, CT 06880  
 203-226-6967

☐ Credit card payment (circle one):

AMEX MasterCard  
 VISA Diners Club

Card No. \_\_\_\_\_

Exp. Date \_\_\_\_\_

Cardholder's Signature \_\_\_\_\_



### Letters Up

With all the needed alphabet tools, different word groups can be analyzed for letter frequency. The word groups can be names, sayings, places, or things. For instance, if a list of recent presidents is subjected to letter counting, the results can be compared to the first presidents.

```
TO RECENT.PRESIDENTS
OUTPUT [ RONALD REAGAN JIMMY CARTER
GERALD FORD RICHARD NIXON LYNDON JOHNSON
JOHN KENNEDY]
END
```

```
?INIT.LETTER.COUNT ALPHABET
?HUNT.FOR.ALL ALPHABET RECENT.PRESIDENTS
?PRINT.LETTER.COUNT ALPHABET
```

The most frequent letters for this group are A, D, N, O, and R. Three of these are the same as for the FIRST.PRESIDENTS. By this time, students should be inventing their own word groups to be analyzed. Depending on age and interests, many word groups are possible.

- names in the class
- paragraphs from textbooks
- state names
- state capitals
- objects in the room
- morals from Aesop's Fables
- pet names
- Bartlett's quotations
- planet names
- Spanish words
- Hemingway vs. Vonnegut

The question to be raised in all of this is whether the frequency of letters is constant across all the word groups. Do certain kinds of word groups have patterns not apparent in other word groups? Using a spreadsheet might be an effective way to organize the various results. Percentages might also be better for comparison than raw count. Finally, think about whether the strategy used in guessing letters on Wheel of Fortune is the best one possible.

Another investigation might be the letter values in Scrabble. Why are certain letters worth more or less? Is there a relationship between the number of letters and value? The number of letters available in Scrabble might be a standard to compare other letter counts.

Playing with letters and words alerts children to language characteristics. Logo provides a powerful tool for looking into language. Just as children can be mathematicians with Logo, they can also be linguists with Logo.

Some students in computer science class may find ways to create the full game of Wheel of Fortune including the spinning wheel and "flipping" of letters. (Can you imagine the turtle as Vanna White? or vice versa?) Perhaps students

can use LogoWriter to design an interesting variation of the game. Whatever level your students are working, challenge them to a game of Wheel of Fortune, Logo style.

Finally, perhaps several of your students would be interested in exploring a more efficient method of organizing the counting of letters. One suggestion would be for Logo to go through the word list just once, identifying each letter as it is encountered, and updating the letter count variable at that time.

I would be interested in any applications or extensions of the ideas in this column. Please write to:

Steve Tipps  
Midwestern State University  
Wichita Falls, TX 76308

---

*Steve Tipps is the West Professor of Education at Midwestern State University in Wichita Falls, TX, and has been involved with Logo since 1982. He conducts Logo workshops for school systems throughout the United States, and is a popular conference speaker. His CompuServe number is 76606,1623.*

---

## Teacher Feature

by Rebecca Poplin

### Featuring: Bev and Lee Cunningham

#### Dynamic Duo

If there were dynamic duo awards for members of the Logo community, one would surely be given to Bev and Lee Cunningham of Treynor, Iowa. The Cunninghams are twin whirlwinds of Logo activity in their own environment as well as far afield. When you have been with them just a little while, you will be caught up in their enthusiasm, too.

Bev's daily work involves the unlikely combination of teaching both special education and gifted students. In the Gunn - Council Bluffs School District, Bev's school serves 250 youngsters in grades K - 6. In her resource room you might find learning disabled, emotionally disabled, or mentally or physically disabled students at any given time. Students stay in her classroom for up to two hours a day depending on individual needs. In special cases, some children might stay longer or be transferred to a self-contained special education class. To those of us familiar with the paperwork and time burdens of special education, it is amazing that Bev has any energy or time left, but her job is only the beginning of her professional commitment.

Bev has the distinction of being the only special education teacher in her area who also works with the gifted. Once a week for an hour a day, she works with these other special students. This part of Bev's work began as a spinoff of a noon hour Logo program which has filled her lunchtime with excitement ever since it began.

### Turtle Haven

When Bev began using Logo and computers, she decided to sponsor a Logo users' group in the school. Students visit Bev's class during lunchtime, eat lunch together while discussing computer topics, and then find time to work on the computers. Some of her students entered the National Council of Teachers of Mathematics logo design contest using Logo and were the Iowa winners! The group publishes a newsletter called *Logo, Kids, and Computers*, full of procedures the students have written, helpful hints, computer vocabulary, and features like "Things You Could Get a Computer Lover for Christmas." The newsletter gives students different types of experiences and a chance to articulate their thoughts. Anyone interested in starting a student Logo newsletter could contact Bev's group for more specific pointers.

### Togetherness Builds Understanding

One of the exciting outcomes of Bev's work has been to bring all types of students together. In the Logo users' group, special education students can often outshine the "regular" students. In this give-and-take situation, regular students can see that special education students have unique talents and abilities. Many of the stereotypes have been destroyed along with the stigma. All the students can learn from each other and make their own contributions.

Bev's classroom is often used before and after school for special projects. The children choose their own directions. Sometimes Bev has the ideas and lets students accomplish these in any type of project they like, using their own creativity. *Microquests* (a quarterly Logo-based mathematics project booklet formerly published by Kathleen Martin and Donna Bearden) has been a source of many ideas such as pentominoes. Bev finds that her students have a good sense of things they would like to learn.

### Togetherness at Home

When Bev became interested in Logo, she soon involved her husband, Lee. The family had started a computer business and Lee was semi-retired. He spent time reading materials about computers to send to their son. Bev's enthusiasm was contagious, and the couple decided to attend the Logo 84 conference at MIT. There, Lee was truly bitten by the Logo turtle. The Cunninghams talk and live Logo daily, and have even devoted a section of their house to Logo.

Lee is seriously involved in his own Logo projects. His most recent one has been an extension of his interest in science experiments. Most of the computer applications for science are written in BASIC, so Lee is developing his knowledge of that language and wants to convert lots of programs into Logo. He sees lots of possibilities to create applications and changes for programs. The long term project is to develop simple tools for science with Logo. He believes Logo should be more visible in the school system, particularly in the science classrooms.

### Joint Mission

Both Cunninghams are committed to their personal use of Logo, but in a sense they are missionaries, too. Together they have taught Logo at Creighton University in nearby Omaha and have presented several workshops for parents and teachers. Now, they have tentative plans to work together on a science and Logo interface course at Creighton this summer.

Lee and Bev are both concerned about the quality of Logo instruction. Where people have not had the opportunity to learn about teaching Logo, it is being taught like BASIC. Too many people have no idea that Logo has a philosophy, also. The Cunninghams feel that this misunderstanding is holding Logo back. They share a strong desire to help people really understand what Logo is and how it can be used most effectively.

Bev and Lee Cunningham are models of the enthusiastic sharing found so often in the Logo community. Others often find it surprising that "Logo people" are so willing to share ideas and materials. The Cunninghams believe that sharing is a way of life with Logo, and that Logo people are more interested in giving than receiving. They plan to share many of their ideas in a presentation at the upcoming East Coast Logo Conference, April 2 - 4. If you would like to correspond with Lee and Bev about their projects, please write to:

Bev and Lee Cunningham  
PO Box L  
Treyner, IA 51575

If you know of someone who should be featured in this column, please write to:

Rebecca L. Poplin  
2421 Fain Street  
Wichita Falls, TX 76308

---

*Rebecca Poplin uses Logo to teach computing and mathematics at a junior high school in Wichita Falls, TX.*

---

### West Coast Logo and Telecommunications Conference

The West Coast Logo and Telecommunications Conference will be held March 6 and 7, 1987, at the Los Angeles Airport Hilton Hotel. Teachers, administrators, and others who use the Logo language or who have an interest in telecommunications are invited to attend. A major focus of the conference will be the integration of Logo into the curriculum. For more information, write to:

West Coast Logo and Telecommunications Conference  
Pepperdine University  
3415 Sepulveda Boulevard  
Los Angeles, CA 90034

## Teaching Tools

by Glen Bull and Paula Cochran  
Science and Sensors II

How does temperature vary during the course of a 24-hour day? You would expect a warming trend during the daytime, with temperatures cooling at night. How much variation is there in the pattern? Recording the temperature once an hour throughout the period would provide an answer. A student could record the temperature during the six or seven hours of the school day, but after school and during the night presents a problem. Who wants to get up at 3:00 a.m. to record the temperature?

An automatic data logger is the answer. A few short Logo procedures provide the tools needed to automatically collect data throughout the night. In last month's column ("Science and Sensors") we demonstrated how the computer could be used to read a sensor attached to the game port. Broderbund offers a Science ToolKit (\$39) which contains both a temperature probe (thermistor) and a light sensor. (If you prefer an alternative to the ready-made Broderbund temperature probe, one can be constructed for about \$13 in parts.) The Science Toolkit also offers a convenient interface box which has four input sockets for attaching sensors. We attached the temperature probe to "Input Socket C" of our unit.

### Reading the Sensor

Once the temperature sensor is attached to the input socket, you can examine its output with the READ.SENSOR procedure from last month's column.

```
TO READ.SENSOR
  PRINT PADDLE 0
END
```

Try putting  
the temperature probe  
in a cup of ice water.  
The numbers should  
change.

Put the probe  
in a cup of warm  
water. (The manual  
accompanying the  
Science Toolkit con-  
tains a number of safe-  
ty precautions. Be  
sure to follow these  
precautions as you  
conduct experiments.)  
This time the tempera-  
ture shifts in the oppo-  
site direction.

```
?READ.SENSOR
```

```
23
```

```
23
```

```
23
```

```
24
```

```
25
```

```
25
```

```
26
```

```
...
```

```
?READ.SENSOR
```

```
30
```

```
30
```

```
29
```

```
28
```

```
28
```

```
27
```

```
...
```

The numbers registered by the probe change as the temperature changes. Because of the electrical characteristics of the probe and interface, the numbers decrease as the temperature climbs, and increase as the temperature gets colder.

Temperature HOT ----- COLD

Probe Values 10 ----- 40

Once the data have been acquired by the computer, it will be possible to convert the numbers to a scale in which larger numbers reflect higher temperatures.

### Collecting the Data

The next step is to store the data as it is acquired. Ultimately we may want to analyze the data and determine the average temperature over the course of the day, or plot the temperature curve on the graphics screen. The first step is to collect raw data. These procedures will record 50 data points. (Terrapin Logo users change [STOP] to STOP.)

```
TO COLLECT.DATA
  MAKE "RAW.DATA []
  COLLECT.LOOP 1
END
```

```
TO COLLECT.LOOP :DATA.POINTS
  IF :DATA.POINTS > 50 [ STOP ]
  MAKE "RAW.DATA SENTENCE :RAW.DATA
  (PADDLE 0)
  PRINT LAST :RAW.DATA
  COLLECT.LOOP :DATA.POINTS + 1
END
```

The COLLECT.DATA procedures store the data as a list in the variable :RAW.DATA. First collect some data from the temperature probe. Then examine the raw data.

```
?COLLECT.DATA
?PRINT :RAW.DATA
23 23 23 23 23 ...
```

The value for each of the 50 data points will probably be the same if you did not change the temperature at the probe while the data was being collected.

### Building a Timer

The COLLECT.DATA procedure collects data as fast as it can, recording dozens of readings per second. For some applications, this may be too much data. At times, one data point per second, or possibly one reading per minute, may be enough. A timer is needed which will pause for a set amount of time in between data points.

Some versions of Logo have a built-in command which will wait for a set amount of time. For example, in Apple Logo II, the WAIT command will wait for 1/60th of a second.

Thus, WAIT 1 will produce a 1/60th of a second delay, and WAIT 30 will cause a half-second delay. This procedure would produce a one second delay.

```
TO SECOND.DELAY
WAIT 60
END
```

In other versions of Logo, the length of the delay may differ. For example, in IBM Logo, the command WAIT 1 produces a delay of about 1/18th of a second. If your version of Logo does not have a built-in WAIT command, you can easily create a procedure which will produce a delay.

```
TO DELAY :TIME
REPEAT :TIME [ ]
END
```

In some versions of Logo, DELAY 700 will produce a delay of about a second. If your version of Logo does not have a built-in WAIT command, experiment with a DELAY procedure until you find a value which produces a delay of a second.

The RECORD.LOOP procedure below is just the COLLECT.LOOP procedure with a one-second delay inserted between each reading of the probe. (Terrapin Logo users change [STOP] to STOP.)

```
TO RECORD.DATA
MAKE "RAW.DATA [ ]
RECORD.LOOP 1
END
```

```
TO RECORD.LOOP :DATA.POINTS
IF :DATA.POINTS > 50 [ STOP ]
MAKE "RAW.DATA SENTENCE :RAW.DATA
(PADDLE 0)
PRINT LAST :RAW.DATA
SECOND.DELAY
RECORD.LOOP :DATA.POINTS + 1
END
```

To try out the RECORD.DATA procedure, get a glass of ice water. Start the RECORD.DATA procedure, and then place the temperature sensor in the ice water. (If ice is not available, warm tap water can be used to produce a change in the temperature produced by the probe.) This time, the raw data recorded show a change in temperature. The raw data also indicates that it takes four or five seconds for the value of the probe to change by one point.

```
?RECORD.DATA
?PRINT :RAW.DATA
23 23 23 23 24 24 24 25 25 25 25 26 26 26 27 ...
```

The SECOND.DELAY procedure can be used to build a MINUTE.DELAY procedure, which in turn can be used to create a HALF.HOUR.DELAY or an HOUR.DELAY.

```
TO MINUTE.DELAY
REPEAT 60 [ SECOND.DELAY ]
END
```

```
TO HALF.HOUR.DELAY
REPEAT 30 [ MINUTE.DELAY ]
END
```

```
TO HOUR.DELAY
REPEAT 60 [ MINUTE.DELAY ]
END
```

Thus, to take a data reading every half hour, substitute the HALF.HOUR.DELAY for the SECOND.DELAY in the RECORD.LOOP procedure. The following procedures can be used to record a temperature reading every half-hour for 24 hours. (Terrapin Logo users change [STOP] to STOP.)

```
TO RECORD.DATA
MAKE "RAW.DATA [ ]
RECORD.LOOP 1
END
```

```
TO RECORD.LOOP :DATA.POINTS
IF :DATA.POINTS > 48 [ STOP ]
MAKE "RAW.DATA SENTENCE :RAW.DATA
(PADDLE 0)
PRINT LAST :RAW.DATA
HALF.HOUR.DELAY
RECORD.LOOP :DATA.POINTS + 1
END
```

(Ed. note: Sometimes the delays will not be as accurate as you like, because Logo will periodically suspend operations to perform a "garbage collection" to recovery usable memory. However, the length of time required for this is small compared to the length of the HALF.HOUR.DELAY, for example.)

