# A A LOGO A EXCHANGE The Magazine for LOGO Activities Worldwide

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VOLUME 5 NUMBER 9

MAY 1987



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# Logoware<sup>TM</sup> from Terrapin

Be among the first to explore data handling through Logo with the all new Logo Data Toolkit from Terrapin. In developing Logoware products, Terrapin continues to extend applications of the Logo language into a wide range of subject areas. The Logo Data Toolkit, developed in conjunction with educator and Logo enthusiast Dorothy Fitch, is the first Logoware product to be released by Terrapin.

The Logo Data Toolkit contains comprehensive programs for gathering and manipulating data designed for a variety of classroom settings. The package contains a manual with descriptions of each tool program as well as helpful classroom activity ideas. The individual tools can be used "as is" or can be modified in the Logo environment to suit your own classroom and curriculum needs.





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- . . . . . . . . . .
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Four exciting projects incorporate each of the *Logo Data Toolkit* tools to collect and study data. These projects include A Look at Advertising, Studying Weather Patterns, Exploring Another Country and Learning More About Books. The projects can involve student groups or an entire class and can be carried out over a week or several months. An appendix contains useful information on Logo data structures, frequently used tool procedures and Data Conversion programs. Reproducible worksheet planning pages for each data tool are also provided.

There are versions of the *Logo Data Toolkit* for use with Terrapin Logo (both 64K and 128K files provided) and for Commodore Logo. Please indicate Apple or Commodore version when ordering.

Note: The Apple version of the Logo Data Toolkit requires Terrapin Logo version 2.0 or 3.0.

Price: \$49.95

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MAY 1987

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Cover: The design added to this month's cover was contributed by Mark Lindsey, a 5th grader at St. Anne's - Belfield School, in Charlottesville, VA. He constructed the design as part of a project with squares.	

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#### From the Editor by Tom Lough Does Logo Really Make a Difference?

"There were no significant differences between the Logo group and the control group..."

"It is not clear that Logo made a significant contribution to the performance of the subjects..."

These and similar statements appeared throughout the early Logo research literature. They tended to dim somewhat the bright promises Logo offered to the education community by *Mindstorms*. In fact, some educators even suggested a moratorium on Logo use until the "benefits" were discovered and documented.

As with most complex issues, there are many dimensions to it. One of the advantages of an editorial column is that I am not restricted to the strictly professional aspects of what I write about. I take advantage of that now.

I would like to relate some personal perspectives on Logo. These perspectives are not based on research, scholarship, or in-depth analyses. Rather, they are simply personal observations and reports on my experiences and how Logo has affected me. Even though n=1, I hope that you will find something in common with your own experiences.

My earliest Logo experience took place in the University of Virginia classroom of Steve Tipps and Glen Bull back in early 1982. It was my first encounter with the language. When they showed me that I could put the SQUARE and TRIANGLE procedure names as commands into another procedure called HOUSE, I was changed forever. Suddenly, modular thinking was never the same. I understood in a completely new way the power of breaking problems down into smaller, more manageable pieces.

And it was shortly afterwards that the idea for a Logo newsletter for teachers suggested itself. Of all the ideas I have ever had, this one has had the most impact on my life (with the exception of the idea to marry Posy!). Through the newsletter and now this magazine, I have met some of the most warm, caring, and competent professional educators in the world. I am convinced that the nature of Logo is mainly responsible for these wonderful interpersonal experiences.

Later the next year, I found myself in an airport lobby under renovation while on the way to a conference. You can imagine the confusion, the detours, the impatient crowds. I had a plane to catch, 43 gates away, and no idea how to get there. Time was running out. I saw a "you are here" map, which was utterly confusing. And then the idea entered my head to pretend I was the Logo turtle, and ask how to tell myself to go from "you are here" to the distant gate shown on the map. After deciphering the lefts and rights and forwards, suddenly it made sense to me. I made the plane, but barely. If I had not helped both students and teachers to "walk it out" while planning Logo procedures, I do not believe the idea to navigate the detour correctly would have entered my head. A couple of years later, I attended a talk by a speaker billed as a pure mathematician. Although the talk was interesting, I especially enjoyed the example problems he presented. I remember one in particular, in which he wrote a long and complex mathematical expression on the board. The speaker was commenting on how tedious and involved the algebra would be from that point on. However, as I was examining the problem, it occurred to me that it could be expressed and solved in a recursive manner. The mathematical expression became greatly simplified, and I was able to do the calculation in my head. I'm confident that I would not have thought of this idea unless I had been working hard to understand Logo's recursion.

While developing Logo tool procedures for my college physics classes, I stumbled upon a model for accelerated motion. The Logo procedure was so simple and elegant that it still enthralls me to this day. Moreover, I was able to extend the thinking which this procedure stimulated to a point where I can view the input of the FORWARD command as the value of (what is called in calculus) the first derivative of position with respect to time. From this, I was able to set up models of electric circuits with direct currents which grow and decay exponentially, and to draw these exponential curves with turtle graphics using only the ordinary arithmetic cperations. This personal experience has been fascinating to me, and I value highly the special learning Logo has made possible.

More recently, I enrolled in an artificial intelligence course this past semester at the University of Virginia. The course was a combination of artificial intelligence background, theory, philosophy, and programming projects with the Prolog computer language. Prolog is an interesting language which operates according to rules of logic given by the programmer. It requires a different way of thinking about programming and solving problems. Like Logo, it is a recursive language. In that regard, I was able to make quite a bit of progress in understanding how to do what I want in Prolog because of my previous understanding of recursion from Logo.

"None of the above" would probably show up on standardized tests as making a significant difference in my performance in various tasks. Yet, I *know* that my Logo experiences have affected me in a deep and profound way. I have grown cognitively, affectively, socially, emotionally. I have great difficulty in describing this growth, much less in measuring it. If I cannot understand how to measure that in myself, how can I ever hope to measure that in my students?

You don't suppose Logo is something we have to accept on faith, do you?

FD 100!

m

# Polishing Programs for Publication: A Neglected Step in the Logo Programming Process

by Molly Watt and Daniel H. Watt



Bill and Tanya's Logo sailboat presents a lively, pleasing picture. It shares their experiences and expresses their personal interests. It communicates in ways that remind us of our own experiences in small boats. Constructing and debugging the drawing took a lot of work, and completing it gives Bill and Tanya a great deal of satisfaction. For many Logo students and teachers, the project would be over.

But not for us. Behind the graphics is a Logo procedure which has the same possibility for expressing and communicating ideas as the drawing which appears on the screen:

#### TO BOAT

PC 2 BK 30 FD 150 PC 4 RT 130 FD 20 RT 130 FD 20 PC 1 LT 120 FD 150 RT 135 FD 90 LT 90 PU FD 19 RT 90 FD 100 RT 180 PD PC 3 FD 200 PC 2 RT 120 REPEAT 6 [FD 10 RT 10] FD 100 REPEAT 6 [FD 10 RT 10] FD 10 RT 30 PC 4 FD 25 PU RT 90 FD 227 RT 90 FD 40 RT 45 PD PC 5 REPEAT 6 [RARC 30 LT 90] PU LT 135 FD 255 RT 90 FD 5 RT 45 PD REPEAT 6 [RARC 30 LT 90] PU LT 135 FD 255 RT 90 FD 5 RT 45 PD REPEAT 6 [RARC 30 LT 90] PU LT 135 FD 255 RT 90 FD 5 RT 45 PD REPEAT 6 [RARC 30 LT 90] PU LT 135 FD 255 RT 90 FD 5 RT 45 PD

END

Without its name to give us a clue, we'd have no way of knowing what the procedure is supposed to do. And without playing turtle -- with painstaking attention to every detail -- a reader has no way to understand how Bill and Tanya constructed their boat, or to understand their problem solving process.

Before this procedure is shared with others, either in printed form or on a disk, we would suggest that Bill and

Tanya rewrite it as a set of subprocedures, so that each subprocedure has a name, reflecting its part of the overall design. For example,

TO BOAT MAST FLAG SAIL HULL WAVES END

In our book, *Teaching with Logo*, we show how this can be done easily, using the Logo editor.

Logo was developed with the idea that students of all ages could learn to express themselves in well-defined clearly named procedures and subprocedures. Each subprocedure's name would reflect its purpose in the overall design, thus giving each learner a clear expression of her own thinking and problem solving strategies. In practice, however, we have observed that this objective is rarely achieved the first time a program is written, even when a teacher stresses this style and provides clear examples of structured Logo programs for students to use as models. Some additional teacher intervention is required.

We are beginning to see the process approach to teaching writing as a useful model for teachers of Logo. Writing as a form of expression is at least as complex as Logo. We can take two ideas from research about the writing process in classrooms. First, we observe that students write more effectively, using better form, when they are writing for an audience. When students know that their writing will be read by many people in addition to their teacher, they work to make sure that their ideas are communicated as clearly as possible.

Second, we notice that the process approach to teaching writing is based on the ways that real writers approach their craft. It allows a writer to focus on getting the shape of the ideas first, before concentrating on correct spelling and syntax. In classrooms, this is often described as a five step process.

- 1. Prewriting
- 2. Generating ideas
- 3. Revising for meaning and organization
- 4. Polishing for grammar and spelling
- 5. Publishing

This seems to be similar to the approach of many adults we know who work in Logo. We rarely begin by

writing clearly articulated programs in an elegant top-down structured programming style. Our first programs are preliminary drafts, explorations to see if we can get something to work the way we want it to. If we decide to share our work, on disk or via printed media, we clean up our programs to make them easier to read, and to present accurately to readers our ideas about how our programs work.

Although revision is a separate step, carried out after our programs are fundamentally working, we often make other changes to our procedures to make them work more efficiently or to elaborate and enhance what they do.

In our *Collaborative Logo Research Project*, supported by the National Science foundation (Grant number MDR -8561600), we have begun to identify a Logo Programming Process which parallels the writing process.

- 1. Brainstorming
- 2. Choosing a project
- 3. Simplifying the project and making a plan
- 4. Identifying specific tasks
- 5. Creating first drafts of different parts
- 6. Putting the parts together
- 7. Embellishing and extending
- 8. Polishing and refining the programming
- 9. Publishing and sharing

Or, as Brian Silverman said to us recently, "It's just beautiful to see a well-structured program."

#### References

1. Daiute, C. Writing and Computers. Addison-Wesley, 1985.

2. Graves, Donald. Writing: Teachers and Children at Work. Heinemann, 1983.

3. Watt, Molly, and Daniel H. Watt. *Teaching with* Logo: Building Blocks for Learning. Addison-Wesley, 1986.

Molly Watt and Daniel H. Watt are teachers, lecturers, authors, and consultants in the field of educational computing. Write to them in care of Logo Collaboration Research Project, Center for Learning Technology, Education development Center, 55 Chapel Street, Newton, MA 02160.

#### West Coast Logo and Telecommunications Conference Held

Los Angeles was the site of the second West Coast Logo Conference in early March, joined this year by an enthusiastic group of educators interested in telecommunications. A crowd of over 700 people attended a wide variety of sessions. Keynote addresses by June and Bernie Dodge, David Thornburg, and Seymour Papert provided memorable accents to the occasion. Hosted by Pepperdine University, in association with a number of educational computing organizations, the conference provided an opportunity for professional growth in many directions.

#### East Coast Logo Conference Held April 2 - 4

The East Coast Logo Conference '87 was attended by more than 500 people over a three day period. The conference was hosted by the University of Virginia, in association with Meckler Publishing and *Logo Exchange* magazine. A half-day set of "warm-up" activities organized by Judi Harris (including juggling, recursion plays, singing, math manipulatives, LEGO Logo, and Logo video tapes) set the tone for the conference. Over 80 presentations and 7 special interest group meetings provided opportunities for information interchange. A special evening of entertainment included Logo songs led by Peter Rawitsch, and Logo plays and contra dancing led by Dan and Molly Watt. The program culminated in an exciting address by Seymour Papert.

#### East Coast Logo Conference Reflections by Sharon Burrowes

The conference was over. I'd said farewell to new friends and old...and begun the drive through rain and then snow from Arlington Virginia to Ohio. Before I had even left Virginia, the post conference "let down" hit. I'm sure you all know the feeling -- wondering where those few days went and why you never managed to do quite all of the things you planned.