### Transforming the Data

Sometimes it is necessary to convert data from one scale to another. For example, at times it is necessary to convert temperatures from the Fahrenheit scale to degrees Celsius.

Celsius	0	-----60-----	100
Fahrenheit	32	-----140-----	212

A conversion factor can be used to convert from one scale to another. For instance, to convert a Celsius temperature to the Fahrenheit scale, multiply by 1.8 and add 32. This can be expressed in the form of a Logo procedure in the following way:

```
TO FAHRENHEIT :FROM.CELSIUS
OUTPUT :FROM.CELSIUS * 1.8 + 32
END
```

Thus, 60 degrees Celsius is 140 degrees on the Fahrenheit scale.

```
?PRINT FAHRENHEIT 60
140
```

The same kind of conversion process is needed to convert the data collected from the temperature probe to the Fahrenheit scale. (The actual numbers we obtained from our probe were slightly different, but we have rounded them to make the process easier to follow.) This case is slightly more complicated than the Celsius to Fahrenheit example, because numbers obtained from the probe get smaller as the temperature gets larger. However, the principle of using a conversion factor still applies.

COLD -----> HOT

```
Fahrenheit  30 -----50-----70-----> 90
Probe       40 -----30-----20-----> 10
```

The following Logo procedure will convert a raw data point from the probe into temperature in the Fahrenheit scale.

```
TO CONVERT :DATA.POINT
  OUTPUT 120 - (:DATA.POINT * 2 + 10)
END
```

For example, 40 on the probe scale is 30 degrees on the Fahrenheit scale, while 10 on the probe scale is 90 degrees on the Fahrenheit scale.

```
?PRINT CONVERT 40
30
?PRINT CONVERT 10
90
```

The chances are that your probe will register slightly different values than ours. A procedure for calibrating your probe is found at the end of the column. The CONVERT procedure is used to transform the raw data into degrees Fahrenheit. (Terrapin Logo users change [STOP] to STOP.)

```
TO TRANSFORM.DATA
  MAKE "CONVERTED.DATA []
  TRANSFORM.LOOP :RAW.DATA
END
```

```
TO TRANSFORM.LOOP :RAW.DATA
  IF :RAW.DATA = [] [STOP]
  MAKE "CONVERTED.DATA SENTENCE
:CONVERTED.DATA CONVERT FIRST :RAW.DATA
  TRANSFORM.LOOP BF :RAW.DATA
END
```

Run the TRANSFORM.DATA procedure and then look at the converted data. The data displayed should be transformed to the Fahrenheit scale.

```
?TRANSFORM.DATA
?PRINT :CONVERTED.DATA
64 64 64 64 62 62 62 60 60 60 60 58 58 58 58 56 ...
```

### Analyzing the Data

What was the average temperature for the last 24 hours? An AVERAGE procedure will allow us to obtain the answer. Please note that there *must* be a space before and after the parentheses "(" and ")" in the ADD procedure.

```
TO AVERAGE :LIST
  OP ( ADD :LIST ) / ( COUNT :LIST )
END
```

```
TO ADD :LIST
  OP RUN FPUT "( FPUT "SUM LPUT " ) :LIST
END
```

In Terrapin Logo, ADD must be created in a different way.

```
TO ADD :LIST
  IF :LIST = [] OP 0
  OP (FIRST :LIST) + ADD BF :LIST
END
```

The AVERAGE procedure calculates the average temperature.

```
?PRINT AVERAGE :CONVERTED.DATA
60.8
```

The minimum and maximum temperatures for the day can be found by looking at the data, or a Logo procedure could be developed for this purpose.

### A General Purpose Recording Tool

The Broderbund Science Toolkit comes with a light sensor as well as a temperature sensor. The temperature should increase as the light gets brighter, particularly during the transition from night to day. The RECORD.DATA procedure could be revised to record both light and temperature data for a possible comparison.

Does the location of the sensor affect the temperatures recorded? Additional temperature sensors can be obtained from Broderbund for \$15 each, and up to four sensors can be attached to the interface box at one time. The RECORD.DATA procedure could be changed to record temperatures from four different sites to test this hypothesis.

In last month's column, we described how the motion of a pendulum can be monitored by the computer. If waits and delays are removed from the RECORD.DATA procedure, it can be used to record and store this information for further analysis.

### Science and the Science Class

Data from the real world is frequently "messier" than data found in simulations. The issues of transformation and conversion factors are frequently found in real science. Factors such as calibration of sensors and linearity of probes also appear when this type of science is done. In this type of experiment, the algebra involved appears in the context of a real problem, rather than in a disconnected fashion.

Students using the microcomputer as a laboratory tool are doing real science. In Computer-Assisted Instruction (CAI) and simulations, the answers are predetermined; they are stored in the computer before the student begins work. CAI and simulations can be valuable educational aids, but are no substitute for the real world. The microcomputer can also provide a data acquisition and analysis tool which would otherwise be too expensive for the classroom.

### Contest

We would like to encourage this kind of science. Send us a description of your best science fair project involving Logo and microcomputer-based sensors. We will publish the most interesting example we receive by April 1. In addition, each class which sends a project description will receive a certificate suitable for framing.

### Acquiring Probes and Sensors

The Broderbund Science Toolkit comes with its own manual, and a disk which simulates scientific instruments such as a strip-chart recorder.

Broderbund  
17 Paul Drive  
San Rafael, CA 94903  
(415) 479-1170

If you are interested in constructing your own sensors, we suggest *How to Build a Better Mousetrap, and 13 Other Science Projects Using the Apple II*, by David L. Vernier. The manual comes with its own disk of software (although many of the sensors can be used directly with Logo as well) and is \$24.95. Highly recommended.

David L. Vernier  
Vernier Software  
2920 SW 89th Street  
Portland, OR 97225

### Probe Calibration Procedure

Since the temperature sensor has a scale which is different than the Fahrenheit scale, a calibration and conversion procedure is needed to convert the scale.

#### 1. Calibrate Probe

The first step is to match the scale of the probe to known values on the Fahrenheit scale. Place the probe and the thermometer in a cup of ice water. Use the READ.SENSOR program to read the value obtained for the probe. Wait until the value registered by the probe stabilizes before recording it. Then record the corresponding value on thermometer. Repeat the process with a cup of warm water to obtain a value at the other end of the scale.

COLD -----> HOT

Fahrenheit	30	----->	90
Probe	40	----->	10

#### 2. Find Scale Factor

The next step is to match the range of the probe to the range of the Fahrenheit scale. This is done in three steps. The scale factor in this case is 2.

##### a. Find Fahrenheit Range

Maximum F - Minimum F = Fahrenheit Range  
(90 - 30 = 60 degrees)

##### b. Find Probe Range

Maximum P - Minimum P = Probe Range  
(40 - 10 = 30 points)

##### c. Divide Fahrenheit Range by Probe Range

Fahrenheit Range / Probe Range = Scale Factor  
(60 / 30 = 2)

Multiplying the probe values by the scale factor of two produces the following change in the scale

COLD -----> HOT

Fahrenheit	30	-----50-----70----->	90
Probe	40	-----30-----20----->	10
Probe * 2	80	-----60-----40----->	20

#### 3. Find Offset

The offset between the two scales is the next variable which must be calculated. Here, the offset is 10.

Maximum F - (Maximum P \* Scale Factor) = Offset  
90 - (40 \* 2) = 10

Offset shifts the two scales so the numbers are the same (though running in opposite directions). Adding the offset value of ten accomplishes this.

COLD -----&gt; HOT

Fahrenheit 30 -----50-----70-----> 90  
 Probe 40 -----30-----20-----> 10  
 Probe \* 2 80 -----60-----40-----> 20  
 Probe \* 2 + 10 90 -----70-----50-----> 30

#### 4. Find Scale Reversal Factor

Our probe scale runs in the opposite direction of the Fahrenheit scale. If your does also, it will be necessary to reverse the direction of the scale, so that high numbers reflect high temperatures.

Maximum F + Minimum F = Reversal Factor  
 90 + 30 = 120

Subtracting each number in the probe scale from the maximum number in the scale (90) plus 30 will reverse the direction of the scale.

COLD -----&gt; HOT

Fahrenheit 30 -----50-----70-----> 90  
 Probe 40 -----30-----20-----> 10  
 Probe \* 2 80 -----60-----40-----> 20  
 Probe \* 2 + 10 90 -----70-----50-----> 30  
 120 - (Probe \* 2 + 10) 30 -----50-----70-----> 90

#### 5. Develop Conversion Formula

The relationship developed above to reverse the direction of the scale is also an algebraic formula which can be used to convert probe values into the Fahrenheit scale.

Reversal Factor - (Probe Value) \* Scale Factor + Offset  
 120 - (Probe Value) \* 2 + 10

#### 6. Write Logo Procedure

This formula is expressed in the form of a Logo procedure.

```
TO CONVERT :DATA.POINT
OUTPUT 120 - (:DATA.POINT * 2 + 10)
END
```

The procedure can be used to convert any probe value into its corresponding Fahrenheit temperature.

```
?PRINT CONVERT 10
90
```

Glen Bull is a professor in the University of Virginia's Curry School of Education, and teaches Logo courses at both the graduate and undergraduate level. His CompuServe number is 72477,1637. Paula Cochran is an assistant professor in the Communication Disorders Program of the University of Virginia's Curry School of Education. She is interested in Logo applications for language arts and special populations.

## TO BEGIN :CIRCLES

by Elaine Blitman  
 and Barbara Jamile

For most elementary level children, thinking about circles will begin when they explore the properties of such figures as triangles, squares, hexagons, and octagons. This thinking can be enhanced if teachers can appropriately help children to make the connection between these forms and circles. Sharing in a kindergartener's excitement when he said, "I see how a square can turn into a circle!" inspired us to think about exploring circular forms this month.

#### Getting Started

A circle scavenger hunt might be motivated by books such as Tana Hoban's *Round and Round and Round*, showing beautiful photographs of circular forms in unusual places.

*Circles*, by Mindel and Harry Sitomer with illustrations by George Giusti, continues the "where circles can be found" theme, then extends into many activities reinforcing concepts related to circularity. An idea from the book is to have one child hold the end of a length of string in place on the floor, while another ties a piece of chalk to the other end and uses it to draw a big circle on the floor. (First, check to make sure the chalk markings can be cleaned from the floor easily!)

This would be a natural place to teach about "radius" since the term becomes part of the experience. Children might then "turtle walk" the circumference of the drawn circle, noticing how it is necessary to make small steps and small turns to get around the perimeter. Another section of the book suggests how to use a compass to learn about the relationships of various parts of a circle. These are brought out through very clear directions for activities to be experienced.

#### Exploration

Children can begin exploring circles using the computer by starting with what they already know about polygons. It's helpful if they know how to use a variable procedure, such as the POLYGON procedure from last month's column:

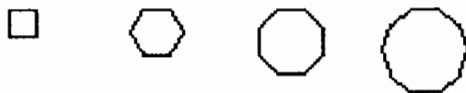
```
TO POLYGON :NUMBER :STEP
REPEAT :NUMBER [FD :STEP RT 360 / :NUMBER]
END
```

Variable procedures used as tools allow for efficient exploration. Type:

```
?POLYGON 50 4
?POLYGON 30 8
?POLYGON 5 20
```

and observe the differences in the figures the turtle makes. This procedure has a fairly long name to type. A shorter name for the procedure, selected by your students, might be substituted.





Encourage the children to explore the polygon procedure, suggesting that they gradually increase the number of sides in the figure. As the sides increase, the figure looks more circular. Can they figure out when a polygon looks like a circle? Is a circle a polygon? One possible definition for discussion: "A closed line with every point on it exactly the same distance from a point inside called the center." Sharing printouts, questions, and ideas provides motivation for group discussion and additional concrete experience.

*Circles and Curves* by Arthur G. Razzell and K. G. O. Watts contains many good ideas for hands-on circle exploration. Your school library probably contains other "circle-math" books that can give you additional material. This circular exploration is the ideal tie-in with the geometry sections of mathematics texts.

Provide string, compasses, protractors, rulers, plastic circle guides, and other tools for trying out the concepts. Working cooperatively on descriptive charts with information for the whole class helps children learn while creating.

Keeping their own records of their explorations in a notebook or on cards helps children to remember what they've done and allows them to share information with their classmates. The notebook might be chronological or organized by topic. It's helpful to include both graphic printouts and written explanations. Student notebooks also help the teacher to observe where it might be useful to intervene with a suggestion, transfer of information, or concrete example.