However, by the time I reached the mountains of Pennsylvania, I began to reflect how I could best share the "feeling" of this this conference. Of course there were many familiar faces, some superb sessions, and delightful new ideas. But what made the ECLC unique?

Those of us who attended will all laugh about the construction equipment at every corner and the mud puddles at every turn. We'll all remember our many jaunts up the stairs to sessions and then back down to the exhibit area. But, every conference has its unique setting.

For me, there was a different flavor at this conference. For example, at what other Logo conference could you learn to juggle? Or listen to songs about how to get the "bat out of your bath" (using BUTLAST, of course). How about the dancing that included children and adults, both familiar faces and new ones. Or watching as a group of people "played Logo" to sing Old MacDonald? How often can you attend sessions filled with Logo thinking, only to realize as you leave that you saw not one line of Logo code?

Different, you say? But similar, too. We shared ideas. We shared our Logo success stories. We discussed our similar frustrations. And, of course, Seymour's speech, enhanced by a large screen display filled with ever changing and evolving patterns of colored squares, was a high point for us all.

We sang, and danced, and laughed, and learned. What more could you ask?

How long until ECLC '88?

# **Tipps for Teachers**

#### by Steve Tipps

### **Random Revisited**

Flipping coins, spinning spinners, and rolling dice are three methods of generating random events. Random events provides the basis for the study of probability which later provides the basis for inferential statistics. In elementary and junior high, students need to explore and to expand ideas about randomness. Last month, several random experiences were presented for random movement of the turtle using a Logo die simulation. This month, the topic of random continues.

#### Spinning Wheel

Children enjoy spinners in playing many games. Working with real spinners is important because students need to recognize the important that variables such as the free movement of the spinner, the flatness of the spinner, the strength of the spin, and the number and relative size of the areas play in determining whether the spinner is fair.

However, using a real spinner to work out theoretical probabilities can be a pain in the finger. A Logo spinner is a good substitute. It involves making a spinner board and then causing the spinner to spin.

> TO SPINNER.BOARD CS SETPC 1 PIECE SETPC 2 PIECE SETPC 3 PIECE SETPC 4 PIECE SETPC 5 PIECE SETPC 6 PIECE END

TO PIECE REPEAT 30 [ FORWARD 40 BACK 40 RIGHT 2] END

TO SPIN HOME SETPC 0 RIGHT RANDOM 360 FD 30 END

With these procedures, a 6 segment board is created with each segment a different color. The arrangement of colors might be better or the size / number of segments can be arranged.

SPIN is used to generate values. At first this can be done manually by typing SPIN 60 times and recording the results for each spin. The expected values for the spinner would be 10 times for each color. This is also known as the "theoretical" probability. You might determine how fair the Logo spinner was by comparing the "theoretical" probability to the observed probability of the actual spins. A chart is useful in organizing the results.

	WHITE	BLUE	ORANGE	GREEN	PURPLE	REVERSE
Expected	10	10	10	10	10	10
Observed						

The observed probability should become closer and closer to the expected if the spinner is fair. However, typing SPIN 120 or 2000 times to find out is just as tiring as flicking the spinner 2000 times. Wouldn't it be nice to have Logo spin and count the spins while you were busy with another task? Then you could eat lunch or do a science experiment while it was doing the repetitions. You could even let Logo work all night and report the results to you the next morning.

The spinner has six possible answers, just as a die does. Rather than work with the spinner, keep track of the numbers from 120 rolls of a die. This activity is developed in "Rolling Dice" in *Nudges* by Bull, Tipps, and Riordon (Holt, Rinehart and Winston, 1985). How would you adapt this activity for a spinner of four equal sections or a die with four sides instead of six?

#### **Heads Plus One**

Students should recognize that this repetitive task is a perfect one to assign the computer. Another way to keep track of the actual flips involves making a counter for coin flips. Begin with one coin flip.

TO FLIP OUTPUT 1 + RANDOM 2 END TO FLIP.COIN TEST FLIP = 1 IFTRUE [ OP "H] OP "T END

The coin flip now can become the basis of another random exploration with binary outcomes. The coin will be either heads or tails.

> PREPEAT 20 [ PRINT FLIP.COIN] H H T

The expected outcome would be 10 heads and 10 tails. If the experiment is repeated 10 times, most of the observations should be close to 10/10 but some may actually be as far off as 5/15 or 16/4. Such extreme outcomes are unlikely, but they are possible.

If the coins are fair, flipping one coin 10 times should have the same possible outcomes as flipping 10 coins 1 time. Try actually flipping 10 coins at once and counting the heads and tails. You may find that you spend as much time picking up the coins off the floor or hunting for them as you do counting. The computer does not lose the coins however. You can make it flip two or three or ten coins at once. However, you need to think carefully about the possible outcomes.

#### Two at a Time

Begin with only two coins. If you flip two coins at the same time, the possible outcomes for each coins is still H or T. However, together the possible outcomes look a little different because the result is not simply H or T. It is a combination of the H and T of two coins. Flip two coins several times. You should see that the observed outcomes can be TT, TH, HT, or HH.

If order is not important in the result, HT and TH are the same result. Although four outcomes are possible, only three are unique. The expected probability is not 33% however. The theoretical probability is 25% for TT or HH and 50% for one head and one tail. Try the Logo simulation for flipping two coins.

> TO TWO.COINS PRINT SENTENCE FLIP.COIN FLIP.COIN END

?REPEAT 100 [ TWO.COINS WAIT 20] H T H H T H

•••

This displays the result of 100 double flips. Counting the results is not too difficult, although a counter would be better. Tally the actual frequency of two coins to see whether the result conforms to the expected values.

#### Three Coins

When three coins are used, the counter becomes almost a necessity. Try out a few of the three coin experiments to make sure you know what all of the results are. Have students list all of the possible results and group them into ones which are unique. The list will include eight possible outcomes but only four unique ones: TTT, THT, HTT, TTH, HTH, HHT, THH, and HHH.

Although you could extend the TWO.COINS method to include three coins, the demands of a counter suggest a different plan. Create counting variables and initialize them to 0.

> TO SETUP MAKE "NO.HEADS 0 MAKE "ONE.HEAD 0 MAKE "TWO.HEADS 0 MAKE "THREE.HEADS 0 END

TO THREE.COINS MAKE "TAILS 0 MAKE "HEADS 0 FLIP.THREE PRINT (SE :ONE :TWO :THREE) END TO FLIP. THREE MAKE "ONE FLIP.COIN MAKE "TWO FLIP.COIN MAKE "THREE FLIP.COIN END TO COUNT.SIDES TEST :ONE = "H TALLY TEST :TWO = "H TALLY TEST : THREE = "H TALLY REPORT **KEEP.COUNT** END TO TALLY IFTRUE [ MAKE "HEADS :HEADS + 1] IFFALSE [ MAKE "TAILS : TAILS + 1] END TO REPORT PRINT SE "HEADS :HEADS PRINT SE "TAILS : TAILS END TO KEEP.COUNT TEST :HEADS = 0IFTRUE [ MAKE "NO.HEADS :NO.HEADS + 1 STOP] TEST :HEADS = 1IFTRUE [ MAKE "ONE.HEAD :ONE.HEAD + 1 STOP] TEST :HEADS = 2IFTRUE [ MAKE "TWO.HEADS :TWO.HEADS + 1 STOP1 TEST :HEADS = 3IFTRUE [ MAKE "THREE.HEADS : THREE.HEADS + 1 STOP] END ?SETUP ?REPEAT 100 [ THREE.COINS COUNT.SIDES]

After the heads and tails are counted, you need a handy way to display the results.

TO DISPLAY PRINT (SE "HHH :THREE.HEADS) PRINT (SE [ HHT HTH THH] :TWO.HEADS) PRINT (SE [ TTH THT HTT] :ONE.HEAD) PRINT ( SE "TTT :NO.HEADS) END **?DISPLAY** HHH 7 HHT HTH THH 30 TTH THT HTT 34 TTT 9

The experiment can be repeated 10 or 20 more times. Collect the individual experiments and note the largest and smallest value for each set of answers. Also accumulate all the results. You should begin to get close to values of .125, .375, .375, and .125.

#### More Change

Extend the experiment to includes 4 or 5 coins. After the model is established, students should be able to add more cases to it. As they look over the possible combinations, they may find a pattern, especially if they organize the results in a chart.

> 1 1 One Coin 1H and 1T 1 2 1 Two Coins 1HH, 2HT, 1 TT 1 3 3 1 Three Coins 1HHH, 3HTT, 3THH, 1TTT 1 4 6 4 1 Four Coins 1HHHH, 4HHHT, 6TTHH, 4THHH, 1TTTT

A pattern such as Pascal's triangle helps students organize their ideas and predict other possibilities. More coins means more change and many experiences with probability. Logo makes change easy and fun. RANDOM makes it exciting!

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.

#### Logo Fellowship Winners Announced

Keith Lawrence Abbott and Mary Upton have been named recipients of Logo Fellowships to study at the University of Virginia this summer. Funded by a grant from Logo Computer Systems, Inc., the fellowships are awarded on a competitive basis to selected applicants to provide an opportunity to come to the University of Virginia for a period of residence and work on a self-designed Logo project.

Keith Abbott is an assistant principal at Wellington Junior Secondary School in Nanaimo, British Columbia, Canada. Mary Upton is a computer programmer and teacher trainer in the Lubbock (Texas) Independent School District.

Information about the next cycle of Logo Fellowships will be mailed out in mid-October. To receive this information, send a self-addressed mailing label to: UVA Summer Logo Fellowships, Attn: Tom Lough, Dept of Educational Studies, Curry School of Education, 405 Emmet Street, Charlottesville, VA 22903-2495

# Teacher Feature by Rebecca Poplin Featuring: Penny Rendall

#### Tourist Attraction in St. Paul

Planning a summer trip? Recently, students in Penny Rendall's class created an ideal vacation spot for Logo lovers, the town of Logoville. In Logoville you could see a movie at Appleup Theater, get copies printed at Stamp Copying Company, and plan your remodeling at Setbackground Wallpaper Store. Later, you could take a break at the Spacebar Cocktail Lounge then go to your room in the Embassy Turtles Hotel. On the weekend, you might take the family to Turtleson Monument, gaze at Mount Rushturtle or visit the FD 100 Racetrack. Logoville was a monumental effort and just one of many exciting learning experiences in Penny's class.

Penny Rendall is a fifth grade teacher and Logo resource teacher at Groveland Park Elementary School in St. Paul, Minnesota. Under the direction of Gerri Kozberg, St. Paul schools have made a major commitment to Logo and LogoWriter. As one of the first teachers trained, Penny has participated actively in teacher training, has conducted seminars for parents, and has been a facilitator for the St. Paul Summer Logo Institute.

#### **Timetables and Schedules**

Penny feels that computer time should be deeply integrated with classroom work. She has two computers which students use throughout the day in 15 minute intervals. Although a schedule is kept, time and computer use are flexible. Students can choose whether they want to use the computer. Most often, there is a specific project or a real purpose for computer use. For example, students might be asked to create a book report using STAMP to illustrate the report. Each week, computer sharing time enables students to show what they have been working on or for Penny to introduce a skill or primitive.

#### Excursions

Recently, students have been using LogoWriter to help them travel back to the time of the early settlers. As part of a social studies project, each child or group organized a class presentation which included a computer program. For example, one group working on early medicine developed a true false test using the word processor function of LogoWriter.

One of Penny's students discovered that several countries have exactly the same flag with different colors, so he created a graphics program about the flags. Program users are to guess which country the flag represents.

A project directed by one of Penny's colleagues was called "Peace and Peacekeepers." Students did research on

famous people who worked for peace. Using the computer, they wrote essays and created symbols to represent peace and the person they learned about.

#### Science World

Three weeks are set aside at Groveland Park to have all the computers together in a lab situation. Cathy Overby, the science teacher, introduces many new computer skills and interfaces measuring instruments with LogoWriter. One recent project involved using the paddle port hooked into a thermometer and having the data read onto a chart. Since Cathy is the science teacher for grades K-6, she found that she needed extra help during computer lab time, especially with the kindergarten children. Penny helped work out an interesting solution to this problem. She began a project called Turtle Tutors.

#### **Tour Guides**

Turtle tutors are third and fourth grade students who work with the kindergarten class. Becoming a tutor wasn't easy. An application process resulted in selection of 25-30 students. Tutors received special training and learned special Turtle Tutor Tips: Never press the key for the student; point or give clues instead. Always sit next to the student; be at their level. Penny adapted an idea from *Instructor* magazine for the tutors. It is the 3P method: Pause, Prompt, Praise. Penny is planning to do some role-playing with the tutors and will also go over lesson plans with them so they will have a purpose for going into the kindergarten class.

#### A Wider World

Penny Rendall feels that teacher training is vital to Logo's success. If teachers aren't trained and don't feel ownership, Logo could become another game or word processor rather than a philosophy. The effectiveness of teacher training depends on how it is presented. The watchword in St. Paul is "Logolike thinking."

As a part of a week-long seminar on LogoWriter, teachers toured businesses where Logolike thinking was going on. Some went to an artificial intelligence lab while others went to a publishing company or to 3M. Penny's group visited a neonatal center. Teachers studied the kinds of activities taking place in these business and analyzed skills they are now teaching for their relevance and effectiveness. Logolike thinking is a part of the planning for teacher training, too.

Penny believes that Logo has changed her in the past five years. Since learning Logo, she has become excited about discovery learning and has developed a deeper appreciation of how students learn from each other. In addition, her perspective about Logo's place has changed. She believes even more strongly that it is important to integrate computer use into the curriculum. Unless the computer is part of social studies or language or writing, it can become just another add-on. In nearly any job students take, they will be using a computer. It will be an integral part of their lives. Computers in education must be integrated with everything we do and be a natural part of the learning environment.

If you would like to know more about Penny Rendall or the Logo program in St. Paul, contact:

> Penny Rendall Groveland Park Elementary School 2045 St. Clair St. Paul, MN 55105

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

#### Logo Notices

Learn Logo with the Logo Exchange columnists at the University of Virginia this summer. Two courses are being offered, both for graduate credit. Introduction to Logo (EDES 547, 1 graduate credit) will be taught by Judi Harris, author of "Logo LinX" column in Logo Exchange magazine, July 6-10, 1987. Logo in the Classroom (EDES 548, 3 graduate credits) will be taught by Glen Bull, author of "Teaching Tools" column in Logo Exchange magazine, July 13-31, 1987.

The latter class will have the opportunity to meet and work with the 1987 Logo Fellowship recipients. For additional information write:

> Peggy Marshall Curry School of Education University of Virginia 405 Emmet Street Charlottesville, VA 22903-2495

Dan and Molly Watt will host their summer Logo Instutite in association with Union College in Schenectady, NY, August 3 - 16. Institute participants will receive 4 graduate credits upon completion. The institute closes with a two-day conference, August 15 - 16. Separate registration is available for the conference, which features many well-known Logo leaders. For more information and registration materials, write to: Logo Institute, Union College, Graduate and Continuing Studies, 1 Union Avenue, Schenectady, NY 12308.

Two one-week long advanced Logo institutes for teachers will be held at the University of South Alabama, July 6 - 10, and July 13 - 17, 1987. Registration costs \$595 with lodging, and \$470 without lodging, and includes all meals and materials. Each institute is limited to 20 participants. IBM Logo will be used. Instructors are John Strange and Mary Ann Robinson. For more information, write to: Dr. George E. Uhlig, Dean, College of Education, University of South Alabama, Mobile, AL 36688, or call (205) 431-6535.

# **Teaching Tools**

by Glen Bull and Paula Cochran Poetic Justice

SUMMER IS HOT SUMMER IS A BUTTERFLY ON MY SWING

SUMMER IS CLEAR SUMMER IS A BIRD UNDER THE TREES

SUMMER IS ENDLESS SUMMER IS A SUNBEAM IN THE GRASS

The success of a Logo activity depends more on the teacher than on the Logo code she uses. Two teachers can use identical Logo procedures with a class, but get very different results. This is true not only of Logo but of all teaching activities, and comes as no surprise. In this column, we would like to identify some of the procedures (teaching procedures, not Logo procedures) that enhance a Logo activity. As an example, we've chosen a short Logo poetry program. In this column, we plan to present some ideas for how to do justice to a Logo poetry activity.

#### The (Logo) Procedures

The procedures which generated the verses at the beginning of this column will be familiar to many of our readers. (See the "Listful Thinking" columns in the October 1984 and April 1986 issues of the *National Logo Exchange*.) Only three or four procedures consisting of a line or two each are required to generate poems like these.

> TO POEM PRINT SENTENCE [SUMMER IS] ADJECTIVE PRINT SENTENCE [SUMMER IS A] NOUN PRINT PLACE PRINT [] END

TO ADJECTIVE OP PICK [HOT SUNNY BRIGHT FUNNY WARM ENDLESS CLEAR COLORFUL FULL]

END

TO NOUN OP PICK [FROG KITE BIRD BUTTERFLY SUNBEAM CLOUD DAISY] END

#### TO PLACE

OP PICK [[IN THE GRASS] [UNDER THE TREES] [IN THE PARK] [AT A PICNIC] [BEHIND OUR HOUSE] [ON THE PLAYGROUND] [IN THE WOODS] [ON MY SWING]] END TO PICK :LIST OUTPUT ITEM 1 + (RANDOM COUNT :LIST) :LIST END

After the procedures have been typed into the computer, type POEM to see a computer-generated poem.

?POEM

•••

You can add your own words to the ADJECTIVE, NOUN, and PLACE procedures to for more satisfying results.

#### The (Teaching) Procedures

I. Lesson Preparation

The first step in preparing any sort of instructional activity is to choose appropriate objectives. If the teacher is planning an activity for English class, then her objectives should focus on English. This is true for Logo activities that are being used to explore any aspect of a regular content area, such as science, math, or language arts.

What are some appropriate language arts objectives that could be addressed through a Logo poetry activity? How will these objectives be addressed? There are many possibilities, ranging from goals directly related to poetry forms, such as rhythm and rhyme patterns, to goals related to grammatical forms such as nouns and verbs:

- Synonyms and Antonyms

- Article and Noun Agreement

- Mass Nouns vs Count Nouns ("some" popcorn vs "a" potato chip)

- Grammar and Parts of Speech (adjective, adverb, prepositional phrase)

- Poetry Elements (metaphor, simile, alliteration)

- Poetry Forms (haiku, sonnet, limerick)

- Practice with Dictionary and Thesaurus Skills

The same basic poetry activity can be used with the class, but the focus of the activity will depend on the teacher. For example, a goal could be to practice using a thesaurus.

How many words can you think of that mean "hot"? Summer is hot; how many other words could we use to describe summer and make our poems more interesting? The activity of trying to think of synonyms for "hot" for our Logo poems provides an incentive for consulting a thesaurus. This even happened spontaneously in one middle school class.

In a quick foray into *Roget's Thesaurus* we found the following HOT words which describe summer:

torrid, muggy, sunny, sultry, stuffy, humid, sticky, broiling, warm, toasty, tropical, burning, scorching, scalding, blistering, roasting, simmering, broiling, sizzling, smoking, blazing

> SUMMER IS SULTRY SUMMER IS A LEMONADE ON THE PORSCHE

It is also desirable to involve objectives from other content areas. If the class is studying Italy in social studies, students can generate poems which incorporate vocabulary associated with Italy (Mediterranean, classic, Rome, Venice, olives, forum, coliseum, Pantheon, pizza).

Besides choosing objectives for the activity, the teacher should prepare the Logo procedures and have them ready on a disk. The teacher can seed the activity with a set of starterwords in each poetry procedure (POEM, NOUN, ADJECTIVE, PLACE).

#### II. Logistics

The instructional objectives we mentioned are especially appropriate when Logo poetry is used in a group activity. It is certainly possible to have very successful lab experiences with Logo poetry, where one or two children at each computer work on their own poems, starting with the core procedures (tools) on disk. However, Logo poetry makes a wonderful, interactive group activity as well.

If you have one computer in your classroom, you can do Logo poetry with 3 or 4 students at a time clustered around the monitor. It is possible to expand this for a larger group by making use of a 25 inch TV. The TV can be attached to the computer, permitting up to 20 or 25 students to see the poems. Most schools already have televisions for viewing instructional video tapes.

Another possibility for use with large groups of students is a projection pad. This is a new device which can be used to project the computer image with the aid of an ordinary overhead projector. The image appears on a screen just as an overhead transparency does. The Kodak DATASHOW is one example of such a projection pad. At the time of this writing its retail price is about \$1200. In other words, for the cost of one more computer, a school can purchase the ability to use a single computer with a large number of students.

#### III. Class Activities: Pre-Computer

The first part of a Logo poetry activity should occur away from the computer. The group should discuss the topic of the poems. This is a chance for the teacher to assess whether the class really knows enough about the chosen topic to think of good words and ideas for the poems. Vocabulary items that arise during this brainstorming session can be listed on the board for use later in the Logo activity.

#### IV. The Computer Activity (Finally)

The class may do the Logo activity in a laboratory setting, or students can take turns adding to the poem at a single computer station in the back of the room. If so, it will be necessary to have some written instructions which nudge the student in the desired direction.

The Logo exercise may also be conducted as a group activity, with several children or an entire class watching the screen. The teacher can type students' suggestions as they volunteer them, or choose a student helper to do the editing. This activity works well when an assistant types the words into the appropriate procedures as the teacher coordinates the class discussion.

First the class should look at several poems generated with a starter-kit prepared by the teacher:

#### REPEAT 4 [POEM]

Soon it becomes clear that the computer is choosing the same words over and over again. The students are invited to add their own words to the poem. For example, the teacher could edit the NOUN procedure, and add words suggested by the students which are associated with summer.

The teacher must serve as a facilitator, and focus the activity on the objectives she has chosen. For example, the goal of the activity could be to work on number agreement between nouns and articles. Sooner or later a student will suggest a word (e.g., GAMES) which will not agree with the article (e.g., A) in the poem. Rather than pointing out that some words do not fit the teacher types them in along with all the rest.

As more poems are generated with the new words, eventually a poem will appear which contains the word that does not fit. Usually it is obvious that something is wrong:

> SUMMER IS SIZZLING SUMMER IS A GAMES IN THE PARK

Often the class will recognize the problem, if not the solution. Then the teacher can help them determine how the problem might be resolved. The class could remove the article from the second line:

SUMMER IS SIZZLING SUMMER IS GAMES IN THE PARK

Another possibility is to completely remove the offending noun from the NOUN procedure. Or, the class could change GAMES from plural to singular, and agree to use singular nouns throughout the poem. After the discussion, the class can vote on which approach they would like to take. The point of the discussion is to allow the students to think about how language works. Students in the class remain very interested in the language generated, because each one is waiting for HIS own word to appear on the screen.

#### V. Class Activities: Post-Computer

After the lesson, poems can be used as the inspiration for other classroom activities. The class may want to vote for favorite verses and put them on the bulletin board. In the lower grades, students can illustrate their favorite poems and turn them into greeting cards, posters, or booklets. In the upper grades, poems may find their way into the school newspaper. In all cases, copies can be provided so that students can share their work at home.

After the group activity, older students may continue to develop other poems on their own. As an advanced exercise,

students could be asked to modify the form of the poem itself. For example, they could create poetry about a different topic, such as their favorite sport or rock star. The structure of the poem could be modified; haiku is a favorite choice because the structure is short and easy to explain. In high school, students can be challenged to create a poem with a specified meter. Writing a poem that only generates iambic pentameter is a challenge, and leads to examination of English prosody even if the poem generator is not perfected.

Students can participate enthusiastically in a group Logo poetry activity without knowing anything at all about Logo. Students do not even need to know a great deal of Logo in order to participate in Logo poetry activities on their own. It is necessary to show students how to turn on the computer and load Logo, and how to use the Logo editor. If Logo poetry tools are provided on a disk by the teacher, students can begin creating their own poems in the first class session.

#### Summary

A teacher could start with many other Logo poetry procedures. Rather than having procedures named NOUN, ADJECTIVE, and PLACE, a teacher could just as easily create procedures such as COLOR, SCENT, and TEXTURE:

#### PURPLE SMELLS LIKE VIOLETS IN A VASE PURPLE FEELS LIKE VELVET AND OLD LACE

Logo poetry tools can also be integrated into language arts activities in many other ways. We have provided a few concrete examples to illustrate the important role of the teacher. If a teacher waited for a class to spontaneously invent the poetry procedures, she would wait a long time, and she would have to spend many weeks teaching Logo programming skills. If a teacher simply hands the Logo poetry procedures to the class without direction or guidance, the learning which may take place is unpredictable. Some students may learn about articles, some may learn about metaphors, and some may not learn anything at all. The teacher is the one who must provide the structure in which discovery takes place.