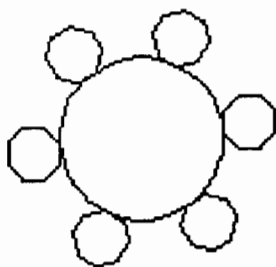
### Repeat and Circles

The REPEAT command without variables can be used to show how the size of the circle is changed by increasing or decreasing the steps and the angles. This also may be an appropriate time to demonstrate the use of decimals, especially when a number smaller than one will be effective. Use small steps and small angles or turns to make a polygon that looks like a circle:

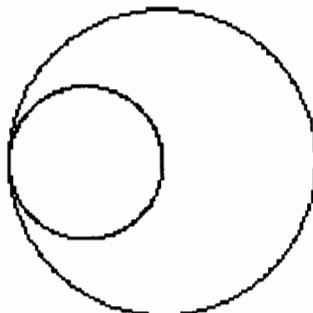
```
?REPEAT 360 [FD 5 RT 1]
```

What happens when the step size is doubled? How big is the first circle compared to the second one?

```
?REPEAT 360 [FD 1 RT 1]
```



Use different sizes of circles to create designs. If inspiration is needed, Ed Emberley's *Picture Pie: A Circle Drawing Book* demonstrates colorful designs made with circles and parts of circles.



### Cut a Circle in Half

Playing with circular forms provides creative learning opportunities for understanding circumference, radius, and diameter. A review of definitions may be helpful:

Circumference- distance around the circle

Radius- distance from a point on the circle to the center

Diameter- distance between any two opposite points on the circle measured along a straight line through the center

Pi- ratio of the circumference of a circle to its diameter

Here is an activity to find pi: Stick a compass point into a large roll of masking tape. Unroll the tape just far enough to see two holes, mark the two with a pen, tear off the length of tape, and affix it to a piece of cardboard. Carefully measure the distance between the two holes with a ruler and write the measurement on the cardboard. Label this measurement the circumference.

Place the tape roll flat on the cardboard between two parallel disk boxes or books. Measure the distance between them to find the diameter. Draw around the tape roll on the cardboard and mark where the edges of the boxes touch the tape. Draw a straight line between these two points. (The line should go through the center of the circle.) Label this line as the diameter.

Use the computer to divide the circumference by the diameter, by typing PRINT 383 / 122 (metric measure) or whatever your measurements show. If the measurements are fairly accurate, the result should be close to pi, 3.1416. Help the children find out for themselves what pi is when they measure other circular forms, and record the results in their notebooks. It may come as a surprise that a value of about 3.1416 is the result for circles of *all* sizes.

Next, relate these concrete activities to Logo procedures. Divide the turtle steps in the circumference by pi to find the diameter of a circle. Use the POLYGON procedure and try:

```
?POLYGON 60 2
```

Note that the turtle takes a total of  $60 * 2$  steps in drawing this figure. Next, turn the turtle to the right, and have it go forward the value of the total number of steps (circumference) divided by pi. This should give you the diameter.

```
?RT 90 FD 60 * 2 / 3.1416
```

The computer will print the length of the diameter:

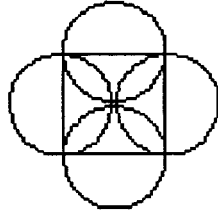
```
?PRINT 60 * 2 / 3.1416
```

These commands can be added to the POLYGON procedure (to avoid confusion, change the name) along with a line to print the length of the diameter:

```
TO DIAMETER :NUMBER :STEP
  REPEAT :NUMBER [ FD :STEP RT 360 / :NUMBER ]
  RT 90 FD :STEP * :NUMBER / 3.1416
  PRINT :STEP * :NUMBER / 3.1416
  END
```

Try repeating the procedure or vary it in other ways.

Centering circles is another challenge in Logo because of the way the turtle draws. For additional ideas about circle activities, see *Nudges: IBM Logo Projects*.



### Arcs - Parts of Circles

Parts of circles not only make interesting designs, but also provide another way to play with circular forms. For example, by repeating a turn of 1 degree 45 times, you can draw 1/8 of a circle (since  $360 / 45 = 8$ ).

?REPEAT 45 [FD 1 RT 1]

After drawing one arc, type RT 90 and repeat the first commands eight times.

Then try:

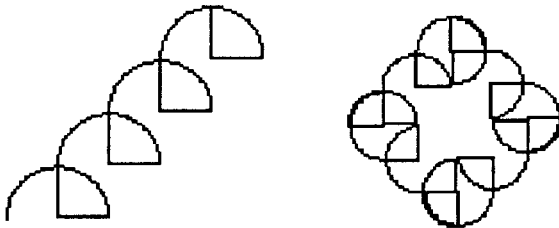
?LT 180 REPEAT 45 [FD 1 RT 1]

What is the most efficient way to repeat this command series with the version of Logo that you're using?

Vary the commands:

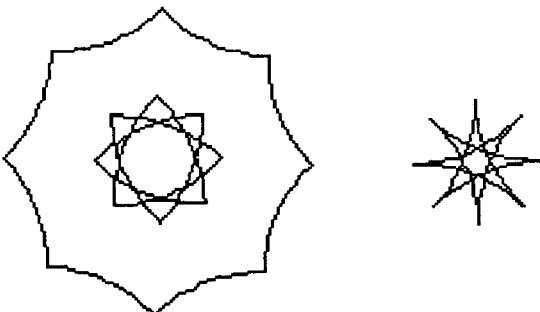
?LT 270 REPEAT 45 [FD 1 RT 1] RT 180

Make other designs, using part of a circle. Increase the steps, angle, number of repetitions, or by turning the turtle as part of the pattern.



It is only *after* students have thoroughly explored the ideas and concepts above that we introduce the CIRCLES and CIRCLEL or ARCL and ARCL tools found as utilities in most versions of Logo. The students then seem to have a much clearer understanding of what the variable inputs can do in these procedures.

### References



Emberley, Ed. *Picture Pie: A Circle Drawing Book*. Boston, Little, Brown and Company, 1984.

Hoban, Tana. *Round & Round & Round*. New York, Greenwillow Books, 1983.

Razzell, Arthur G. and K. G. O. Watts. *Circles and Curves*. New York, Doubleday & Company, Inc., 1968.

Sitomer, Mindel and Harry. *Circles: a Young Math Book*. New York, Thomas Y. Crowell Company, 1971.

Tipps, Steve, Timothy P. Riordan and Glen Bull. *Nudges: IBM Logo Projects*. New York, Holt, Rinehart and Winston, 1984.

*Elaine Blitman and Barbara Jamile are the K-2 and 3-4 supervisors at the Punahou School in Honolulu, HI. They have been using Logo with young children since 1982. Their CompuServe number is 76067,211.*

## Logo LinX

by Judi Harris

### Word Study Logo Style

PNEUMONULTRAMICROSCOPICSILICOVOLCANOCONIOSIS (noun).

Yes, it's a word, the longest in Webster's International Unabridged Dictionary (third edition,) as a matter of fact. But what does it mean?

Let's look at it another way:

PNEUMONO ULTRA MICRO SCOP IC SILICO VOLCANO CONI OSIS

Does that help?

--A lung (PNEUMONO) disease (OSIS) caused by inhaling dust (CONI) like (IC) silicon (SILICO) and volcanic (VOLCANO) ash particles so exceedingly (ULTRA) minute (MICRO) as to be seen (SCOP) only with a microscope. (from Ehrlich, I. (1968). *Instant Vocabulary*. New York: Simon & Schuster, p. 522.)

You have just participated in "syllabalexiscopology," or the study of word meanings by systematic syllabication and syllable analysis. "Pneumonoultramicroscopicsilicovolcanoconiosis" is a real word. "Syllabalexiscopology" is a "sniglet," or,

--Any word that doesn't appear in the dictionary, but should. (from Hall, R. (1984). *Sniglets*. New York: Macmillan, p. 3.)

The exploration of both types of words with Logo can make vocabulary study more meaningful (if you'll pardon the pun).

### Vocabulary Relativity

Face it, facilitators. From the student's perspective, any new word might just as well be a sniglet as an unabridged dictionary entry. Which is more empowering: to memorize lists of words and definitions, or to decode word meanings by the analysis of their component parts? Ida Ehrlich, author of *Instant Vocabulary*, is one teacher who has chosen the second method. She presents 259 "keys," or word components, each accompanied by 15-20 recognizable examples chosen to illustrate each key's meaning. The keys are prefixes, suffixes, and root words. In this way, Ms. Ehrlich indirectly suggests that we empower children with the tools that they need to independently ascertain new word definitions.

Multi-syllabic strangers can be broken down into "mind-sized bytes," and consequently understood.

Does this sound like Logo to you? It did to me.

Here's a good way to integrate the use and study of Logo into upper elementary, middle school, and high school language arts work. First, help the students to identify commonly used prefixes, suffixes, and root words, and research their meanings. Unabridged and collegiate dictionaries often list word parts and their definitions. Popular vocabulary self-study books, such as the one mentioned above, can also serve as resources.

Teach the computer the fruits of the research efforts:

```
?MAKE "PREFIXES [UN RE TRANS IN DI]
?MAKE "SUFFIXES [IBLE LESS NESS
FUL MENT]
?MAKE "ROOTS [PORT AUD VIS MEM
CRED]
```

These lists may be as long as you'd like them to be. Just be sure that the elements are separated by spaces. The following procedure will cause the computer to generate and output a random combination of three elements (one from each of the three lists) concatenated to form a single sniglet:

```
TO SNIGLET
  OUTPUT (WORD PICK :PREFIXES PICK :ROOTS
PICK :SUFFIXES)
END
```

It utilizes the PICK tool, presented in Glen Bull and Paula Cochran's wonderful article, "Poetry Sparks" (NLX, September 1984). This procedure, which selects and outputs a random element from any specified list, should also be typed into the computer's memory:

```
TO PICK :LIST
  OUTPUT ITEM 1 + (RANDOM COUNT :LIST) :LIST
END
```

To see the sniglet that the computer creates, type:

```
?PRINT SNIGLET
```

To see many different sniglets, type:

```
?REPEAT 20 [PRINT SNIGLET]
```

### Capitalize Upon the Process

Rich Hall, sniglet author, has published three volumes of what promises to be a rather unabridged sniglet collection:

*Sniglets*. (1984)

*More Sniglets*. (1985)

*Unexplained Sniglets of the Universe*. (1986)

My students loved leafing through the books as inspiration for on- or off-computer vocabulary / sniglet work. Mr. Hall includes an "Official Sniglets Entry Blank" in each book, and I encouraged the children to use it for their best creations.

A sniglet (or a dictionary entry) is of no value, though (save for a few sniggles), if it is not accompanied by an appropriate definition. These procedures will tell the computer to store the meanings for the sniglets that it generates, or to display the meaning of a sniglet already defined. (If you are using Terrapin Logo, substitute REQUEST in place of READLIST in both the DEFINITION and NOT.DEFINED procedures, and IF THING? :SNIGLET THEN MEANING ELSE NOT.DEFINED in place of IF NAMEP... in the DEFINITION procedure.)

```
TO DEFINITION
  CLEARTEXT
  PRINT [PLEASE TYPE THE SNIGLET TO DEFINE.]
  MAKE "SNIGLET FIRST READLIST
  IF NAMEP :SNIGLET [MEANING] [NOT.DEFINED]
  END
```

```
TO MEANING
  PRINT (SE :SNIGLET "MEANS THING :SNIGLET)
  END
```

```
TO NOT.DEFINED
  PRINT [THIS IS A NEW SNIGLET.]
  PRINT [PLEASE TYPE THE DEFINITION.]
  MAKE :SNIGLET READLIST
  END
```

To use the procedures, type

```
?PRINT SNIGLET
```

until the computer prints a sniglet that the user would like to define. Let's say that the computer has generated REPORT-LESS and the user wishes to define this "word." He or she should then type

```
?DEFINITION
```

If a definition has already been supplied for this construction, the computer might print

REPORTLESS MEANS THE STATE OF BEING UN-  
PREPARED ON THE DAY THE "BIG REPORT" IS DUE

Otherwise, the computer will print

THIS IS A NEW SNIGLET.  
PLEASE TYPE THE DEFINITION.

and wait for the user to type a definition, and press the <RETURN> key.

To preserve the sniglets and definitions generated while students use these procedures, SAVE the workspace after each session with a new file name, and LOAD that new file back into memory the next time that the students work with sniglets. Each sniglet is saved as the name of a global variable, whose value is a list (or, the definition that the student typed in).

The values of the "PREFIXES, "SUFFIXES, and "ROOTS variables can be appended as the students learn new word components and their accompanying meanings.

### Sneaky Sniglets

The objective here, is, of course, to help students to increase their vocabulary through the analysis of word parts and synthesis of word component meanings. So, while they are happily generating and defining sniglets, the computer might generate a word like INAUDIBLE from the prefix, suffix, and root word lists above. As long as they are defining the words based upon the component part meanings, they will generate something like this: IN (not) AUD (hear) IBLE (able); "not hearable"

"Well," you might ask, "How will they know that this is a dictionary entry, and not a sniglet?"

Many of the children that I worked with went to the dictionary quite naturally to look up sniglets that "sounded real." Others, less inspired to use the lexicon tool, could be encouraged to do so by challenges, such as,

"How many sniglets does the computer generate before it produces a real word?"

"Is this pattern consistent?"

"How can you change the contents of the memory to guarantee the production of a real word (or a sniglet) every time? Every other time?"

### A Final Word

I leave you, now, with a few of my favorite sniglets to inspire further exploration.

AQUALIBRIUM - The point where the stream of drinking fountain water is at its perfect height, thus relieving the drinker from (a) having to suck the nozzle, or (b) squirting himself in the eye.

BOBBLOGESTURE - The classroom activity of not knowing an answer but raising one's hand anyway (after determining a sufficient number of other people have also raised their hands, thus reducing the likelihood of actually being called on).

DISCONFECT - To sterilize the piece of candy you dropped on the floor by blowing on it, somehow assuming this will "remove" all the germs.

FLOPCORN - The unpopped kernels at the bottom of the cooker.

HOZONE - The place where one sock in every laundry load disappears to.

OROSUCTUOUS - Being able to hold a glass to one's face by sheer lung power.

SPIROBITS - The frayed bits of left-behind paper in a spiral notebook.