This is as true of Logo in math class as it is of Logo in language arts. This column has been about Logo teaching tools. No matter how elegant or ingenious Logo tools might be, they depend on the classroom teacher for effective results.

Hope your summer is bright, sunny, and (seemingly) endless.

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 :MORE.PROJECTS by Elaine Blitman

and Barbara Jamile

Our collection of Logo activities grows daily. Some bring chuckles, others admiration for the creativity and diligence of elementary students. This month we have several projects to share illustrating the variety of Logo applications in the classroom.

#### **A Shared Experience**

The first graders in Donna Hayes' classroom have been working with LogoWriter since September. Initial experiences were with word processing; now they're exploring with the turtle and combining the two modes. For this project, Donna took the class to the middle school's computer lab so that she could see how they understood the effects of the REPEAT command which they had been exploring during independent work periods on their classroom computers. Working with partners, they provided the number inputs for REPEAT \_\_\_\_\_\_ [FD \_\_\_\_\_ RT \_\_\_\_\_]. The children then were asked to write about the figure their inputs produced.

The teacher was pleased with this project because she could check on each partner's perception of the REPEAT command, and each student left the lab with a finished project combining problem solving and creative writing. Following are a few samples of the first grader's results:



Kathy and Nani

This is my star it is trying to look like a snow flake.



#### Integration with the Art Curriculum

Art teachers Dee Van Dyke and Betty Jenkins used a "castles and dragons" theme this year for a number of kindergarten through fourth grade art activities, culminating in an art show with a fantasy theme. Interest ran high and carried over into many subject areas. Third and fourth graders, working in teams of two with LogoWriter, produced the following stories and graphics during their free time as a follow-up to their art work.



#### **Integration with Social Studies**

Computer resource teacher Paola Williams works with classroom teachers to develop computer activities that relate directly to the curriculum covered in the classroom. The following project was part of the study of the Polynesian migration of the first people to Hawaii. With LogoWriter, fifth graders Diane Kim and Sachie Sullivan made the islands from sprite shapes which were stamped in place, and used LABEL to identify the islands. The arrow is animated and shows the migratory routes believed to have been used within the Polynesian triangle.



A sixth grade class studying the American colonial period wanted to make a database of the information they had found about the colonies. Since most of the students had quite a bit of experience with both Logo and databases, Paola asked them to write their own database system using Logo II. She provided some tools and examples of how lists and their properties work. The results were outstanding. Sharing ideas about the applications of Logo among teachers, students, and other schools has been important to the growth of our Logo program. Ideas are sometimes adopted without change, but more often they're built upon or revised to meet special needs. The more experiences teachers and students have, the better they are at finding new uses for Logo and computers. Creativity flourishes in the Logo environment where the computer truly becomes a tool for the mind.

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 Educational Objective: Fun!

Did I hear you "harrumph"ing as you read this month's subtitle? For shame! Isn't *fun* in your district's standardized curriculum? It should be. "Go tell my principal," you say? OK. Tell him/her that it's really divergent thinking development, or creative design. But you, your students, and I will know what the *real* objective is.

Yes, fun *can* be worked into the traditional curriculum, from kindergarten through graduate school. You already know that. You try your best to make learning fun for your students; isn't that, after all, part of the reason that you use Logo with them? Making an activity fun is an excellent way to motivate learning in all traditional subject areas. But I'd like to look at fun from a different perspective.

If an activity is fun, then it probably fulfills an intellectual, psychological, physical, or spiritual need. This kind of fun isn't manufactured to encourage better spelling or help children to memorize the multiplication tables; it is inherent in the activity itself. If something is fun to do, then I believe that it has a rightful place in a student's schedule.

Is this heretical talk? Not really. Underlying this argument is a very basic assumption: human beings, when provided with a rich environment of possibilities from which to choose, naturally seek out learning experiences that they need. Such Piagetian reasoning must not seem unfamiliar if you have perused the pages of *Mindstorms*. Learning is an inherently pleasurable, self-fulfilling activity.



#### Or this?

This *fun* Logo project was inspired by a wonderful little book by the title of *Droodles*. (Price, R., Los Angeles: Price/Stern/Sloan, 1953.) The original designs for the droodles displayed in this article were taken from the line drawings in that delightful little volume. The author defines a droodle as "a borkey little drawing that doesn't make any sense until you know the correct title." (Price, p. 2.)

By the way: the first design is a "Mended Doughnut." The second one is a "Man in a Tuxedo who Stood Too Close to the Front of an Elevator." As you can see, the droodle is no fun without the label.

#### Droodle LinX

If the Curriculum Enforcement Committee is breathing down your neck, try a droodle that is integrated into the social studies curriculum: (Inside view of Napoleon's coat) Droodles can even get quite philosophical:

(The world outside as seen by a little person living inside a beer can)

But, most of all, Droodles are mind-stretchers, and therefore appropriate for both enrichment and remedial groups.



#### **Droodle Logo**

Droodles can be drawn in the immediate or delayed (procedure) mode, and labeled with a simple PRINT statement. Droodle captioning can be a group or individual activity, and droodle displays draw many admirers. Droodle printouts also make unusual Mother's or Father's Day presents. I hope that by now you are convinced that droodles have a rightful place in The Curriculum during these happy spring months. If that insistent administrator still raises an eyebrow when he/she sees "Logo Droodles" in your plan book, remind him/her what educational objective Roger Price quotes for droodling:

"You will find that droodling will help you to withstand the pressures of a troubled and complex world, develop your character and your motor ability, and make you more selfreliant..." (Price, p. 48)

Now, I ask you, who needs any more reason for "having fun" than that?

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

Uri Leron's article, "Logo Today," which appeared in *The Computing Teacher* in 1985, propelled Uri into the limelight within the Logo community. His presence on the West Coast at Berkeley last fall provided an opportunity for an invitation to come to Vancouver and share his current views on Logo with members of the BC Logo User Group. While here, Uri and a number of my mathematics education colleagues had a chance to discuss the topic of the relationship between Logo and mathematics. Those discussions led to my invitation to Uri to write a column about that topic. I also had an ulterior motive in making the request: I am to teach a Logo / mathematics course to graduate students during the summer of 1987 (it begins just about the time this column will appear), and I wanted the benefit of Uri's ideas and thoughts on the 'intersection' of Logo and mathematics. I was not disappointed when I received Uri's article, as he has begun to capture some the mathematical essences inherent in Logo.

> On the Mathematical Nature of Turtle Programming by Uri Leron Department of Science Education Technion Israel Institute of Technology Haifa 32 000, Israel Bitnet: TTR0128@TECHNION

The invitation from Sandy to write this column gave me an opportunity to reflect once more on what I think is the fundamentally mathematical nature of programming with the turtle. My emphasis will thus be on fundamental processes of mathematical thinking, rather than specific subject matter.

#### What's in a Rectangle?

Let me start by considering a procedure that 11-year olds can typically write on their own after a few weeks (or months) of learning Logo:

#### TO RECTANGLE :SIDE1 :SIDE2 REPEAT 2 [FD :SIDE1 RT 90 FD :SIDE2 RT 90] END

In my view, the most important observation about this procedure is that it is a definition of the concept "rectangle", spontaneously written by a child in a formal language. I shall return to the "formal language" part later. For now, note that in writing this definition on her own, the child demonstrates a certain level of knowledge of all the following facts pertaining to any rectangle: It has four sides; the two pairs of alternate ("opposite") sides have equal lengths; all the angles measure 90 degrees; it is composed of two congruent parts, namely the parts drawn by the REPEATed list.

In contrast, recall how hard it is for children to just repeat correctly - let along create on their own - formal definitions in their regular geometry classes. Why the difference? Briefly, I mention two sources. First, the Logo style is mostly *procedural* (how to *do* a rectangle), whereas the standard mathematical style is mostly *declarative* (what *is* a rectangle). The children can "act out" the Logo procedure in reality or in their minds, thus rendering it more intuitive and meaningful. (This activity is usually referred to as "playing turtle".) Secondly, due to the nature of the interaction with the computer and the feedback given by it, children can arrive at the definition by successive approximations, and do not have to "get it right" the first time around.

#### Intuition and Formalism

But the point is not learning geometry, and even the formal definition is only part of the story. The real drama (and the real mathematics) lies in the interaction between intuition and formalism. Children know what a rectangle is before programming it in Logo - after all, they can easily imagine it or draw it on a piece of paper. By writing the RECTANGLE procedure, therefore, they do not *learn* the concept rectangle. Rather, the significance of their programming activity is that they start with an intuitive representation of a concept, and create a formal representation for it. What is truly important about the children's creation is not the formal representation *per se*, but the *link* they have formed between the intuitive and the formal representations. This link is important both ways.

Formalizing intuitions helps where rigor and communication are necessary. Making the formalism more intuitive, on the other hand, is necessary for any meaningful and creative involvement in mathematics, such as problem solving.

That such links between intuition and formalism are indeed formed is evidenced by the many instances of children pointing to a piece of Logo text and saying things like, "I want to put *this window* there...".

#### Change and Constancy

I am not done yet squeezing mathematical and philosophical insights out of our innocent-looking RECTANGLE procedure. Looking at it the standard way, this procedure defines the concept "rectangle" by giving detailed and explicit instructions for drawing any rectangle. There is, however, a slightly different but revealing way of looking at the situation. The shift is from thinking of "any rectangle" - a sort of "generic object" representing the whole family of rectangles - to thinking of the family itself. The point here is that the use of variables enables the procedure's definition to capture neatly and concisely both the invariance across this family and the *variability* within it.(This observation has been triggered by a remark of Joel Hillel's.) Thus, consider the parts emphasized in the following:

> TO RECTANGLE: SIDE1 :SIDE2 REPEAT 2 [FD :SIDE1 RT 90 FD :SIDE2 RT 90] END

These are the invariants. They describe what is the same across all rectangles in the family, hence what distinguishes members of the family from non-members. The rest of the procedure's definition is emphasized next:

> TO RECTANGLE :SIDE1 :SIDE2 REPEAT 2 [FD :SIDE1 RT 90 FD :SIDE2 RT 90] END

These parts, naturally called "variables," stand for the variability within the family; they describe how members of the family differ from each other.

To summarize, the first part serves to give the family its identity, i.e., to distinguish it from the outside world; the second part serves to give individual members their identity, i.e., to distinguish them from each other.

#### **Controlling Change and Constancy**

We have seen that Logo enables us to capture preexisting concepts (like "rectangle") in a formal definition, by specifying what is the same and what is different about all rectangles, thus delineating the boundaries of the concept. But the real power of this method does not become apparent until we realize that Logo further permits us to freely play with these boundaries, turning invariants into variables and vice versa. Thus, suppose we start with the concept "house", and formalize it in Logo as:

> TO HOUSE :SIZE SQUARE :SIZE FD :SIZE RT 30 TRIANGLE :SIZE END

This definition reflects a certain decision as to the identity of houses, both as a family and as individuals within the family. In particular, according to this definition, only the size of the house matters, and not, say, its color. Thus, two houses with the same size are considered equal regardless of their color. However, we are totally free to decide otherwise by modifying our procedure's definition:

> TO HOUSE :SIZE :COLOR SETPC :COLOR SQUARE :SIZE FD :SIZE RT 30 TRIANGLE :SIZE END

Here, finer distinctions are made. For two houses to be considered equal they must share both size *and* color. Needless to say, we could go on making finer and finer distinctions by bringing in the house's position on the screen, the number of windows, etc. Now suppose we are interested in tiny houses, say of size 20. We could view them as special cases of the general house procedure, or we could dignify them with the status of an independent procedure:

> TO TINY HOUSE :COLOR HOUSE 20 :COLOR END

It is noteworthy that, while it is not uncommon to see teenagers spontaneously doing such transformations in their Logo programming, the analog situation in standard mathematical formalism causes difficulties even to college math majors. I am referring to situations, often arising in calculus, in which one starts with a function of two variables, f(x,y), then proceeds to view it as a function of x alone by looking at y as fixed. This function, which depends on the y we fixed, is commonly denoted  $g_y(x)$  -- a striking similarity to our notation TINY.HOUSE :COLOR and BLUE.HOUSE :SIZE.

#### **Theorems-in-Action**

The phenomena described in this section also fall under the heading of "formalizing intuitions," except that what is being formalized is not the definition of a concept, but relationships between concepts, initially captured as theoremsin-action. Again, we start with a procedure, typically written by young teenagers:

TO SUN REPEAT 10 [ARC LT 90 RAY END	RT 90]
TO ARC	TO RAY

IU ARC	IUKAI
REPEAT 18 [FD 1 RT 2]	FD 20 BK 20
END	END

What is mathematically remarkable about this procedure is the choice of a 90-degree turn before RAY. When you ask children "why 90?", they are likely to answer something like "to make the turtle face away from the circle". On the other hand, when the turtle is actually drawing the circle, it is clearly facing "along" the circle. Thus, the children are demonstrating in their programming the knowledge that "if you are facing along the circle, you need to turn 90 degrees to face away from (the center of) the circle". This is in fact a turtle version of the well-known theorem, "the tangent at each point on the circle is perpendicular to the radius at that point".

Seeing a child writing on her own a procedure like the SUN above, what can we infer about the state of her knowledge regarding the theorem? It would be a bit far-fetched to claim that she actually *knows* the theorem. Not only does she lack the terminology to *formulate* the theorem, but there is no evidence that she is aware of the *generality* of the inherent relationship. Nevertheless, as her programming demonstrates, she does know in some sense the fundamental relationship between the two directions, even if it is not yet elevated to the generality and formality of a theorem. Educationally, this seems a very good entry point to learning the more formal and general theorem - if and when the latter is appropriate.

#### Conclusion

The focus of this note has been the fundamental mathematical process of formalizing intuitions, or more precisely, creating links between intuitive and formal representations of concepts. This process is inherent to meaningful mathematical activity and should be central in any program of mathematics education. We have seen that children working on Logo projects naturally engage in this process. While formalization is never easy, it seems to occur much more naturally in the procedural formalism of Logo than in the standard declarative mathematical formalism. The merit of the Logo Turtle language in this respect is that while being a formal language, it does not force this aspect on the programmer too abruptly. One can pretend to be working wholly intuitively, only gradually coming to grips with the formal nature of the language, as bugs in one's mental models are brought to the surface by bugs in the program.

All this is not to suggest that the Logo formalism should replace the standard mathematical formalism. Quite to the contrary, I believe the former could help learners eventually feel more at home with the latter. There are many aspects of mathematical activity for which the standard mathematical formalism is irreplaceable, e.g. proving theorems. The challenge to the Logo community is thus to build more and better bridges between the two types of formalism, to help the learner move more easily between them.

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.

#### Logo Mathematics Newsletter Begins Publication

The Council for Logo in Mathematics Education (CLIME) has announced the publication of its newsletter. The March 1987 issue contained editorial reflections, reviews of Logo books and articles, a copy of the CLIME constitution, profiles of several officers, a problem solving section, an activity to explore  $\pi$ , an exploration of the powers of 2, a notice about the CLIME electronic bulletin board installed at Simon Fraser University in Vancouver, BC, an overview of the Logo presentations at the Anaheim meeting of the National Council of Teachers of Mathematics, and the schedule for CLIME meetings at various regional and national conferences. Membership in CLIME costs \$5. The benefits are enormous. Contact CLIME, c/o Ihor Charischak, 445 Broadway, Hastingson-Hudson, NY 10706.

# Special Talk by Paula Cochran and Glen Bull Keeping in Touch

We began this column for the purpose of exchanging information about Logo applications and other computer tools for special populations. Through the year we have heard from many of you -- at conferences and in letters -- about what you are doing with Logo and how you have been using ideas from this column.

For example, the design added to the cover of the March *Logo Exchange*, by Anna P. Olson, was part of a "warm fuzzy" procedure. Anna found that Logo warm fuzzies were working well as motivation for her children, not to mention the pleasure she got in designing them. In the Albemarle County, Virginia schools, several classrooms are involved in a Logo warm fuzzy competition -- there will be a prize for the best collection of Logo warm fuzzies, which will then be made available for use in lower grades and special education classrooms (for more about warm fuzzies, see Special Talk, *Logo Exchange*, October 1986).

Now that the school year is coming to a close and the May issue the *Logo Exchange* is being distributed, the concept of continuing to exchange ideas and expertise seems important. In previous columns we have mentioned the use of telecommunications to support teachers working with Logo. This month we would like to provide a few more examples, and encourage you to consider this means of communicating with other professionals throughout the year.

#### What Is Available?

Electronic conferencing and communication is still unexplored territory for most teachers and clinicians. This is in spite of the fact that technical and financial barriers to this technology have been greatly reduced in the past few years. It is now technologically and financially feasible for most professionals to use electronic conferencing as a professional tool -- they just don't know what it is or how to get started.

Through telecommunications, a teacher can have immediate access to many other people who are interested in Logo and Logo-like activities. For example, there is a Logo Forum conducted by Jim Muller on CompuServe, which includes a library of programs that participants can download and use. There is also a Logo conference on the CONFER II system at the University of Michigan, used by many Logo leaders familiar to Logo Exchange readers, such as Anne Federlein, Brian Silverman, and Jim Fry.

The electronic conference that we have been using most is called Special Talk, and also runs on CONFER II at Michigan. Special Talk is for professionals who work with handicapped populations. It serves as a place to exchange new ideas and clinical methods, discuss professional issues, ask technical questions about clinical applications of computers, and develop new intervention techniques.

#### Why Electronic Conferencing?

Why is electronic mail and conferencing something that you should find out about? Many work settings cause teachers and clinicians to feel professionally isolated. Convenient access to fellow professionals via an electronic network can not only provide a supportive peer group, but also additional expertise about difficult or unusual students.

Participants can use an electronic network to ask technical questions about the use of computers in instructional situations. Convenient and prompt help with problems associated with the use of new technology can make a big difference in whether or not a teacher successfully implements an application that is new to her. Communication via telecommunications also can be used to follow up on inservice training or other continuing education experiences.

When an electronic network allows for ongoing conversation about a topic, that is called "conferencing" as opposed to personal messages or bulletin board functions only. The features that appeal to us are:

1. People can be at work or at home, and post comments or capture programs electronically using a computer and a modem.

2. Comments and reactions to previous parts of a conversation are posted at the individual's convenience rather than at a specific time. No more telephone tag.

3. A third and powerful characteristic of electronic conferences is speed of response from a group of peers.

#### What Do We Talk About?

Anyone participating in Special Talk can post an item for others to read and respond to. The topics vary widely -- everything from personal news to hot discussions of professional issues to fairly routine technical questions. There is also a large number of items that represent the ongoing efforts of Special Talk participants to refine and adapt computer applications for particular students and clients.

Examples of topics under which items are categorized for discussion on Special Talk include:

Utility Software	Logo Programs
UVA Highlights	Programming Techniques
Curriculum	Resources
Kid Talk	Technical Questions
Instant Logo	Speech Technology
Social Announcements	Switches
Conferences	Video Discs
Soapbox	Language Disorders

The Special Talk electronic conference grew out of an institute sponsored by the University of Virginia and IBM. Twenty institute participants attended a three-week course on the applications of computers to special populations. One goal of the institute was provision of long-term support for clinicians and special educators, and the Special Talk conference was organized to provide this support. Until January 1987, the Special Talk conference was a closed conference, meaning that new participants were added only with permission of the organizers (Glen and Paula). Now other participants are welcome. For more information about Special Talk and a CONFER application, write to Doris Flowers, UVA Speech-Language-Hearing Center, Charlottes-ville, VA, 22906-9022.

Here is a sample conversation about two teaching tools that are frequent topics on Special Talk: Logo and IBM Listen to Learn (talking word processor).

Item 76 21:42 Nov11/86 15 lines 22 responses Barbara Allen (Oregon)

Has anyone tried to teach spelling using Listen to Learn? I'm thinking about giving it a try. I have a student with a speech disorder. I thought I'd use Listen to Learn to practice contrasting sounds. He has had speech for many years with little progress. Listen to Learn should wake him up from his lethargy! Any ideas, suggestions, etc?

#### Nov13/86 22:27 (Virginia)

76:1) Glen Bull: The people in the McGuffey Reading Center at Univ of Va. are very interested in the possibilities of using L to L as a way of determining the child's internal spelling rules. (They're so excited that they've obtained funding to have Terri Rosegrant come down and talk to them.)

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#### Nov15/86 22:53 (Virginia)

76:3) Paula Cochran: Just got a great report from Bonnie Nelson about using L to L with her pre-schoolers to do Morning News. You should see some of the news that her kids typed in (honest): nnn hhh Ill RRRR SSSS VVVVV BBBBB, etc. :-) Terri Rosegrant says this is exactly what to expect from kids when they first start exploring sound/symbol relationships.

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#### Nov18/86 15:05 (Virginia)

76:14) Bonnie Nelson: Glad you found the LtoL stuff funny. The more perservering ones now are exploring what happens when you add vowels with consonants. I've labeled all vowels on the keyboard and they are now setting goals for themselves like,"Josh made it yell. Can you make it yell? It only burped once and then aaaked off."

#### Nov25/86 12:36 (Oregon)

76:15) Barbara Allen: Bonnie, I love your LtoL tidbits--keep them coming, because I'm copying them for our kindergarten coordinator. Real life examples seal it with a kiss.

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#### Nov30/86 19:51 (Connecticut)

76:16) John Hall: Hi Barbara. I would sure give it a shot. I've been using Listen to Learn for auto shop content reading with super results. I alternate a page of text with a page of questions. The kids learn to page up in no time. The ability for each student to choose the speech mode they want is the best feature. High school students are very sensitive about their reading difficulties. Many of the good readers use the page read command just to hear the computer talk. While, one student who has great difficulty will only use the word command. The one common factor is they all enjoy using LtoL. The one thing the program doesn't do is provide immediate feedback. Maybe Glen could write a Logo tool to give us the word, sentence and page commands??

Dec02/86 21:55 (Virginia)

76:17) Glen Bull: I think I missed the point about a Logo tool - that is, since LtoL can say each word as it is typed in, what kind of feedback is needed?

Dec03/86 20:19 (Connecticut)

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76:18) John Hall: LtoL can only give feedback concerning the word typed, not whether it was the correct word in response to a question. Does it make sense now?

Dec03/86 20:23 (Virginia)

76:19) Glen Bull: Oh ... I see now. You want feedback about the correctness of the answer, not the meaning of the word read. If I understand correctly, that shouldn't be too hard to arrange in Logo. Paula and I will be a convention next week but when I get back, I'll take a look at this.

Barriers of time and geography can be overcome when professionals are linked electronically. Sharing Logo tools and ideas usually requires providing procedures on-disk, as well as documentation-- an electronic network makes it possible to upload and download procedures and documentation, making them available to a large group of users almost immediately. A Logo culture can flourish in such an environment.

Perhaps we will see you "on-line" this summer.

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. 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.

#### Logo and Geometry Research Information Wanted

Nancy Upper, a computer curriculum specialist, is writing a pilot program for the 4th, 5th, and 6th grades of her school district, with the goal of teaching Logo and geometry as a single curriculum unit. She would like to correspond with others who have done similar work, including research on Logo and geometry. Write to Nancy Upper, Winchester Public Schools, 154 Horn Pond Brook Road, Winchester, MA 01890, or call (617) 721-7038.

# Testudinal Testimony by Douglas H. Clements Knowing All the Angles: Part 2 Research on Angle Measure

Last month we heard that none of Kieran's (1986a, 1986b) intermediate grade students knew what an angle was when first interviewed. After informal work with Logo, about half of them thought that they knew what an angle was. These students were asked to draw angles of various measures. Not surprisingly, misconceptions arose in this area as well. For example, three interpretations of 45° angles included: (a) a line segment with a 45° heading, (b) a drawing of the turtle with a 45° (or even a 90°) heading, and (c) an angle measuring either 135° or 45°. Those who said they did not know what an angle was were asked to show what the turtle does when one types

RT 30 or RT 120. Children evidenced little grasp of turns involving more than 90°. For instance, a drawing of RT 120 might appear as the figure on the right.