(from Hall, R. (1984). *Sniglets*. New York: Macmillan.)

---

*Judi Harris was an elementary school computer use facilitator, graduate education instructor, and computer consultant for a number of public and private schools in Pennsylvania. She is now a doctoral student in education at the University of Virginia. Her CompuServe electronic mail address is 75116,1207.*

---

## MathWorlds

*edited by*

*A. J. (Sandy) Dawson*

In my first MathWorlds column I asserted that "...it is not Logo the language which is of critical importance...the language itself is [but] a vehicle for the advancement of an approach to education which honors the integrity, power and creativity of children." I further argued that "...a Logo culture ...subordinates teaching to learning." I wish to revisit these points now.

I first want to talk about learning environments which support the subordination of teaching to learning. What are the critical features of these situations? Next I wish to elaborate on how working within such environments could impact the teaching and learning of mathematics. Finally, I relate this to the environment in which Logo could be taught and learned.

### On Corrections

One of my hobbies is golf, and I am, as are most golfers, constantly on the lookout for ways to improve my game. A number of years ago, I came across Gallwey's book, *The Inner Game of Golf*. [4] I devoured it. I also read his companion book, *The Inner Game of Tennis*. [3] What struck me so forcefully about his books was that he was in fact talking about any teaching and learning setting, not just about

golf and tennis. He was talking about how teachers and learners can make better use of their own and each other's energy if they acknowledge what each is capable of doing in the classroom.

Gallwey writes:

"One day when I was in a relaxed mood, I began saying less and noticing more (as a teacher). Errors that I saw but didn't mention were correcting themselves without the students even knowing they had made them. How were the changes happening? Though I found this interesting, it was a little hard on my ego, which didn't quite see how it was going to get its due credit for the improvements being made. It was an even greater blow when I realized that sometimes verbal instruction to a conscientious student seemed to decrease the probability of the desired correction occurring.

"I was beginning to learn what all good (teachers) and students of (teaching) must learn: that images are better than words, showing better than telling, too much instruction worse than none, and that conscious trying often produces negative results." [3, p. 5 & 7]

I have noticed over many years of teaching mathematics that it is not how much instruction I gave to students, or how often I corrected their mistakes, but the kind and quality of interaction I had with students which had the greatest effect on their growth. I found it was indeed true that images were more powerful than words (at least until such time as the students could use words in order to evoke the images), and that showing was definitely better than telling, especially when the students had been "told" the same thing by previous teachers. So in my mathematics classes one thing which I did was to stop correcting! Instead, I attempted to create situations and exercises which were self-correcting, or, at worst, exercises which could be corrected with help from peers.

What a positive change this made to my lessons and to the atmosphere in the classroom. Students gradually learned to stop judging themselves as good or bad depending on how many right or wrong answers they got in mathematics. And when they stopped judging themselves as good or bad, then they relaxed. When they relaxed they stopped trying so hard as to be unproductive, and then they found they were successful. It was magical! Read what Gallwey says about this based on his experience in teaching tennis and golf.

"The first skill to learn is the art of letting go the human inclination to judge ourselves and our performance as either good or bad. Letting go of the judging process is a basic key....Be clear about this: letting go of judgments does not mean ignoring errors. It simply means seeing events as they are and not adding anything to them. [3, p. 24/28]

"Read this simple analogy and see if an alternative to the judging process doesn't begin to emerge. When we plant a rose seed in the earth, we notice that it is small, but we do not criticize it as 'rootless and stemless.' We treat it as a seed, giving it the water and nourishment required of a seed. When it first shoots up out of the earth, we don't condemn it as immature and underdeveloped; nor do we criticize the buds for

not being open when they appear. We stand in wonder at the process taking place and give the plant the care it needs at each stage of its development. The rose is a rose from the time it is a seed to the time it dies. It seems to be constantly in the process of change; yet at each stage, at each moment, it is perfectly all right as it is. [3, p. 29]

If only we could focus on that in our mathematics classrooms--each student being constantly in the process of change; yet at each stage, at each moment, s/he is perfectly all right. That is a goal worth pursuing. But if each student is perfect at all times, what is the point to the teaching process? The purpose is to expand the world of the knowable for the student, to create situations in which students gain awareness of mathematical patterns, relations, and transformations. Students who have these experiences will possess mathematical learnings which are not divorced from their everyday lives.

### Awareness is Heightening

Awareness is fundamental to learning, because without it nothing can be learned. Non-judgmental awareness allows for the unknown to become knowable. Gallwey argues that:

"Experiential learning is a function of awareness. The word 'awareness' has a bad press: it has an unpragmatic ring to it in the minds of many result-oriented individuals. The word makes some people uncomfortable; it has ethereal connotations associated with the vague, the impractical and the downright weird. Nonetheless, it deserves more respect, (because)...without awareness...there is no such thing as learning....Whatever increases the quality of awareness in an individual also increases the quality of learning, performance and enjoyment.... Awareness is the internal energy that makes it possible to see through our eyes, hear through our ears, feel our feelings, think our thoughts, and understand what we understand. It is like a light that makes our experience knowable. [4, p. 59 & p. 79]

Applied to the study of mathematics, awareness is the internal energy which focuses attention on the dynamics of the mind as it studies patterns and relationships. Mathematics is mental activity richly served by imagery. What conclusions may we draw from this discussion? I suggest the following are valid implications:

1. Mathematics is not just about right and wrong answers. Fundamentally, mathematics involves educating one's awareness; awareness of transformations, of patterns, of relationships, and of the fact that mathematics is created by minds focusing on their awarenesses.

2. Mathematics need not be taught in a judgmental environment. Gattegno has argued that teachers should subordinate their teaching to the learning of their students, that all education is self-education, and that what is educated is awareness. [5,6,7,8] In such an approach, errors and mistakes are treated non-judgmentally, not ignored or left unrectified, but welcomed as opportunities for new insights to be gained.

3. Everyone can do mathematics, even the most fearful and weakest of students. Young children have the capacity to learn many things unhindered by fears of failure, of getting the wrong answer, of being judged by themselves and others. Children have the powers to make transformations, to discover and use patterns and relationships. We know this is true by simply acknowledging the fact that all children learn to speak their native language effortlessly within two years of birth. These powers which children possess are the ones needed to do mathematics. If capitalized upon, all children will be able to learn mathematics as well as they were able to learn to speak.

4. There are alternate ways of teaching and learning mathematics than the familiar and predominate textbook and worksheet approach. For some illustrations of these alternate pathways, see items [1,2] in the references.

5. The learning of mathematics can be a joyful, challenging, engaging, and fulfilling experience for all learners, and the teaching of mathematics can be a similar enterprise for all teachers if they subordinate their teaching--their telling, their correcting, their judgements--to the learning of their students. It is the students, after all, who must do the learning.

### Application Thoughts

Finally, how does this apply to the teaching and learning of Logo? Everything I've said about mathematics is equally true about Logo. Moreover, it is potentially easier to establish the environment envisioned above for Logo than it is for mathematics. In the case of Logo, the dynamics of computer images adds to the power of the situation.

Logo procedures are inherently self-correcting; i.e., the student using Logo knows immediately if the procedure runs or if it doesn't. A teacher is not required to tell students if they are right or wrong, or if the procedure works or not. Further, the computer is non-judgmental. Procedures which don't work are bugs to be fixed, and are not taken as evidence that the learner is somehow deficient. Instead, bugs are viewed as opportunities for new insights and awarenesses to be gained. Whether it is beginners sitting at a computer using Logo in direct mode, or experienced Logophiles creating intricate patterns and relations among Logo procedures, all are educating their awareness. They are educating their awareness of the results of direct input, of order of procedures, of turtle state, and so on.

It is without a doubt their awareness which is being educated. As each new awareness is added to learners' repertoires, their old knowledge is restructured and reorganized so as to serve this new understanding. The beauty of the computer, and in particular the beauty of Logo, is that the creations of the mind as represented by procedures can 'come alive' on the computer screen. The images in the mind translated into procedures are then transformed into visual images on the screen as the procedures are run. The dynamic of the mind is translated to the dynamic of the screen. This can happen much more easily with Logo than it can with mathematics.

However, because Logo is mathematics (an assertion which will be explored in a future column), mathematics is being learned when Logo is being taught. Including the teaching of Logo in a mathematics course doesn't mean something is being subtracted from the mathematics curriculum. The Logo will enhance the mathematics. It may even allow for the creation of a learning and teaching environment for the mathematics which heretofore has been advocated only for Logo.

This new Logo / mathematics learning setting also includes the recognition that teachers must also be learners as they subordinate their teaching to the learning of their students. This point is made admirably well by Gallwey.

"I was once asked: 'In a conversation between a fool and a wise man, who learns the most?' Being a teacher at the time, I was quick to think that since the wise man had more to offer, the fool would benefit the most, but then I saw that the opposite was in fact true. The fool is a fool because he doesn't know how to learn from his experience; the wise man is wise because he does. Therefore the wise man will learn more from the conversation than the fool. Then it became clear to me that if I wasn't learning as much as my...students in the course of a lesson, I probably shouldn't be teaching them. This notion gave me an entirely new perspective on teaching." [3, p. 129]

When you teach Logo or mathematics or both, do you in fact learn as much as your students? Perhaps that is a provocative enough question on which to close off this month's column...

### References

1. Baratta-Lorton, Mary (1976). *Mathematics their way*. Palo Alto: Addison-Wesley.
2. Dawson, A. J., & Trivett, J. V. (1981). And now for something different: Teaching by not teaching. In Ann Floyd (ed.) *Developing mathematical thinking*. London: Addison-Wesley.
3. Gallwey, Timothy (1974). *The inner game of tennis*. New York: Bantam Books.
4. Gallwey, Timothy (1979). *The inner game of golf*. New York: Random House.
5. Gattegno, Caleb (1970). *What we owe children: The subordination of teaching to learning*. New York: Outerbridge and Dienstfrey.
6. Gattegno, Caleb (1973). *The universe of babies: In the beginning there were no words*. New York: Educational Solutions Inc.
7. Gattegno, Caleb (1974). *The common sense of teaching mathematics*. New York: Educational Solutions Inc.
8. Gattegno, Caleb (1977). *Evolution and memory*. New York: Educational Solutions Inc.

A. J. (Sandy) Dawson is a member of the Faculty of Education at Simon Fraser University in Vancouver, British Columbia. His CompuServe number is 76475,1315.



## Testudinal Testimony

by Douglas H. Clements  
and Michael T. Battista

### Why Logo for Learning Mathematics? Logo-Based Geometry

Why would programming in Logo help students learn mathematics? At first blush, it appears obvious. Students seem to be doing mathematics as they program. But how much mathematical thinking are students actually engaged in? How much mathematics do they actually attend to? Leron put it this way: "...the turtle may be a math-speaking creature, but we cannot automatically assume that students are always listening to what it is saying" (1985, p. 30). Thus, it is essential to elaborate precisely how Logo can make a unique contribution to students' learning of mathematics.

We attempted to do just this when we wrote a proposal for using Logo in geometry instruction to the National Science Foundation (NSF). We first asked, "What's wrong with the geometry curriculum that now exists?" then described what Logo might contribute to geometry instruction in light of the deficiencies identified. This month's column includes a brief rendition of our description, and of the project that was funded by NSF, entitled, "The Development of a Logo-based Elementary School Geometry Curriculum."<sup>1</sup>

It is worth mentioning, by the way, that the NSF has also funded other projects to explore the role of Logo in geometry. A notable example is the Atlanta - Emory Logo Project (Emory University, 201 Fishburne Building, Atlanta, GA 30322), aimed at the high school grades.

#### Deficiencies in the Current Elementary Geometry Curriculum

According to extensive evaluations, students are failing to learn basic geometric concepts and are failing to develop geometric problem solving skills (Carpenter et al., 1980). Even a cursory glance at most elementary mathematics texts uncovers deficiencies that are responsible for these failures. The major focus is on recognizing and naming geometric shapes and learning to write the proper symbolism for simple geometric concepts. There is little opportunity for geometric problem solving. There is little chance to develop students' spatial thinking, a commodity that has primary importance in the geometry curriculum. There is little opportunity for students to analyze and re-conceptualize substantive geometric ideas. Another deficiency is that students "perceive their role in the mathematics classroom to be primarily passive... They feel they have little opportunity to interact with their class-

mates about the mathematics being studied, to work on exploratory activities, or to work with manipulatives" (Carpenter et al., 1980, p. 36). It is no wonder that, after experiencing such an impoverished geometry curriculum in elementary school, many high school students do not have the necessary geometric intuition and background for a formal deductive geometry course. They are also not adequately prepared for the later study of important ideas such as vectors, coordinates, transformations, and trigonometry.

#### Logo and Geometry

We believe that proper use of Logo, which includes explicit elaboration of the mathematical ideas in Logo, has the potential to vastly improve the elementary geometry curriculum. Once students decide on or are assigned a figure to draw, they must devise a set of instructions that will make the turtle draw the figure. They must analyze the figure and break it into smaller parts that are more easily constructed. They must determine angle measures and lengths of line segments. Thus, they are constantly involved in geometric problem solving. Furthermore, through such activity, Logo emphasizes verbalizing goals and strategies before making overt moves toward a problem solution, creating efficient problem representations, making executive decisions, and debugging algorithms: problem solving skills that are too seldom explicitly taught in the schools.

Geometry, as studied in Logo, is substantive rather than factual; it promotes meaningful and active rather than rote learning, and is thus fundamentally different than the geometry presented in current elementary school texts. To see this, consider the concept of rectangle. In the usual elementary geometry curriculum, students are required only to be able to identify a visually presented rectangle (a level 0, visualization, activity in the van Hiele hierarchy (Burger and Shaughnessy, 1986)). In Logo, however, students can be asked to construct a sequence of commands (a procedure) to draw a rectangle. This forces them to make their concept of rectangle explicit. They must analyze the visual aspects of the rectangle as a whole and make conclusions about its component parts (a level 1 van Hiele activity).