Another item assessed children's concepts of rotation through "exterior angles" (the amount of rotation in a path). Four angles of equal measure whose line segments differed in size were

presented as roads. Children in the non-Logo group tended to reply that the road on which would you have to turn the most was the one with the longest length line segment or the one whose representation occupied the most global area (this even after their regular classroom geometry instruction). In contrast, the Logo experience encouraged students to focus on factors other than global space in determining an ordering of "exterior" turns. Many indicated that the turns all looked more or less the same, "even if the sides were different." Interestingly, traditional formal (classroom) instruction on angles, following the Logo experience, increased students' reliance on length of arms and space occupied as criteria for ordering exterior turns!

However, as many Logo teachers know, this familiarity with exterior turns has its dark side. These students also were presented with a situation emphasizing rotation between the sides of an angle. They were told that people in a forest begin looking in one direction, then hear a sound and look in another direction. A substantial proportion of the Logo children (about 1/4) persisted in viewing this situation in terms of the "exterior" angle despite the scenario that emphasized the "internal" angle.

Even those who answered correctly evidenced confusion in integrating these views. For example, "RT 45 is smaller than RT 90, but we end up with something bigger." In contrast to the previous question, many Logo children tended to order turns according the the global space occupied by the angle representations. This happened both after their Logo experience and after traditional classroom instruction. Thus, their Logo work which emphasized exterior angles, tended to correct misconceptions for these angles, but not for interior angles. Traditional classroom work did not positively affect misconceptions in either instance.

#### **Misconceptions about Measuring**

Kieran, Hillel, & Erlwanger (1986) identified certain angle measurement schemas students possess. For example, in the "45-90 schema," slanted lines are associated with 45° turns; horizontal and vertical lines with 90° turns. In the "protractor schema," inputs to turns are based on usage of a protractor in "standard" position or orientation (thus, to have a turtle at home position turn left 45°, students might use an input of 135°, which corresponds to a protractor's reading when its base is horizontal).

Combining these results with those reported last month, we can see that children seemed to have a static concept of angle (e.g., corner or slanted line), and another, separate concept of rotation. Kieran's students' misconceptions about angle measure persisted into the following year. Students had much difficulty coordinating the relationships between the turtle's rotation and the constructed angle.

#### **Angle Estimation**

Findlayson (1984) worked with 11 year olds. Both the Logo and control groups received formal classroom instruction concerning angles, reflections, and rotations. The Logo group worked for 28 weeks (2 sessions per week) using a guided discovery approach. Worksheets presented programming ideas and projects and suggested correlated explorations. Mathematical content was nearly always implicit rather than explicit.

As predicted, the Logo group scored significantly higher than the control group on a test of estimation of angles. For example, given one angle, students were required to estimate the size of other angles, often involving knowledge of the additive and inverse properties of angle measure. Whereas the control group scored less than 3 out of a possible 8, more than two-thirds of the Logo group scored 6 or more. Evidence that they had constructed their own angle schema also was supported in that they recognized that angles were measured by the amount of rotation, obeying the laws of addition and subtraction of integers. They recognized one angle as half as large as another, and estimated its measure accordingly. In these activities, they were able to cope with arbitrary, as well as standard (i.e., degrees) units.

In contrast, most of the students in the control group did not recognize that angle measures could be subjected to arithmetic operations. They seemed to view angle measure as labels (e.g.,  $45^{\circ}$  or  $90^{\circ}$ ), and in the absence of an overarching schema, tended to attached these common labels to unfamiliar angles. They could not estimate the measure of one angle given the measure of another. It would seem that the traditional approach to teaching angles did not facilitate this type of learning. Carmichael et al. (1985) also stated that their tests showed that Logo facilitated students' ability to estimate angle measure.



#### What Makes an Angle Bigger?

Another group of items in my own study probed students' ideas regarding angle measure (Clements, 1987). Misconceptions emerged in both groups. However, as with the angle concept items, the Logo group had fewer misconceptions than the control group. They also outperformed the control students on each item to varying degrees (no pun intended-unless you like it). For example, 13 of the 24 Logo students correctly drew a "bigger angle." Some appeared to understand the task quickly. Asked why the angle she drew was "bigger," one girl replied, "The turn at the point is larger." Another stated that, "Because of the way the lines come together it's bigger in between here." Two boys caught their own mistake. After drawing an angle of similar rotation but longer sides, one said spontaneously, "Oh, a bigger angle. This isn't a bigger angle, the lines are just bigger." The second said, "It's taller, but smaller in here [pointing]. This one [draws an angle of greater measure] is bigger in here."

Others were struggling with the two possible interpretations. One boy read the questions and immediately asked, "But the same one?" "Whatever you think is a bigger angle." He queried again, "But the same turn?" "Draw what you believe is a bigger angle." He then drew an angle with similar length segments, but twice the number of degrees. Two Logo students drew a larger exterior angle, but then took care to justify their response (e.g., "This is the angle that's bigger").

Other students drew a line segment with a greater rotation from the vertical than another "slanted line". Six first drew intersecting segments of greater length, then, after prompting, corrected their responses. Two drew an angle of similar measure with longer segments. Another attempted the task three times, drawing a right angle each time. A final student, who previously had drawn "The turtle pointing in a direction" drew two turtles, oriented differently. Asked about the relative size of the angles, he replied, "They're just different. Not bigger or smaller."

Two control students correctly drew a larger angle, one explaining "Because the thing is open wider." Another asked, "Same or different?" When the interviewer replied, "Just bigger," she drew an angle of similar measure with longer segments. She was then asked to draw a "different" angle, whereupon she drew a larger angle. After prompting, five additional students draw larger angles. One explained that it was "enlarged" and the rest explained that it was "wider open." The boy who originally described angle as perspective maintained that "you can't have a bigger angle" [perspective], just a different one. All the other control children drew longer line segments.

The next item asked which of two angle representations (one had a greater angle measure but shorter line segments). Children's responses again revealed the many ways they think about the sizes of angles. One Logo child chose the correct angle with the justification, "That line comes up closer to this line" (in the smaller angle). Another said that in the larger angle, "the opening is twice as big." Similarly, one control child stated that the larger angle had "more space in between." Thus, we can see many different schemas for angle measure. Size is related to length of the line segments, "tilt" of the top line segment, area enclosed by the angle representation, or even the linear distance between the two segments at some arbitrary point. Logo does appear to help develop valid concepts, but even numerous experiences emphasizing angle measure as rotation does not replace previous concepts (cf. Davis, 1984). In addition, not every type or duration of Logo experience may be this helpful.

For example, the findings of two studies were less positive. Horner and Maddux (1985) reported that there was no significant difference in junior high school students' ability to recognize the size of angles after 14 sessions with Logo (although the Logo group's score increased more from pre- to posttest than did that of the control group). Badger's (1983) six graders in a five-week Logo course improved in their ability to recognize a "basic angle" (90°) within the Logo context, but only a small proportion of them (from 19 to 33%) could draw such an angle. Thus, we have, as usual, no guaranteed results. Limited exposure (e.g., 14 sessions) may limit benefits.

#### Implications

As a whole, however, the studies reviewed in this column and the previous one have several clear implications. The most salient is that students possess many different conceptualizations about angles. To be effective, teachers must understand these diverse ideas. If the teacher is not aware of possible misconceptions and does not plan for the development of sound ideas, angles will be a locus of confusion rather than learning in Logo (e.g., Hillel, 1984; Noss, 1984). Teachers also must build on their students' intuitive knowledge. They must avoid the seductive but false belief that students will absorb knowledge in an unadulterated form. But, given that ideas are diverse, which should be developed?

#### Integrating Two Definitions of Angle

Mathematicians themselves do not hold a single conceptualization of angle. Most definitions can be classified as static (the union of two rays with a common endpoint) or dynamic (amount of rotation). Curiously, the dynamic version is not usually introduced until trigonometry and calculus. What should angle be for students ? At what age?

One possible solution is to move children toward an integrated conceptualization. First, children could begin by investigating rotations. The word angle would not be emphasized (e.g., TO POLY :LENGTH.SIDES :TURN might be preferable to TO POLY :LENGTH.SIDES :ANGLE, especially because it is confusing as to which angle one is referring!). Later, when the concept of angle is introduced, the two angles formed by a rotation would be brought to an explicit level of awareness (e.g.,, in a polygon the angle turned through, or exterior angle, and the angle formed, or interior angle). Eventually, students might develop the idea of an angle as the union of a ray and its image under a rotation about its endpoint. (I hope it is clear that the goal is not that students merely memorize a definition! Rather, the teacher provides activities and discussions to help them sort out and relate these two ideas about angle into an integrated schema.) The irrelevance of the length of an angle's arms or its orientation might be discussed during geometry instruction, in and out of Logo.

As we have seen, research results are refreshingly consistent in this area: Logo has the potential to have an impact on students' fundamental ideas about angle and rotation. Appropriate Logo experiences can help students construct the ideas of angle and angle measurement as "objects"— things that they can manipulate and understand. Students know this. When asked whether working with Logo had helped them learn other things more easily, the students in Carmichael et al.'s study (1985) most often referred to having gained a better understanding of angles and degrees. One student said, "Angles make a lot more sense now...[Logo] has helped me grasp the concept and see what the degrees are and not just think in facts, but really understand" (p. 305).

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# Logo Disserts: Dissertations Dealing with Logo by Barbara Elias

What do you do when you teach Logo? You may see a reflection of yourself in a study by Michael T. Charles of Arizona State University. This case study of the teaching and learning of Logo details the kinds of things teachers do in a Logo environment, relates learning in Logo to Bloom's Taxonomy, and describes how well children understand Logo graphics.

Over a period of one year, 33 fifth and sixth grade children in a suburban Phoenix, Arizona, school division studied Logo. The school was equipped with a laboratory containing 15 computers. Twenty of the children were in the homeroom class of the principal investigator. They spent three class periods per week in the computer laboratory studying Logo. The thirteen remaining students were volunteers in an after-school Chapter 1 program. These children spent two class periods per week studying Logo. The researcher and the computer resource teacher worked as team teachers of the two classes.

The study focused on teaching and learning in a Piagetian learning environment. Three questions directed the investigation:

1. How do teachers interact with students?

2. What kind of thinking (as related to Bloom's Taxonomy) occurs with students?

3. How well do students understand the content of Logo graphics?

The approach used in this study was to assign openended projects for students to complete. Students who wished to do projects of their own were required to submit Logo Personal Project Proposals which included a sketch and description of what was to be done. Data sources included field notes and interviews. Field notes resulted from logs of each session, notes on the three questions of the study, chronologs of student behaviors, student projects and individual notes, Logo assignments and problem solving activities, and debriefing notes of outside observers.

Data were analyzed using continuous comparative analysis. This analysis involves collecting data, checking it against other data, forming hypotheses about questions that arise, and testing these with additional observations and judging their worth. Findings relative to the questions of this study are presented in the form of selected teaching episodes followed by an analysis of the episodes and the related question. A schema of teacher interventions in the Logo environment and a correlation of student behaviors to the levels of Bloom's Taxonomy resulted form this study. In addition, insights were gained on the methodology employed and on Logo learning.

A set of ten kinds of teacher interventions with individual students were observed in this study. Acknowledging, discussing, clarifying, and suggesting were observed in this study, and characterize most learning environments. Other interventions, however, are more directive and may not be observed often in the Piagetian learning environment. These include:

1. Requiring the student to do something, such as meet certain standards.

2. Identifying a problem for the student to solve. This usually was done to help the student gain experience in solving a problem.

3. Guiding students in solving a problem. This time consuming intervention is often used in debugging.

4. Providing an explanation, part of a solution, or a mini-lesson on a skill in Logo. Much instruction in Logo was done through mini-lessons when needed by students for a new skill.

5. Modeling a solution or skill in Logo. This means showing the student what to do and monitoring the student to insure understanding and the ability to do the modeled behavior.

6. Changing a student's work with student observing. This was used to relieve frustration or when a student had finished a project and allowed the researcher to show how it would be changed had the researcher completed it. It is easy for students to lose a sense of project ownership when this intervention is used.

Logo appears to provide a fertile environment for student thinking on the higher levels of Bloom's Taxonomy in debugging (which utilizes analysis) or in writing procedures and solving problems (which demonstrate behavior at the level of synthesis), for example. Quantitative research is recommended for this area.

Logo learning was found to be most evident in procedures students had written themselves. Students were able to steer the turtle, use pen control commands, write procedures, and use disk commands. Some students were not able to understand fully REPEAT commands, writing subprocedures and superprocedures, and the use of variables. Students created a number of procedures (one letter names only) which served as tools for their work.