In the words of Papert, "...the computer allows, or obliges, the child to externalize intuitive expectations. When the intuition is translated into a program it becomes more obtrusive and more accessible to reflection" (1980, p. 145). With proper teacher guidance, this program can then be used as material "for the work of remodeling intuitive knowledge" (p. 145). That is, by designing a rectangle procedure or program, students are forming an abstract definition of a rectangle (a level 2 van Hiele activity); they are externalizing their intuitive ideas about rectangles. Running the program on the computer allows them to test the validity of their definition, to reflect on their conceptualization.

Through such experiences, not only are students progressing into higher levels of geometric thinking in the van Hiele hierarchy, they are building conceptual structures or

1. This material is based upon work supported by the National Science Foundation under Grant No. MDR-8651668. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.



frames about rectangles that can be useful in other situations such as drawing quadrilaterals, triangles, or regular polygons, and are thus learning geometry meaningfully.

### Mappings, Connections, and Frames

However, as we have seen in earlier columns, students do not necessarily develop such frames on their own. We believe that teachers must take great care to create explicit "mappings" between Logo and other mathematical activities. Such mappings between Logo explorations and classroom work will enrich students' knowledge structure of particular mathematics topics, allowing them to build new connections within those topics and new mental representations, or frames, for mathematical situations. Furthermore, by highlighting how geometric concepts manifest themselves in different environments (Logo and non-Logo), the mappings will facilitate transfer. Through careful attention to these mappings, Logo experiences can become a knowledge base for developing mathematical concepts and skills.

For example, in a traditional textbook approach, the concept of regular polygon is defined, examples and non-examples are provided, and students are required only to accurately discriminate examples from nonexamples. But a teacher utilizing Logo could supplement the traditional approach by asking students to have the turtle draw several regular polygons. This would force students to analyze their conception of regular polygon, searching for a way to reconceptualize it in terms that they can "explain" to the turtle via the Logo language. This procedural definition would enhance students' understanding of regular polygon. The teacher might then have the students determine the relationship between the angles turned by the turtle in drawing the polygons and the number of sides of the polygons.

Finally, to connect their Logo work to the more traditional perspective, students should investigate the relationship between the angles turned by the turtle and the vertex angles of the polygons. The whole process helps concretize and bring to an explicit level of awareness the concept of regular polygon, helps the students see how the concept can be applied and generalized, and furthers the students' mental development in geometry by encouraging them to function at higher levels in the van Hiele scheme.

### A Logo-Based Geometry Project

Our project was conceived to help realize this potential. It will be conducted over the course of three years. Aiding us throughout this time will be consultants from the areas of mathematics, computer science, and mathematics education / psychology: Dick Brown, Ken Cummins, Bob Davis, Wallace Feurzeig, Alan Hoffer, and Grayson Wheatley. In addition, expert elementary teachers will help us design and evaluate the curriculum.

This year, existing curricula and research in elementary geometry are being reviewed. Next, a new geometry curriculum will be developed, predicated on the belief that computers and Logo will be soon available in the majority of classrooms. Finally, Logo activities that will promote the objectives of that curriculum will be constructed. A strong emphasis of the curriculum design effort will be to create explicit connections, or mappings, between the computer activities and other mathematical work.

In the second year, the new, Logo-enhanced curriculum will be pilot-tested by the participating teachers. The teachers will evaluate the materials both for their instructional soundness and effectiveness in teaching geometry. The teachers and the rest of the project staff will then revise the materials. In the third year, a more extensive field test and evaluation will be conducted, the materials will be revised and written in final form, and the materials will be disseminated.

We would, of course, appreciate hearing your ideas concerning the directions we should take, effective activities you have created, and your reactions to our ideas about how and why Logo can help children learn mathematics. Please write us at:

Logo-Based Geometry Project  
Kent State University  
118 White Hall  
Kent, OH 44242

### References

- Burger, W., & Shaughnessy, J. M. (1986). Characterizing the van Hiele levels of development in geometry. *Journal for Research in Mathematics Education*, 17, 31-48.
- Carpenter, T. et al. (1980). National assessment. In E. Fennema (Ed.), *Mathematics education research: implications for the 80's*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Leron, U. (1985). Logo today: Vision and reality. *The Computing Teacher*, 12(5), 26-32.
- Papert, S. *Mindstorms: Children, computers, and powerful ideas*. Basic Books, New York, 1980.
- 
- Douglas H. Clements is an associate professor in the College of Education at Kent State University in Kent, OH. He teaches Logo courses and conducts research on the use of Logo to develop cognitive, mathematical, and social-emotional competencies. His CompuServe number is 76136,2027.
- Michael T. Battista is an associate professor in the College of Education at Kent State University.
-

## Logo Disserts: Dissertations Dealing with Logo by Barbara Elias

A model for diagnosing the problem solving skills of elementary school students was developed, field tested, and evaluated in a study by Martha H. Hopkins of Florida State University (FSU). The model, designed to go beyond computational skills and learning styles (components so often found in this type of diagnostic instrument), diagnoses process skills as well, and uses Logo as the vehicle for doing this.

A set of seven diagnostic instruments was used, organized into two areas: Prerequisite Skills and Processes. This set included group tests on understanding operations and computation, and individual Logo tests. Prior to the Logo test, students spent three sessions in introductory work with Logo. None had previous experience with the language.

The Logo test was used for the collection of data on process skills associated with problem solving. Designed to assess the degree of procedural thinking used by students when they could not apply a previously learned process, this test required students to solve each problem in a recognizably organized manner (in other words, by using procedural thinking).

In addition to understanding the problem, a student needed to devise and carry out at least one plan for solution, and to look back over the solution to check on completeness and correctness in order to demonstrate procedural thinking.

Three sets of problems, with two projects each, were used in the Logo test. All could be solved with procedural thinking or by other means, such as drawing pictures, making a table, or using equations.

Participants in the study were 12 fourth, fifth, and sixth grade boys and girls who were enrolled in a summer program at FSU. A printout of each student's work along with written notes formed the data for the process of diagnosis. The analysis of process data included an adaptation of the work of Cynthia Solomon ("Introducing Logo to Children." *Byte* magazine, August 1982, pp. 196 - 208) for grouping students as:

1. Planners or procedural thinkers,
2. Macro-explorers, those who evidenced procedural thinking, or
3. Micro-explorers, nonprocedural thinkers.

Following an analysis of data from all test results, a case study was written for each student, which included an individual assessment of strengths and weaknesses in problem solving. This assessment formed the basis for a set of predictions for each student's performance on a validation test, which included textbook and process problems, administered by individual interview.

Using this model, the researcher was able to predict correctly the performance for 9 of the 12 students on the textbook problems and 8 of 12 students on the process

problems. Overall, 5 of the 12 students were diagnosed correctly.

After necessary revisions have been made, this model may be a useful diagnostic tool for elementary teachers. It can be administered in a relatively short amount of time, incorporates a test for use with process problems, and can be used to provide diagnostic data which are useful for instructional decisions addressing individual problem solving abilities and needs.

>>>Hopkins, Martha H. (1984). *A Classroom Model for Diagnosing the Problem Solving Skills of Elementary School Students* (Doctoral Dissertation, Florida State University, 1984).

(Ed. note: Each month, Barbara Elias highlights a dissertation or thesis dealing with Logo. She is accepting copies of recent research results for the LX Dissertation and Thesis Repository. Reports may be mailed to Barbara Elias, 4223 Hickory Road, Ettrick, VA 23803. Barbara will be attending the East Coast Logo Conference, April 2 - 4, and would be interested in consulting with conference attendees supervising or carrying out educational research related to Logo.)

---

*Barbara Elias is an assistant professor in the School of Education of Virginia State University in Petersburg, VA, and a doctoral candidate at the University of Virginia.*

---

## LIFT's

### Teacher to Teacher by James Fry Computer Science Can Be Fun!

This month's review is the second of a three part review on Brian Harvey's three volume series of *Computer Science Logo Style*. (Volume 1 was reviewed in the November 1986 *Logo Exchange*, page 27.)

*Computer Science Logo Style, Volume 2: Projects, Styles, and Techniques*, by Brian Harvey, 1986, published by The MIT Press, 28 Carleton St., Cambridge, MA 02142. \$19.95.

**Target Audience:** Computer hobbyists or Logo users who have some knowledge of Logo and the Logo editor and are familiar with some of the basic rules and techniques of programming with Logo.

**Content:** Volume 2 is the second of the 3 part *Computer Science Logo Style* series. It is a reflection of the author's ideas on the stages that one goes through in learning about programming. Volume 1 explored the first stage of needing to learn the rules of a programming language by giving a series of lessons on Logo. Volume 2 explores the second stage: the

exploratory stage, when a learner works on producing programming projects that are both useful and interesting.

The book consists of ten projects. Each of the projects has been written in an LCSI dialect of Logo. Minor modifications will probably be needed with some or all of the projects depending on the version and machine that is being used. There is an appendix at the end of the book that discusses the differences with the different versions and machine types.

A disk containing all the procedures necessary to work through the book can be ordered for each or the following versions at \$9.95 each: Apple Logo II, IBM Logo, and Microsoft Logo for the Macintosh.

The ten projects have been grouped into five categories.

The first category is Cryptography. Project one is about cryptograms, a type of word puzzle. The idea is to solve a quotation in which each letter has been replaced with a different letter. It is a type of secret code called "simple substitution cipher." The key is to discover the replacements that have been made for each letter, such as finding that all e's in the original text have been replaced with r's. A program Cryptographer's Helper will help a person solve cryptograms. It doesn't solve the puzzle but helps make guesses and collect information on the puzzle so you can solve it. The program consists of about 60 procedures.

The second project is called the Playfair Cipher. Instead of the simple single letter substitution of the first project, *pairs* of letters are translated into other pairs of letters. This project is smaller and contains about 17 procedures.

The second category is Games. The first project is a tic-tac-toe game where a human opponent plays the computer. What is so interesting about this project is the discussion Brian presents on deciding what kinds of rules and strategies are involved in playing tic-tac-toe and the priority of these rules. The project contains 32 procedures.

The second game project is a solitaire game. The program deals a hand of solitaire and then keeps track of the cards as you play the game on the computer. It doesn't give help but it does know the rules, so no cheating! This is a much more complex program than tic-tac-toe and contains around 80 procedures.

The third category is Mathematics. The first project is a Fourier Series Plotter. The program generates graphs of the Fourier (harmonics of sine waves) approximation to a square wave. This project definitely sounds like one for Tom Lough. (Ed. note: You bet!) If you are interested in music or the physics of sound, this is an excellent example of what can be done with Logo. The project contains 7 procedures.

The second project is the Pitcher Problem Solver puzzle. It's the type of problem that most everyone hated when they were in school. You remember, the one where you are at the side of a river with a 3-liter and a 7-liter pitcher? The pitchers have no markings on them to measure smaller amounts. You need 2 liters of water. How do you do it? There are different mathematical solutions to this problem. The author's program uses a Tree Search approach: to try all

the possible pouring steps until one of the pitchers contains the proper amount. This project contains about 14 procedures.

The fourth category is Programming Utilities. The first project is called Pretty Print. It allows you to print a very large and complex list (for example, a list of many lists) in a readable way. It breaks down the lines so they are separated and indented to make it easy to read and understand the order. The program is set up for an 80 character screen. The project contains 8 procedures.

The second project is an iteration compiler. This project is a set of procedures that give much more flexibility than the normal two ways of carrying out repetitive computations in Logo, that of REPEAT and recursion. The project contains about 18 procedures.

The fifth and final category is Pattern Matching. The first project is Pattern Matcher, a set of procedures that provides a set of comparison tools such as MEMBERP and EQUALP but in a much more advanced manner. The project contains about 23 procedures.

The second project is Doctor, a simulation of the behavior of a psychotherapist. This program is a version of many such versions that originated from the Eliza program by Joseph Weizenbaum. This is an excellent study for anyone interested in linguistics. The project contains around 29 procedures.

**Strengths:** The author has not only given Logo users a set of projects that are most interesting and challenging, but also an opportunity to experience firsthand the power of Logo. The projects presented are only a starting point to learn much more about the structure of Logo and different styles of programming with it.

I also strongly recommend the purchase of the diskette, unless you really enjoy typing in lots of procedures. The diskette is a helpful addition to the book.

In summary, if you are ready for a real challenge or to move up to a greater understanding of computers and programming, then *Computer Science Logo Style, Volume 2: Projects, Styles, and Techniques* is what you have been waiting for.

I can't wait for Volume 3!

---

*James Fry uses Logo with his Chapter 1 remedial mathematics students at Novi Community School, Novi, MI, and is a co-founder of the LIFT group. His CompuServe number is 76317565.*

---

## The Adventures of Jacques and Elsie

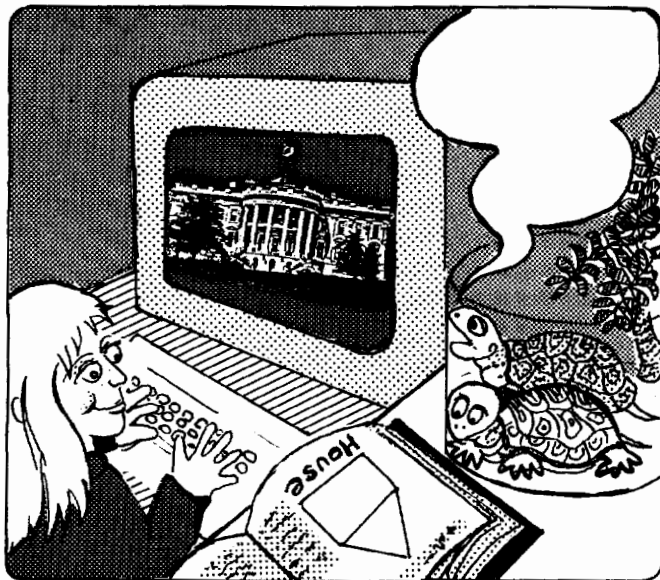
drawings by  
Linda Sherman

In our December cartoon, Elsie was dreaming about interacting with her computer counterpart. Our favorite caption was submitted by Pauline Beyer of Hendersonville, NC.