An unexpected finding of this study is that students, introduced to note-taking in the Logo environment, seemed intrinsically motivated to use note-taking when it served their needs. Most used note-taking throughout the year even when it was not required. The assigned project approach is recommended for large classes with one teacher. This method was found to add structure to the environment without students experiencing a loss of ownership in their work. Even though the circumstances of this study may not be generalizable to other school settings, the researcher feels that the findings may offer other elementary teachers ideas for reflecting on their own teaching and student learning in Logo environments they create.

>>>Charles, Michael T. (1986). Teaching and Learning in a Logo Environment: A Case Study. (Unpublished thesis, Master of Arts, Arizona State University, 1986.)

Interested readers may write to: Michael Charles, Pendergast School, 3802 North 91st Avenue, Tolleson, AZ 85017

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.

# LXionary A Lectionary of Selected Logo Readings

with Commentary and Opinion by Bill Craig

In introducing Logo to teachers, I have often claimed that Logo is an example of a computer use which can enhance our students' critical thinking skills. But I have rarely elaborated on exactly how this enhancement happens or identified the thinking skills that are being practiced. As the teaching of critical thinking and problem solving skills increases in popularity, more attention has been paid to specifying the skills that make up critical thinking. The articles reviewed here reflect that trend.

>>>"Decision Making: New Paradigm for Education" by Charles E. Wales, Anne H. Nardi, and Robert A. Stager, *Educational Leadership*, May, 1986

"Schooling focused on decision making, the critical thinking skills that serve it, and the knowledge base that supports it will allow students to...claim their capacity to think and their heritage as human beings."

With statements like this, the authors make the claim that decision making should become the focus of education. But before the focus can be shifted from an emphasis on facts, educators must understand the decision making process. A model for decision making is described in detail based on four components:

State the goal
 Generate ideas
 Prepare a plan
 Take action

Each of these components is broken into smaller steps so that the model for decision making has twelve tasks. Examples of these tasks include create goal options, identify new situation problems, and select the next action.

The article is not about Logo or about computers. But I think it adds credibility to our efforts to sell Logo. If we accept this model of decision making as valid, it is possible to tailor our Logo instruction to fit the model. The authors cite several examples of the types of activities in which critical thinkers are involved, such as:

"...visualize situations, ask appropriate questions, ...generate options, use techniques such as brainstorming, synectics, and lateral thinking and can synthesize ideas."

Don't we say the same things about our students when they use Logo?

This article is one of several in the issue dedicated to critical thinking skills and their place in the curriculum. Many of the articles have themes which relate to what we are trying to accomplish with Logo. The appearance of these themes in educational literature affirms the value of our Logo efforts.

>>>"Assessing Learning With Logo: A Pilot Study" by Jane Horton and Ken Ryba, *The Computing Teacher*, August-September, 1986.

Horton and Ryba describe a project in which students were assessed "in terms of their ability to acquire Logo-related thinking skills and the extent to which they could transfer these skills to non computer problem solving tasks." The article describes in detail the research design and results. The good news is that the results of the pilot indicate that there are ways of using Logo which enhance cognitive development. What remains to be seen is whether these same skills will transfer to less similar problem solving tasks.

While I was happy to read about those promising results, I was much more excited by the work that the authors did in designing the pilot. Horton and Ryba have identified thinking skills which can be taught with Logo:

- 1. Exploration
- 2. Analysis and planning
- 3. Creativity
- 4. Debugging
- 5. Prediction

As well as identifying the skills, the article mentions Logo activities used to measure acquisition of the skills. The activities are not new. They are the same ones many of us use in introducing turtle graphics. What is new is the effort to describe the thought processes of Logo users and the potential benefits of involving students in these activities.

Perhaps the choice of teaching basics or teaching Logo will become obsolete as educators recognize that skills learned with Logo are basic skills, the basic skills of critical thinking.

Bill Craig is the Computer Education Program Specialist for the Chesterfield County Schools, Chesterfield, VA 23832.

## LIFT'S Teacher to Teacher by James Fry A Year-End Look at Books

Writing reviews for the *Logo Exchange* for the last three years has been a wonderful and rewarding experience. We have seen the number of Logo publications grow as well as the quality of the content. In this last issue of the school year, we look back on some of the more interesting books that we felt were part of important turning points in Logo. We have also included some "Golden Oldies," Logo classics that should be part of every Logo collection.

#### **Golden Oldies**

Mindstorms: Children, Computers, and Powerful Ideas, by Seymour Papert, 1980, published by Basic Books. (Reviewed September 1982)

What can we say? The classic of all the Logo classics. A definite must for everyone's Logo reading list. It's something that can be read many times. If ever you experience a Logo slump and need to get back the energy and excitement that Logo gives to all of us, curl up with *Mindstorms* for a couple hours.

Turtle Geometry, by Harold Abelson and Andrea diSessa, 1981, published by the MIT Press. (Reviewed October 1982)

Another classic that should be shown to everyone who has said that Logo is just for young children. If you want to see the power of Logo and turtle geometry, then this is a "must" book.

Discovering Apple Logo: An Invitation to the Art and Pattern of Nature, by David Thornburg, 1983, published by Addison-Wesley. (Reviewed December 1984)

A wonderful book that expresses well the wonderful world of discovery that Logo encompasses. A good book for someone who thinks that Logo is just a programming language. I placed it in this section because of its place in the Logo publishing timeline. David was talking about discovery, explorations, and using Logo to teach, when most people were still on level of teaching just turtle graphics.

#### **Programming Resources**

Apple Logo and Logo for the Apple II, by Harold Abelson, 1982, published by BYTE/McGraw-Hill. (Reviewed December 1982)

Logo for the Apple II was the first Logo book I ever purchased. It was all I had to learn about Logo besides the Terrapin Logo manual that came with the Language disk (which at that time had only graphics information with no list processing chapters). Logo for the Apple II gave me a look at what Logo could do. I still use it as an excellent reference for programming information on Terrapin Logo.

Apple Logo Programming Primer, by Donald Martin, Marijane Paulson, and Stephen Prata, 1984, published by Howard W. Sams & Co., Inc. (Reviewed December 1985)

I have this book handy whenever I'm involved in an Apple Logo programming project. It has an excellent appendix of Logo commands and other programming information. There are also many excellent programming projects and examples throughout the book.

Computer Science Logo Style, Volumes 1 and 2, by Brian Harvey, 1985, 1986, published by The MIT Press. (Reviewed, Vol. 1 November 1986 and Vol. 2 February 1987)

Two "must-have" books for all you "Logo experts" or those who wish to be. A super collections of Logo programming examples and lessons that really show the power and beauty of Logo. Something to show someone who thinks Logo is only for young children.

Nudges: IBM Logo Projects, by Steve Tipps, Timothy P. Riordon, and Glen Bull, 1984, published by CBS College Publishing, Holt, Rinehart and Winston. (Reviewed April 1986)

Just the right book to give your students that "nudge" they might need to explore all the possibilities that Logo offers. A wonderful set of projects to get yourself or students started in the right direction.

Logo Microworld: Picture Puzzles, by Ihor Charischak, 1985, published by K-12 MicroMedia Publishing, Inc. (Reviewed November 1985)

I had to add this in the collection because of the concept behind this publication. Not really a book (only 10 pages, disk included), but a set of five activities or microworlds. I thought it was a great idea and have always wanted to see more of these "microworld packages" offered by the same author or others.

#### **Curriculum Orientation**

Learning with Logo, by Dan Watt, 1983, published by Byte / McGraw-Hill. (Reviewed October 1983)

My second Logo book. This is probably one of the best selling Logo books ever. Everyone I work with on Logo either owns it or has used it at some time. It was one of the first books that showed what you could do with Logo instead of just teaching you about Logo.

Teaching with Logo: Building Blocks for Learning, by Molly and Dan Watt, 1986, published by Addison-Wesley Innovative Division. (Reviewed February 1986)

This publication was one of the first of many to look at interactions between Logo teachers and Logo students. It illustrates many of the "powerful ideas" that are possible with Logo. Learning Math with Logo, by Rudy V. Neufeld, 1986, published by Logo Publications. (Reviewed September 1986)

An indepth look at how Logo can be integrated into the curriculum in the area of mathematics. A good resource to use when answering to teachers and administrators the question of "Why Logo?"

Mathematics and Logo: A Turtle Trip through Geometry, by Kathleen Martin and Donna Bearden, 1985, published by Reston Publishing. (Reviewed April 1986)

An exciting Logo book and one of the earlier publications that really started to get to the real needs of Logo teachers and students. Some super ideas and activities on integrating Logo into the math curriculum.

Beyond Mindstorms: Teaching with IBM Logo, by Joyce Tobias, Jerry Short, Sharon Burrowes, and Tom Lough, 1985, published by CBS College Publishing, Holt, Rinehart and Winston. (Reviewed September 1985)

This publication does not go beyond "Mindstorms" in terms of ideas but in terms of applications. It presents an approach designed to help teachers learn to use Logo and then to teach it to their students and to enhance the curriculum. A great teacher resource.

The Logo Project Book: Exploring Words and Lists, by Alison Birch, 1986, published by Terrapin, Inc. (Reviewed October 1986)

Another great collection of Logo projects and ideas for applications beyond turtle graphics.

#### In Closing

As you can see by this list, the number of books that have become available for teaching with Logo by integrating Logo into the curriculum has been growing steadily. Teaching and learning is what Logo is all about. We are delighted to see this area of curriculum and Logo projects growing, and hope to find many more publications in these areas in the future.

James Fry uses Logo with his Chapter 1 remedial mathematics students at Novi Community School, Novi, MI, and is a cofounder of the LIFT group. His CompuServe number is 76317,565.

#### Logo 87 Announced

Seymour Papert has announced that the Logo 87 Conference will be held at the Massachusetts Institute of Technology (MIT), November 20 - 22, 1987. For additional information, write to:

> Logo 87 MIT Epistemology and Learning Group 20 Ames Street, E15-309 Cambridge, MA 02139

# Welcome to LogoWriter Again

#### by Sharon Burrowes

#### Introduction

The end of the school year is near, and here is the last of this series of articles. It seems like only yesterday it was fall! As those of you who have been reading these articles know, I divided each into a section for teacher trainers, a section for those switching from other versions of Logo to LogoWriter, and a section for the classroom teacher. For this final article, I am taking a different approach: to focus on the text processing capabilities of LogoWriter.

#### **Text Processing**

For many of us who have worked with traditional Logo's, talk of Logo "list processing" set our knees to shaking and our palms to sweating. List processing -- that was that scarey stuff "beyond turtle graphics." Some of us never ventured into this realm and others gave it a try only to be convinced that most of it was *not* for our students.

LogoWriter offers an excellent bridge between Logo graphics and traditional list processing. LogoWriter's text editing / processing capabilities are more concrete and easier to understand. Further, they are accessible to much younger minds. Many of you have no doubt reached page 17 in Word Adventures and have begun using *Select*, *Cut*, *Copy*, and *Paste*. With some instruction, these word processing functions become valuable tools to fairly young children. They are powerful, yet easy to use. If you have progressed that far, then you have taken the first step towards learning about text processing in LogoWriter.

#### For Beginners

Using the word processing mode, type a couple of short paragraphs on the page. Press *Return / Enter* only at the end of each paragraph. Move your cursor down to the Command Center. Now, try typing

> ТОР ВОТТОМ ТОР ВОТТОМ

Watch the cursor move from the beginning to the end of the text on your page a couple of times. Painless, huh? Next try

> TOP EOL SOL

The cursor moves to the top of your page, then to the end of the first paragraph and then back to the beginning of the paragraph. EOL stands for End of Line; SOL stands for Start of Line...but they actually move from one *Return / Enter* to the next. They are more correctly "end of paragraph" and "start of paragraph".

Here's another easy thing to try.

TOP SELECT REPEAT 8 [CF] CUT

The first eight characters disappear. Next type

BOTTOM PASTE

Those characters reappear at the end of your text on the page. Whenever you use the *Cut* (or *Copy*) command, the information highlighted after *Select* is used is put on the Clipboard. In fact, that information stays on the Clipboard until it is replaced by other information. Try typing

#### SHOW CLIPBOARD

nd you should see those first eight letters!