"I have this recurring Mindstorm."



In this month's cartoon, Jacques and Elsie are witnessing an unusual extension of the HOUSE procedure. What is Jacques saying about the situation?



Please send your caption suggestions no later than February 25, 1987, to: Jacques and Elsie, Logo Exchange, PO Box 5341, Charlottesville, VA 22905. Include your name and address so that we can give proper credit should your caption be chosen.

All captions become the property of Meckler Publishing. None can be returned.

Linda Sherman is a freelance author and artist living in Shipman, VA, with her husband and two-year-old son.

# Q

and

# A

by  
Jim  
McCauley

Q. Why do most versions of Logo have the DEFINE primitive? I can define all the procedures I want with TO or with the Logo Editor. I find the syntax of DEFINE much more difficult to understand.

A. The DEFINE command is one of Logo's "power" primitives, normally used only in advanced programming.

DEFINE is a lot like TO. It can be used to create new procedures that look exactly like those created with TO. The formal syntax looks like this:

```
DEFINE "procedure-name [[variable-list] [line-1] [line-2]...]
```

Everyone's first Logo program looks like this when it is defined with DEFINE:

```
DEFINE "BOX [ [ ] [ REPEAT 4 [ FD 50 RT 90 ] ] ]
```

BOX with a variable called SIZE looks like this:

```
DEFINE "BOX [ [ SIZE ] [ REPEAT 4 [ FD :SIZE  
RT 90 ] ] ]
```

I agree that the syntax of TO is simpler. In fact, TO is just a convenient "mask" that DEFINE wears. Notice the important differences between the two. DEFINE accepts two arguments: a quoted name for the procedure and a list containing a list of variables and an arbitrary number of lists that are the body of the procedure instructions. Thus, it is convenient to use DEFINE in the body of a procedure, while TO is very clumsy indeed, since it requires an unquoted word as its input, thus eliminating the use of a variable for this purpose. Also, TO won't accept a program in the form of a list. Finally, in some versions of Logo, invoking TO takes you immediately into the editor.

DEFINE is an important command because it represents Logo programs in a way that allows Logo to assemble new programs from words and lists (which Logo can manipulate easily) and *define them as new procedures under program control*. Thus, it is possible to write programs that write other programs. Using TEXT, a Logo operation that returns a procedure as a list, it is also possible to write programs that will *edit* or change other programs, or even themselves. This probably sounds a bit science-fictional, but it's the sort of thing that LISP programmers do all the time.

There are some practical applications of DEFINE in Logo. In the Apple Logo documentation is an interesting program called LEARN; it "listens to and remembers" everything that the user types in and allows the entire sequence of commands to be defined as a procedure. It can be very handy for beginners who are just starting out in turtle graphics.

One of the best applications of DEFINE that I have seen is in Brian Harvey's new book, *Computer Science Logo Style, Volume 2: Projects, Styles, and Techniques*. In Chapter 8, Brian describes an "iteration compiler" that automatically rewrites programs for increased speed and efficiency. (Ed. note: See review in this issue.)

One grand project (which I have never attempted) is to write programs that use DEFINE to actually change the "behavior" of other programs, or even their own behavior. Such programs are very difficult to create or even envision. Those who have access to machine turtles with touch sensors might want to experiment with this. Atari Logo users are fortunate to have four "collision-detecting" turtles built into their version; they might want to try such programs as well.

Why not play around with DEFINE a bit? Perhaps you will gain a greater appreciation for the power of this little-known Logo command.

Each month, I will answer a selected question related to Logo. If you have a question, send it along with a stamped self-addressed envelope to:

Jim McCauley  
Logo Exchange Q and A  
876 East 12th Avenue, #4  
Eugene, OR 97401

---

*Jim McCauley is a graduate student at the University of Oregon, studying with David Moursund, and has written Logo articles for many national publications. His CompuServe number is 70014,1136.*

---

## Terrapin Logo for the Macintosh Now Available

Terrapin Inc. has announced that a pre-release version of Terrapin Logo for the Macintosh is available for ordering. Terrapin Logo for the Macintosh runs on the 512K Macintosh and the Macintosh Plus. The package includes a nonprotected language diskette and nearly 400 pages of documentation, consisting of a tutorial and a reference guide.

Many standard Macintosh features are included, such as windows and pull-down menus. Programming features include property lists, multiple turtles, multi-dimensional arrays, and automatic loading of files. STAMP and SNAP commands make it possible to create animation effects.

The price for the package is \$79.95 plus \$5.00 for shipping. Sets of 10 and 20 language disks are available for \$399.95 and \$699.95 respectively, plus \$5.00 for shipping.

The final version of Terrapin Logo for the Macintosh is scheduled for release later in 1987, with a list price of \$99.95. Purchasers of the pre-release version may upgrade to the final version for \$20.00.

For more information, write to Terrapin, Inc., 222 Third Street, Cambridge, MA 02142, or call (617) 492-8816.

## IntLxual Challenges

by Robs Muir  
Nested Orbits

*[Herb Simon] has said...that the computer is a 'once in several centuries innovation.' If you begin thinking about an innovation of that magnitude, you really must appreciate that it's going to be decades at least before we realize the full implications in terms of our teaching practice.* [diSessa, 1986]

In politics, revolutions can occur overnight. Whole systems of government can be overturned and an entire population can redefine its organizational structure in a fortnight. But government is mostly form; it is the *substance* of politics--the ideas embodied in the system of governance--which may take years to be fully implemented. (One might argue that, after 200 years, the West is still struggling to "get democracy right"!)

Contrast this with a revolution in *ideas*. A revolutionary thinker can have a lasting and profound impact on history. However, often these new ideas take years (or centuries) to reshape a population's view of the world. Seldom, in the history of ideas, does an idea reshape the world overnight.

On November 11, 1572, Tycho Brahe observed a new star (a nova, really) near the constellation of Cassiopeia. For us, this is of mild curiosity; we are used to thinking of the Universe as a dynamic system filled with creation and destruction. But, for Tycho and the rest of 16th Century Europe, this was impossible!

Here, in Brahe's nova, was a substantial refutation of Aristotelian belief; the "common sense" of the time. The celestial sphere, as Aristotle taught, was eternal and unchanging. The Platonic ideals of purity and harmony were fully integrated into common thought--bound, in part, in the cosmology and tradition of the Church.

If Aristotle was wrong about this, what else was he wrong about?!

Johannes Kepler, one of Brahe's assistants, struggled for the remainder of his life to keep the Platonic harmonies close to home--at least within the Solar System. Plato said that circular orbits were the only appropriate shape for the six planets.

Remember, Uranus, Neptune and Pluto hadn't been discovered yet. How would the Creator arrange these six planets around the Sun, if not with the mathematical precision of a geometer? Indeed, Kepler's first book (published in 1596 at age 25) built an elaborate model to explain the distances between, and respective sizes of, the planet's orbits.

### Coming Around to the Challenge

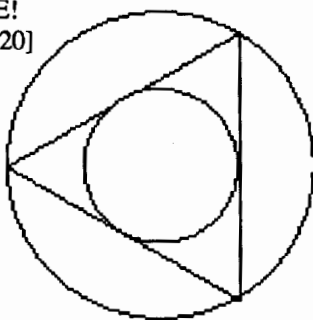
Let me use a simplified model to explain... Imagine a large circle

REPEAT 360 [ FD 1 RT 1 ]

with a triangle

```
RT 60
;THIS IS APPROXIMATE!
REPEAT 3 [FD 100 RT 120]
```

inscribed within it; that is, with the three corners just touching the large circle. Next, let's inscribe a circle inside the triangle, so that the circle just touches the sides of the triangle.



```
RT 30
;AGAIN, SEVERAL APPROXIMATIONS!
PU FD 86 LT 90 PD
REPEAT 360 [FD .5 LT 1]
```

The outer circle is the orbit of Saturn and the inner circle is Jupiter! For Kepler, the outer two planets were the "first" planets and (translated from the original Latin) "the triangle is the first figure in geometry. Immediately I tried to inscribe into the next interval between Jupiter and Mars a square, between Mars and Earth a pentagon, between Earth and Venus a hexagon..."

Can you build Kepler's first attempt here into a Logo drawing? Remember to include all six planets. Hint: You might choose to use a larger starting circle. Can you eliminate the approximations? See [Muir, 1985].

This was not what Kepler finally set forth in his *Mysterium Cosmographicum*; the proportions weren't quite right. Kepler settled on five three-dimensional solids within which he inscribed the orbits. These five Platonic solids, of which all faces are identical, are

1. the tetrahedron (pyramid, with four sides of four equilateral triangles)
2. the cube
3. the octahedron (eight equilateral triangles)
4. the dodecahedron (12 pentagons)
5. the icosahedron (twenty equilateral triangles)

For the masochistic problem-solvers among you, build this into a 3-D Logo challenge a la "Turtle Geometry" or Horacio Reggini. Five perfect solids and five intervals between the six planets! Of course we know it now to be a massive coincidence (??), but this was such a fixation for Kepler that it would color his work for the rest of his life. Even after the discovery of his Three Laws of Planetary Motion, which demanded elliptical rather than circular orbits, Kepler continued to cherish his nested spheres and solids. Old ideas die hard.

New ideas have difficult births. It would take nearly 100 years for Isaac Newton to incorporate Kepler's Three Laws into his Law of Universal Gravitation. By this time, a new model of the Solar System began to supplant the dogmas of

the Vatican. Don't forget the last years of Galileo's life--imprisoned for his new ideas.

As usual, we will redistribute to all contributors copies of the most interesting solutions. But you have to send in *something* (even a bug-infested attempt) in order to receive anything. Please include a stamped self-addressed envelope. Mail your solutions to:

IntLXual Challenges  
c/o Robs Muir  
1688 Denver Avenue  
Claremont, CA 91711

### References

Andrea A. diSessa, "From Logo to Boxer, A New Computational Environment." *Australian Educational Computing*, July, 1986.

Arthur Koestler, *The Watershed: A Biography of Johannes Kepler*. Anchor Books - Doubleday & Company, Garden City, NY, 1960.

Robs Muir, "NLXual Challenge: Ella and the n-gon." *The National Logo Exchange*, November, 1985.

---

Robs Muir is a physics and computer science teacher in Claremont, CA, and an instructor at the Claremont Graduate School. His CompuServe number is 70357,3403, and his Bitnet address is MUIR@CLARGRAD.

---

### Center Your LogoWriter Text

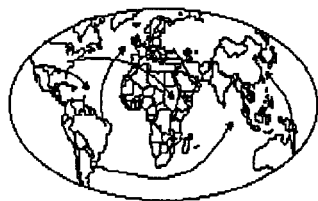
Steve Matthias, the principal of Washington Center Elementary School in Fort Wayne, Indiana, has contributed the following LogoWriter procedures which have been developed at his school. The CENTER procedure will center selected text when it is printed in 80-column format.

```
TO STARTUP
WHEN "P [PRINTTEXT80]
WHEN "O [CENTER]
END

TO CENTER
NAME COUNT CLIPBOARD "CENT
REPEAT :CENT [CB]
INSERT CHAR 13
REPEAT (40 - :CENT / 2) [INSERT [ ] ]
REPEAT :CENT [CF]
INSERT CHAR 13
EOL
END
```

Run the STARTUP procedure. (If you save the page containing these procedures, the STARTUP procedure will be run automatically each time the page is selected. Next, select the text you want centered on your printout and copy it to the clipboard. Then use Ctrl-O to center the text and Ctrl-P to print the text in 80-column format.





# International Logo News



Dennis Harper  
Logo Exchange International Editor

## Global Comments

by Dennis Harper  
Institute of Education  
469 Bukit Timah Road  
Singapore 1025, Republic of Singapore

Conferences, conferences! This month's international selections summarize Logo conferences in Europe and South America. Seymour Papert is found in Japan, England, and Argentina and must certainly be commended for his continual globe-trotting efforts in promoting Logo. Unfortunately, the world is a very big place and, even if money was available, it would be impossible to quench the thirst for Logo knowledge. Although some readers may be tired of attending Logo conferences, I can assure you that many areas of the world would still like to gather and discuss Logo.

A recent computer exposition (November 22, 1986) in Kuala Lumpur, Malaysia, illustrates this desire. More than 60,000 people attended the three-day show. Saturday was set aside for educational forums. I gave the keynote address which dealt with computer education from an international perspective. I was fortunate to be on a Logo panel with two Malaysian Logo teachers. The Logo session had the highest attendance figures and many came to ask the question, "What do we do after the kids make the house?" Since I had attended countless Logo talks, pieced together much of the Logo '86 bibliography, and just completed an 800-page Logo book, this question was like being asked to describe the history of western civilization.

Haven't these people read anything, talked to anyone, or attended any educational conferences? For most people, the answer to this question was, "No." Fortunately, Mr. Ng Chee Aun, a middle-school teacher on the panel gave an inspiring talk about how he used Logo with his students. I was madly taking notes that explained some of the techniques and projects he was doing, and marveling how he had managed to establish an exemplary Logo environment through readings as well as trial and error. Many of the teachers attending left the session with a re-kindled enthusiasm for Logo and a thirsting for additional knowledge -- yes, an entire conference based on Logo. How about a Pan-Pacific Logo Conference sometime in the next few years?

A question was raised as to why Asia seemed to be generally lagging behind other areas of the world when it comes to implementing Logo. One participant felt that the

Chinese belief in "saving face" had something to do with it. Exploring, making mistakes in front of students, and students knowing more than the teacher are totally out of the question for many Chinese teachers. There are some Chinese throughout Asia doing formidable Logo work, but just how much this cultural phenomenon affects Logo use in the future will be interesting to see.

I also attended a conference in Perth, Western Australia, this past December. During five days of papers and speeches, I never heard the word Logo mentioned. Was I attending America's Cup action? No, this was the EdTech '86 conference sponsored by the Australian Society of Educational Technology. Perhaps because Australia is relatively isolated, communication software was all the rage. Also, there was a lot of soul-searching as to why we need computers at all. Theoretical issues abounded, and I concluded that either much has happened in the rest of the world during my nine months in Singapore or Australia is in many ways at the forefront of the world in computer education. (I also concluded that they may be ahead in sailing as well!)

Our international readership is increasing and I hope that each of you will spread the word about the LX so Seymour Papert and other international Logo speakers won't be spread quite so thin. I would also again like to encourage all LX readers to send any international Logo news to either myself or the appropriate continental editor.

FD 100!

## Pan-Pacific Logo Conference Contemplated

Ideas, suggestions, and declarations of interest in the possibility of a Pan-Pacific Logo Conference are being collected. The program of such a conference would be designed to address the needs of Logo using educators from North America, South America, Asia, and Australia. The conference site would be a central location, such as Hawaii.

Please note that this is *neither* a call for papers *nor* an announcement of such a conference.

Send your ideas, suggestions, and declarations of interest to: Tom Lough, PO Box 5341, Charlottesville, VA 22905-0341 USA.



Asia  
by Hillel Weintraub  
Doshisha International High School  
Tatara, Tanabe-cho, Tsuzuki-gun  
Kyoto-fu, Japan 610-03

### Logo in India, Part 2

As explained in the last Asian Column, the two year pilot program of computers in schools, known as CLASS (Computer Literacy and Studies in Schools) basically de-emphasized traditional programs of study and the teacher directed approach to learning. Much emphasis was given to students working with data bases and spreadsheets and according to Professor Maheshwari at the Indian Institute of Technology, Delhi, "Logo and turtle graphics were introduced as an environment for problem solving."

A limited Logo package DART was used for a year, but at the beginning of 1985, Sandeep Kumar completed a full turtle graphics language with variables and conditionals as the graduating project for his Bachelor of Technology degree. This language was called MATHLAND, and was felt to be more user friendly than DART, especially because of improvements in the editing facilities. Furthermore, MATHLANDS's command structure and ability to do proper recursion were considered an improvement over the early package. At the beginning of 1985 then, MATHLAND was introduced to the first year high school students involved in the CLASS project.

Professor Maheshwari notes in the preface to the package that the educational value of turtle graphics for "encouraging the development of creativity in a child and in learning the principles of programming and problem solving is now well understood and accepted" and that MATHLAND was seen as a medium for encouraging talking about problem solving methodology, top-down design, and the use of decomposing and integrating as problem solving techniques.

Professor Maheshwari kindly passed the MATHLAND manual to me when we met this past summer in Tokyo. Not having access to a BBC micro, I have not been able to work with MATHLAND directly, but could get some feeling for it through the manual.

Although the name "Logo" is nowhere mentioned in the manual, there is no doubt that the spirit of Logo, as interpreted by Mr. Kumar and his advisors, is present. Various terms which have become known to us through Logo, such as "turtle graphics," and much of Logo's syntax are the same.

However, there are interesting differences between MATHLAND and the usual turtle graphics with which I am familiar. Some are just differences in terminology; for example, FRESH is the command to clear the screen, and CENTRE returns the turtle HOME. Other differences are syntactical. For example, REPEAT has its own indentation structure which allows a variety of commands to be listed until END is written. Thus, our infamous BOX can be drawn by what looks like a procedure, but is the particular form which is given to REPEAT in MATHLAND.

```
REPEAT 4 TIMES
  FORWARD 100
  RT 90
END
```

None of this is executed until the END is typed. When executing the set of commands between REPEAT and END, the user is given the option of having each line of the set displayed at the bottom of the screen, similar to the TRACE command in some versions. The manual discusses this REPEAT command as a "loop," an idea seldom if ever mentioned in Logo books, as looping seems to have a reputation for inelegance in some computing circles. MATHLAND is not bothered by this and provides explanation for various kinds of loops.

Here is an example provided in the manual for "nesting of loops" to create a window.

```
REPEAT 4 TIMES
  REPEAT 4 TIMES
    FORWARD 100
    RT 90
  END
  LT 90
END
```

Most familiar Logo versions could execute the above as

```
REPEAT 4 [ REPEAT 4 [ FD 100 RT 90] LT 90]
```

though we would usually write a BOX procedure and then a separate procedure WINDOW which calls BOX.

TO BOX	TO WINDOW
REPEAT 4 [ FD 100 RT 90]	REPEAT 4 [ BOX LT 90]
END	END

MATHLAND has a two-step procedure for creating and assigning values to variables:

First we CREATE a variable name or symbol by entering CREATE. For example, CREATE AMOUNT. The next step would be to ASSIGN a value to that variable, thus, ASSIGN AMOUNT VALUE 100 gives the variable we just created the VALUE 100.

FORWARD AMOUNT would move the turtle forward 100 steps. Notice the lack of quotes in naming and dots in calling which is common in other versions.

Procedures or complex commands (both names are used in MATHLAND) are created by typing DEFINE + a name and defined by typing DEFEND, meaning DEFinition END. Thus a procedure to draw a star could be:

```
DEFINE STAR
  REPEAT 5 TIMES
    FD 200
    RT 144
  END
DEFEND
```

In this example for creating spirals, we can see MATHLAND's method for creating input variables.

```
DEFINE SPIRAL :ANGLE, LENGTH, INCREMENT, NUM
  REPEAT NUM TIMES
    FD LENGTH
    LT ANGLE
  END
DEFEND
```

When calling the procedure you would type SPIRAL :90,5,5,15.

The idea of recursion is introduced at the end of the manual with another example of SPIRAL.

```
DEFINE SPIRAL :LENGTH, ANGLE
  FD LENGTH
  LT ANGLE
  SPIRAL :LENGTH + 10, ANGLE
DEFEND
```

There is no comparison mentioned of the two SPIRAL procedures and how recursion and looping compare, but the manual notes, after introducing conditionals to stop such a recursive procedure, that we "can use recursion to generate repetitive figures elegantly."

The overall pattern of the manual upholds the usual idea of Logo books; that is, giving enough information to allow users to make discoveries on their own. Thus, the syntax and various commands are introduced and then users are given problems to solve (e.g., "Draw a circle with a radius of 200 units.") or pictures to create.

There are certainly some things about MATHLAND that will seem strange to those of us reared on other versions. According to Professor Maheshwari, there is an interest in combining certain aspects of Logo and Smalltalk to create another object oriented language for schools. MATHLAND may be viewed as a first step in that direction.

### Logo Writer Comes to Japan

Logo Computer Systems Inc. (LCSI) of Canada, the company associated with Seymour Papert and responsible for Apple Logo and LogoWriter, has recently opened a Japanese office here called Logo, Japan. In order to promote the philosophy of Logo, their new office, and LogoWriter, Seymour Papert and Kiyoko Okumura spent the last week of November in Japan giving two workshops, meeting with government committees regarding education and computers, and talking with various groups in the community which have been supporting Logo during the past few years.

The workshops on LogoWriter were an attempt to promote Logo as something more than "just graphics," a reputation with which it has been struggling in most countries. Materials carefully prepared in Japanese, along with the skillful introduction of Logo programming concepts by

Kiyoko Okumura (who is known to the Japanese community for her translation of *Mindstorms* and a previous visit with Professor Papert in 1982), plus Papert's programming examples and audience-involving lecture / discussions provided a stimulating introduction to both the software and the philosophy of Logo. Like Logo itself, Papert's examples and analogies were tools to think with, able to be used by people with a wide range of experience and understanding.

Both Papert and Okumura emphasized that Logo wasn't just a computer language, but a means for using the computer as "glue" to bring together various concepts, thus very useful for making personal connections between normally distant, unrelated school subjects and the individual. This idea is not familiar to most Japanese teachers. They will need a "playing time" and guidance in order to see the vast potential of such uses of the computer.

While attending one of the workshops, I had an opportunity to talk to the president of Logo Japan, Takayuki Tsuru, about the new company's plans to introduce Logo into Japan. I think this interview is instructive for people in other parts of the world as Japanese business practices are so much in the news these days. We can see the depth of planning and the patience in forming long range goals which are so much a part of Japanese businesses, even those involving education. The interview is also instructive in giving some insight into the plans of the Japanese Ministry of Education.

**LX:** What are your plans for Logo in Japan?

**Mr. Tsuru:** Our main goal is not numerically increasing the number of Logo users, but increasing the number of people who think in a Logo way. Our focus will be on children. They have no prejudice about computer languages; adults have many pre-conditions.

**LX:** Will you start with young children? (This was asked because Mr. Tsuru's experience has been in musical education for young children in the home.)

**Mr. Tsuru:** Our first thought was to focus on kindergarten children, but teachers are needed for this. We need to consider how the teacher thinks about Logo and computers. Training instructors was felt to be crucial, so our initial plan was to make a training school and wait for 1-2 years until a core of such instructors existed.

However, the *Mobusho*, the Japanese Ministry of Education, suddenly stated their new policy of putting many computers in junior high schools by the school year beginning in April, 1988. The teacher problem is going to be very big there, too.

We still feel that kindergarten is a good age to start Logo. But since the *Mobusho* will start at the junior high school level, we have shifted our focus. We investigated how to introduce Logo to teachers and we found out that LogoWriter was a good way to introduce Logo to them. Students begin to study English at the junior high level, so we felt that they could study English and Logo.

**LX:** So these workshops are aimed at these junior high school teachers?

**Mr. Tsuru:** Yes, we want them to understand the purpose of Logo and LogoWriter. We want them to see various ways that they can use Logo to help them become familiar with English.

The *Mobusho* has decided to introduce Logo as part of the computer study program which will be introduced in schools, so these workshops are a first step in familiarizing teachers with Logo. Now we will release the English version of LogoWriter for the IBM jx and then within two years we will have a Japanese version for younger children and older people. We are planning to have this software available for other Japanese machines.

### Europe

by Richard Noss

London University Logo Group  
Institute of Education  
Depart. of Math, Statistics, & Computing  
20 Bedford Way  
London, England WC1HOAL

### Logo Maths Conference

Rosamund Sutherland of the London Logo Group reports:

As far as the London Logo Group is concerned, the big event of 1986 was the Second International Logo and Mathematics Conference held at the London University's Institute of Education. On a surprisingly warm afternoon the participants, researchers and educators from all over the world began to arrive "just in time for tea." Having greeted our old and new friends, we settled down to listen to Joel Hillel from Montreal speak about the links between "trial and error" and analytic approaches to programming in Logo. This stimulated an energetic discussion over dinner and put everyone in a reflective mood for the rest of the conference.

The next morning the very full program of research reports and working groups began. Papers were submitted before the conference and had been grouped into the following areas:

- The Programming / Mathematics Interface
- Geometry and Imagery
- The Learning Environment
- The Representation of Turtle Graphics Tasks
- Microworlds
- Pedagogy

These dealt with both the issues of learning Logo and the potential of Logo for learning of mathematics. André Rouchier, Renan Samurçay, and Dominique Guin from France had all individually submitted papers on the learning of recursion.

Patrick Mendelssohn, from Grenoble in France, reported on a research project in which 10 and 14 year old students had been introduced to Logo via procedures which produce elementary forms. In one of his examples, the students were presented with four procedures all drawing rectangles. The students then used these together with procedures to "step aside" and to "jump" to produce more complex forms such as a layout of a tennis court. Perhaps the most memorable paper in the Geometry and Imagery section was by Uri Armon and Uri Leron from Israel on "How to Teach a Turtle to Draw a Cycloid." For additional details on these two presentations, see Sandy Dawson's "MathWorlds" column in the November 1986 LX.

Herbert Loethe from West Germany is working on using Logo for the learning of "advanced" mathematics and certainly his paper on "Posting and Direction Finding for a Three-Dimensional Turtle" kept us thinking. Portugal's Candida Moreira reported on her work with Logo and teacher training and Anne McDougall from Australia presented a paper on "Children's Difficulties in Perceiving Structure and Using Subprocedures." From the USA, John Olive reported on his work using Logo to improve the understanding of geometric relationships and Patrick Thompson talked about using "Logo as a Context for Thinking about Thinking."

Half of the program was devoted to working groups in which smaller groups met to discuss such topics as "Mathematical Microworlds" or "Classroom and Didactical Issues."

It felt good to be part of a community which, whilst agreeing that Logo has considerable potential, also knows that certain aspects of learning Logo are far from trivial. By coming together as an international group, there is a chance for real change in the mathematics curriculum throughout the world, although no one expects these changes to happen overnight.

If the conference was the highspot of 1986, then the highspot of the conference was the final banquet in which the conferees packed into the local L'Almacas wine bar and were lavished with fresh salmon and wine. The floor space was so small that everyone danced with everyone in a recursive whirlwind, and just as the evening was reaching its peak, Celia Hoyles appeared with an enormous pink and white cake in the shape of a turtle. She presented this to Seymour Papert who took cutting the cake in his stride. The next day Papert spoke to a large audience (including school children, teachers, and conference participants) on the controversial topic of "The Best Way to Teach Mathematics is to Abolish Mathematics." Somehow he managed to address everyone whilst dodging between Lego bricks, children, and computer cables. Finally, the remains of the turtle cake appeared again to be instantly devoured by the children from the audience.

### British Logo Book Available

*Microworlds: Adventures with Logo*, by Richard Noss, Clare Smallman, and Michael Thorne, has been published by Hutchinson and Co. Ltd., 17-21 Conway Street, London, England W1P 6JD.

### Latin America

by Eduardo Cavallo and Patricia Dowling  
 Instituto Bayard  
 Salguero 2969  
 1425 Buenos Aires, Argentina

### Third International South American Logo Congress

The Third International Logo Congress took place on November 6-8, 1986, in Nueva Hamburgo, Rio Grande do Sul, Brazil. It was organized by the Department of Psychology of the Federal University of Rio Grande do Sul, with the motto, "A New Perspective in Education for Everyone."

This event, which was attended by nearly 1500 people, included national and international lectures and symposiums addressing such populations as primary and secondary schools, teacher trainers, and special education.

In the opening session, the local authorities welcomed the participants who had arrived from Paraguay, Chile, Argentina, Uruguay, USA, France, and various states in Brazil. The first keynote lecture was delivered by Ernest Sarlet and was followed by Dr. Antonio Battro's paper on the possibilities of computers as a means for distance communication. During the Congress, a communication was established between Brazilian and Argentine children.

The next day Gustavo Silva and Miguel Rode from Uruguay talked about an investigation on model shaping in children. Catherine Berdonneau from France outlined a prospective view of the introduction of computers in the French schools. Then Lea da Cruz Fagundes told of her experiences in the Laboratory of Cognitive Studies, which is a group including mathematicians, linguists, psychologists, teachers and researchers. This interdisciplinary group is carrying on observations on children working with Logo. Jose Valente from Sao Paulo lectured on his work with disabled children.

Professor Horacio Reggini of Argentina talked about Marvin Minsky's concepts on the possibility of building complex structures on the basis of very simple ideas. Professor Reggini started his talk with brief references to the theme of the Congress -- "A New Perspective in Education for Everyone." In that sense, he recalled a paragraph written by N. Machiavelli in 1500 which applies to the insertion of Logo in the classroom: "There is nothing more difficult, and of more doubtful result, or more dangerous to deal with, than taking the initiative of introducing new modalities..."

The nucleus of Reggini's talk was the concept of Logo procedures as "society of procedures," or "society of agents," following the concept recently defined by Marvin Minsky. After stressing the relevance of intrinsic geometry and modularity, Reggini exemplified the role of "agents" in a collection of three-dimensional Logo designs. Using elementary building blocks and assembly procedures, he showed how different elegant and graceful objects may be created.

He compared the importance given by Minsky in his forthcoming book *The Society of Mind* to Papert's ideas.

Minsky's book includes a chapter named Papert's Principle, which states,

"Some of the crucial steps in mental growth are based not simply on acquiring new skills, but on acquiring new administrative ways to use what one already knows."

The procedures written by Reggini illustrate these principles in three-dimensional geometry, since the 3D designs shown result from the adequate joining and interaction of many small parts and processes.

Minsky's book will soon be published in English by Simon and Schuster, New York, and in a Spanish translation (*La Sociedad de la Mente*) by Ediciones Galápagos, Buenos Aires.

Seymour Papert gave the closing address in his usual thoughtful and humorous manner. Professor Papert discussed many of his thoughts about Logo including

- (1) the importance of simplicity,
- (2) the respectful acceptance of different ways of thinking, and
- (3) the need of making Logo projects one's own so that they become a source of discovery and new knowledge.

He also mentioned the concept of the invisible computer which has to lose the excessive importance it has had up to now.

During the closing event, several farewell messages carried the desire of repeating these meetings. All the attendants then held hands to keep a minute's silence for peace.

### Spanish Logo Book Published

Vector Ediciones has published *Logo: de la Tortuga a la Inteligencia Artificial*, a 590-page Logo book written in Spanish. This is among the more comprehensive Logo texts, presenting not only an excellent introduction, but also details of many Logo advanced applications.

The author, Luis Rodriguez-Rosello, uses an "English-speaking" Logo as the basis for the book, but defines procedures and variables with Spanish names.

TO HEXAGONO  
 REPEAT 6 [FD 40 RT 60]  
 END

Soon, however, superprocedures are calling the "Spanishly-defined" ones, leaving TO and END as the only English words appearing in many procedures. This interesting transformation to a near-Spanish Logo is more testimony to the power and extensibility of the language.

Excellent illustrations appear throughout the book.

For more information, write to: Vector Ediciones, Gutierrez de Cetina, 61, 28017 Madrid, Spain.



by Barbara Randolph

As we journey worldwide to gather new LogoPals, I would like to pause and acknowledge several teachers who have become "Ambassadors" for our LogoPal project. Through their interest and enthusiasm, they have successfully invited students of theirs to become involved as Logo penpals. Some of their students' "ads" were presented in last month's column.

I asked three of these teachers to share how their students happened to join, and why they encouraged them to become LogoPals.

Gloria Cathcart, is the computer coordinator and the teacher of grade three and the Academic Challenge students at the Lansdowne School in Edmonton, Alberta, Canada. Gloria chose the activity to be a voluntary one for students experienced with Logo. She herself is highly enthusiastic about Logo and has seen the learning that has taken place with its problem solving aspects. Through a collaborative group discovery process, which lasted well after school was out, some of her students were thrilled to solve an "intellectual challenge" last year. Gloria sees her students' involvement with LogoPals as an opportunity to extend that same collaboration worldwide.

John Schell is a visiting computer teacher for several elementary schools in Milwaukee, Wisconsin. His approach was to share the LogoPal project idea with the classroom teachers first, because he feels his students will benefit from their encouragement as well. Next, he recommended the LogoPals project to his students as an optional activity. In one instance, he wrote a detailed letter to a class of third graders about LogoPals. He expected that there would be plenty of questions when he saw them next. Three days later, he visited the class and their teacher, Dorothy Schneider - Fuelling, had over twenty letters already written by her students to their soon-to-be LogoPals. Talk about enthusiasm! John feels that there is not a lot of Logo time in the students' week, so the LogoPals is an activity that would broaden their Logo experience. As they write to their penpals, the students will exchange Logo ideas, or work on Logo problems that will generate even more excitement about Logo in the classroom. He also feels the writing activity alone is beneficial for his students.

Gwen Roberts is the computer lab teacher at The Open School: Center for Individualization, in Los Angeles, California. Gwen has made all the LogoPals columns available to her fellow teachers, and to her lab students. Those students who were interested were invited to get involved. Students of three teachers, B. J. Conn, Sybil Woods, and Judy Zaidner, decided to join LogoPals. Gwen sees the LogoPals as a way for

children to share about themselves, exchange Logo ideas, and as a means to facilitate communication with children from other places. She feels those far away places seem closer when new friends seem more "real" with each letter, becoming friends for her students to care about. Her students will share Logo designs, or animation, or project ideas. Gwen and her students are looking forward to seeing what students from different cultures are doing with Logo.

I'd also like to thank two teachers, Annika Levy and Nancy Williamson, from my son's former elementary school, Ancona Montessori School, here in Chicago. They allowed me to visit their students and tell them about LogoPals. I really enjoyed my visits!

The LogoPals project was also highlighted at a recent meeting of the Chicago Area Logo Network, now a SIG of the Illinois Computing Educators.

Teachers, if any of your students would like to become a LogoPal, have them send brief descriptions about themselves, to:

LogoPals  
Barbara Randolph  
1455 East 56th Street  
Chicago, IL 60637

Please enclose a stamped self-addressed envelope. Those outside the USA need to enclose international postal coupons for a 1-ounce or 28-gram reply.

In addition to students from the North America, I hope to hear from children from other continents. I've received requests from LogoPals for Logo students from places like Africa, Asia, and so on. If you know anyone with students of Logo around the world, let them know about the LogoPal children's network. You can become a LogoPal "Ambassador," too!

---

*Barbara Randolph is a librarian and instructional media center teacher in the Chicago Public Schools.*

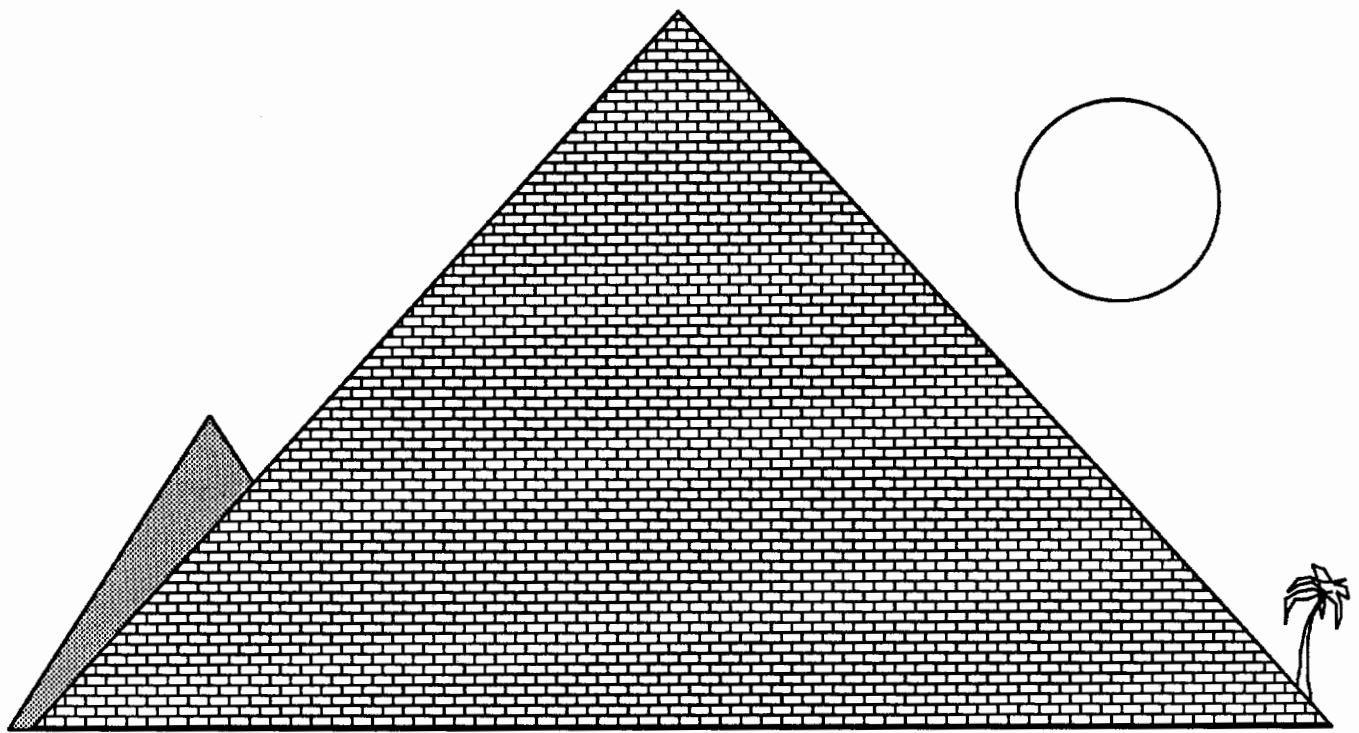
---

### East Coast Logo Conference April 2 - 4

The 1987 East Coast Logo Conference will be hosted by the University of Virginia, in association with Meckler Publishing Corporation and the Logo Exchange magazine. Scheduled for April 2, 3, and 4, at the Stouffer Concourse Hotel in Arlington, VA, the conference will focus on Logo classroom applications and the extensions of Logo into areas of related technology.

To receive a copy of the ECLC '87 advance program and registration materials, send your name and address to:

ECLC '87  
Meckler Publishing Corporation  
11 Ferry Lane West  
Westport, CT 06880



“If something’s not broken, don’t try to fix it . . . support it!”

- Ancient Turtylonian

Terrapin™ Logo, from the original Logo people, is the Logo of choice in education. Terrapin has developed the **LogoWorks™** series of curriculum support materials including *Logo Works: Lessons in Logo* and *The Logo Project Book: Exploring Words and Lists*. Terrapin is also developing a host of Logo tools and applications for its new **Logoware™** product line including *The Logo Data Toolkit*—many more are on the way. So you can be sure that Terrapin Logo is the best possible Logo to use as a foundation for *your* choice of Logo activities—to suit *your* classroom needs. Plus, with Terrapin’s 10-Paks, 20-Paks, networked version and district pricing, Terrapin is the best value for your money. Terrapin. The support you’ve been looking for!

***Terrapin Logo***  
***The Original Logo People***

Terrapin, Inc., 222 Third Street, Cambridge, MA, 02142 (617) 492-8816



# **\*\* Teacher's Pet \*\***



*"...the best robot I've ever seen..."*

—Seymour Papert, M.I.T. LOGO '85 Conference, Cambridge, Massachusetts.

*"We have found the Valiant Turtle's presence has increased the interest level of students and teachers in Logo, facilitated the understanding of Logo commands, and changed personal interaction during Logo work, providing students more time to share and discuss their observations."*

—June 1986 review in *The Computing Teacher* by Jim Ellickson-Brown, Mountain View Elementary School and Doris Mimnaugh, 4th grade teacher, Wilson Elementary School, Corvallis, Oregon.

Meet Valiant Turtle, state of the art in Logo programming! Controlled from your Apple II+, IIe, IIc, IBM PC, PCjr or Commodore 64 computer by an infrared beam, the Valiant Turtle requires no cords or wires to move. Create a design on the screen and watch Valiant draw it on paper! Watch as Valiant executes your commands in three dimensions. Plan some fancy footwork and choreograph a dance in Logo!

Valiant Turtle is the ideal learning tool for students learning Logo as well as a great introduction to the world of robotics. Valiant is simple to use and easy for even the very youngest Logo learner to understand. Complicated and sophisticated ideas are presented in simple, graphic form. Students build artificial intelligence concepts and learn to think about space and spatial relationships.

Valiant Turtle operates with most popular versions of the Logo language. Watch through Valiant's transparent plexiglass dome as the Valiant Turtle draws with extreme accuracy with its built-in pen. Valiant comes completely assembled with easy-to-read instructions and control software. Because it's so easy to set up and use, the Valiant generates much enthusiasm in the classroom! Young imaginations fly whenever Valiant Turtle enters the room!

The Valiant Turtle is available from Harvard Associates, Inc., 260 Beacon Street, Somerville, Massachusetts 02143. Harvard Associates provides full technical support for the Valiant. For more information, or to order your Valiant Turtle, please call (617) 492-0660.