There are many easy to understand text editing capabilities available in LogoWriter. Nearly everything you can do with keystrokes when you are typing on the page can be done from the Command Center with LogoWriter commands. Exploring all of these exciting capabilities is clearly beyond the scope of this article.

#### An Application of Text Processing

When we think about word or text processing, language arts applications usually come to mind. However, here is an interesting use of LogoWriter's text handling capabilities for math. Suppose you have some math problems that you would like students to solve. Type them on the page as follows:

```
3 + 4
23 * 7
15 - 4 + 8
STOP
```

Next, enter this program on the flip side of the page.

```
TO COMPUTE
TOP GET.PROBLEM
END
```

TO GET.PROBLEM

```
SOL <--moves to the beginning of the line

SELECT <--turns on Select

EOL <--moves to the end of the line, thus

selecting the whole line

COPY <--puts the line on the clipboard

IF NOT EQUAL? CLIPBOARD "STOP <-- checks for
```

```
the word "stop"
```

[DO.COMPUTATION

CD <--moves to the next problem

GET.PROBLEM] END TO DO.COMPUTATION (INSERT CHAR 32 "= CHAR 32) <--puts an = sign with blanks on each side INSERT RUN PARSE CLIPBOARD

# END

The last line of DO.COMPUTATION needs some explanation. Text is stored on the Clipboard as a word. RUN requires a list as input. PARSE converts a word to a list. Thus, the problem (on the Clipboard) is evaluated and the answer is printed.

This fascinating procedure can be used in yet another way. Suppose you, the teacher, enters the problems on the page as follows:

> 3 + 4 = 7 - 3 = 20 \* 4 = STOP

and then the student enters the word processor and types the answers. After completing the answers, the student can go to the Command Center and type COMPUTE. LogoWriter will print "true" or "false" after each problem depending on whether it is right or wrong! Try it. It's neat!

#### A Tool

As you work with these new LogoWriter commands, you may find it annoying that SEARCH will not accept a list as input and REPLACE will not take a list as first input. Using traditional Logo list processing, you can have versions of SEARCH and REPLACE that will use lists:

> TO SEARCH.LIST :LIST.IN SEARCH MAKE.WORD ":LIST END

TO REPLACE.LIST :OLD.LIST :NEW.LIST REPLACE MAKE.WORD " :OLD.LIST :NEW.LIST END

TO MAKE.WORD :THE.WORD :A.LIST IF EMPTY? :A.LIST [OUTPUT :THE.WORD] OUTPUT MAKE.WORD (WORD :THE.WORD FIRST :A.LIST CHAR 32) BUTFIRST :A.LIST END

These procedures can be saved as a tool page to be loaded when needed.

#### A Comparison with Traditional List Processing

If you have worked with traditional list processing, you have no doubt encountered a program to convert words to Pig Latin. If you were "deprived" and never learned Pig Latin, the rules are as follows: if a word begins with a vowel, then add "ay" to the end of the word. If the word begins with a consonant, then move the letter or letters before the first vowel in the word to the end and add "ay". Thus, "This is Pig Latin" becomes "isThay isay igPay atinLay." One version of the traditional procedure to convert a word to Pig Latin is:

#### TO PIG.WORD :WORD

IF MEMBER? FIRST :WORD [A E I O U] [OUTPUT WORD :WORD "AY]

OUTPUT PIG.WORD WORD BUTFIRST :WORD FIRST :WORD

#### END

This is certainly not transparent, and requires an understanding of recursive operations (reporters in LogoWriter). Here is the LogoWriter equivalent:

TO PIG.WORD SELECT <-- turn on Select CF <-- move the cursor forward to select the first letter IFELSE MEMBER? SELECTED [A E I O U] [VOWEL.WORD] [CONSONANT.WORD] END

TO VOWEL.WORD UNSELECT <--"deselect" the first letter SEARCH CHAR 32 <-- look for a blank (break between words) CB INSERT "AY CF <-- add "ay" at end of word END

#### TO CONSONANT.WORD CF <-- move to the next letter

IFELSE MEMBER? LAST SELECTED [A E I O U] [CB CUT <-- remove the "before vowel" letters

SEARCH CHAR 32 <-- find end of the word CB  $\,$ 

INSERT CLIPBOARD <-- put the consonants at end of the word

```
INSERT "AY <--- append the "ay"
```

CF]

```
[CONSONANT.WORD] <-- keep selecting until a vowel is found
```

#### END

The LogoWriter version requires more lines of code, but is much clearer. Notice that this program uses text that is typed on the page in much the same way as the COMPUTE example given above. (Be sure to type words with a space after each one since the program looks for a "trailing" space.) This use of text processing can serve as a concrete bridge to more advanced Logo list processing.

Sharon Burrowes is a computer coordinator for the Wooster (OH) Public Schools, and the author or co-author of numerous books and articles on Logo. Her address is 807 College Avenue, Wooster, OH, 44691, and her CompuServe number is 73007,1645.

# The Adventures of Jacques and Elsie

drawings by Linda Sherman

In our March cartoon, Jacques was making a comment to Elsie about the "turtle music" emanating from the computer.

Our favorite caption was submitted by Peter Rawitsch, a first grade teacher in Guilderland Center, New York.

At least they are not playing "Frere Jacques!"



In the May cartoon, the turtles are being taken to their summer home. What is Elsie's parting shot at the Logo turtle?



Please send your caption suggestions for the above cartoon no later than June 1, 1987, to: Jacques and Elsie, Logo Exchange, PO Box 5341, Charlottesville, VA 22905. Please 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. Logo seems to have many ways to "bind" a name to a word or a list structure. You can attach a definition-list to a word with TO or DEFINE, bind a variable globally with MAKE, bind values to variables when entering a procedure, or associate words or lists with one another using property lists. Why does Logo have so many ways of sticking things together?

**A.** Your question is in itself a rather neat summary of Logo's binding strategies. The question also deserves an answer that would take much more space than I have here, but let

me take just one of several approaches to answering it.

The real issue is, "How do you want to *think* about an approach to programming?" It is possible to write programs in Logo in a style that entirely excludes MAKE. It's also possible (but very cumbersome) to write simple Logo programs in a style that excludes TO and DEFINE:

?MAKE "BOX [REPEAT 4 [FORWARD :SIZE RIGHT 90]] ?MAKE "SIZE 60 ?RUN :BOX

You pay a price with this method, though: you lose the flexibility of local variables. That means it is not possible to write the most interesting kinds of recursive programs.

There is probably even a near-impossible way to write Logo programs using *only* the local-variable binding that occurs upon entry to a procedure, but I wouldn't want to try it.

Like many Logo programmers, I don't make much use of property lists. Perhaps one problem is that they are not available in all versions of Logo. I tend to think of property lists as "multiple MAKEs" that allow a wide variety of things to be associated with one another in ways that are far more flexible than any other binding strategy in Logo.

Again, the real issue centers on how you want to conceptualize a program. It might be easier to learn a language initially if it has only a few ways of associating data structures and labels. The real richness of a language is in the utility and beauty of its range of expression. Some association tools are easier to "think with," given a particular kind of problem. I am very pleased that Logo has such a good variety of binding strategies that fit themselves so well to the kinds of computing problems that interest me.

Thank you for your question. I hope that my remarks have given you some appreciation of this aspect of Logo.

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.

# IntLXual Challenges by Robs Muir

Precisely Right

Last spring, I was asked to attend a planning session at a local university that intended to submit a grant proposal to the National Science Foundation, the focus of which was to define and develop a new mathematics curriculum for the elementary grades. The university brought together about 20 national experts in mathematics education to give guidance to the grant writers. Not being a math expert, I suppose that I was invited as the token technologist.

Prior to the conference, the invited speakers were sequestered for a day to brainstorm on the contents of what a revitalized math curriculum might look like. After 8 hours of small group meetings, this was the consensus of the group:

1. Mathematics should be grounded in real-world experiences.

2. Elementary mathematics should take advantage of available technologies, such as computers and calculators.

3. The curriculum should be a problem-rich environment, encouraging higher level thinking skills.

4. The elementary mathematics curriculum should not emphasize rote memorization, nor continue to teach, re-teach, and over-teach the basic arithmetic algorithms!

Although these met with some resistance, the overwhelming conclusion was that schools reinforced the perception among students that elementary math was merely the learning of math facts, while these mathematicians experienced mathematics in a profoundly different way. This was, according to the experts, a major reason why many students leave our schools disgusted with their math experiences.

Not teach the arithmetic algorithms? Do away with teaching long-division, multiplication facts, and the way to multiply a three-digit number by a four-digit number? What else is there in fifth-grade math? If we eliminated algorithms, 250-page math texts would be reduced to 30 page pamphlets! Then what would our students do for the rest of the year?

#### How about Logo?

Computers are good at arithmetic. But most languages for microcomputers (including Logo) suffer from nagging imprecision. Let's ask Logo to do some addition.

?PRINT 12 + 7
19
?PRINT SUM 12867624342 2
1.28676E10

Notice that really big numbers are automatically converted to "scientific notation." In other words, the answer to the last problem is really  $1.28676 \times 10^{10}$  (ten to the tenth power). This is wrong! Close...but WRONG! Even a third grader knows that, to add 2 on to a bigger number, you just add 2 to the "ones" column. Sometimes you have to carry a "one" into the "tens" column. (But that's another part to the algorithm.) The answer, of course, should be 12,867,624,344.

Let's see if we can fix Logo's nasty habit of being imprecise. If we can teach Logo to add using the same algorithm that we teach (and were taught) in grade school, we should be able to get Logo to add any two numbers of any length *correctly*! We need to build an ADD procedure that will replicate what we learned in the second grade.

Our ADDer should work like this:

? PRINT ADD "23 "12 35

What we need is a simple addition procedure that won't convert to "scientific notation." But we have that in the form of Logo's primitive SUM or +, right? SUM can add quoted numbers as well as unquoted numbers. We just need to apply it to each successive column and keep track of the total in a variable as we go.

TO ADD :NUM1 :NUM2 MAKE "TOTAL (SUM LAST :NUM1 LAST :NUM2) MAKE "TOTAL (WORD (SUM BL :NUM1 BL :NUM2) :TOTAL) OUTPUT :TOTAL END

This works fine with some two digit numbers. There are a few trifling difficulties however with problems like

?PRINT ADD "23 "17
310
?PRINT ADD "23 "3
SUM doesn't like as input in ADD

Can you fix this adder? If you can teach third-graders how to use the addition algorithm, try your hand at teaching Logo the same trick. I've learned quite a bit about this since I began playing with this challenge; I bet you (or your students) will, also. No wonder some of my sixth graders still made mistakes in careless addition.

Remember the long division algorithm? Try teaching Logo to divide by building a procedure similar to QUOTIENT.

**PRINT DIVIDE "22 "7 10** 3.142857143

The "10" here specifies how many times you want Logo to repeat the algorithm; in other words, the number of significant digits. Then, you too, can get Logo to approximate  $\pi$  to more than the usual six significant digits.

Send listings of your efforts in a stamped self-addressed envelope to: IntLXual Challenges, c/o Robs Muir, 1688 Denver Avenue, Claremont, CA 91711. I will redistribute copies of interesting solutions to all contributors.

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.



# 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

This month's international selections come from Africa, Australia and Europe. Collaboration is the key word for the African column which summarizes how recent connections between nations have contributed to economic as well as political victories for Logo. In Australia we see major research and development work being carried out with the aid of Logo, while in Europe, Logo interest grows in Greece.

This issue of the LX marks the end of the volume and a chance for a well-deserved vacation for the editors. Not all our editors and readers will be enjoying a summer vacation - some parts of the world are in the midst of both the school year and winter while here on the equator in Singapore there are no seasons at all.

Since the ILX began in January 1986 and its subsequent inclusion into the LX this past September, 13 issues have been completed. Now may be an opportune time to review the global state of affairs in Logo and look a bit at the future. The table indicates which month the story appeared:

#### Index to International Logo Articles

Latin America - Argentina (3/86, 7/86, 10/86, 12/86, 4/87), Brazil (10/86, 12/86, 2/87, 4/87), Chile (1/86), Columbia (9/86), Mexico (3/86, 9/86), Uruguay (1/86, 7/86)

Europe - Bulgaria (1/86, 4/87), Greece (5/87), Iceland (12/86), Israel (5/86), Italy (9/86), Luxembourg (10/86), Netherlands (3/86), Scotland (1/86, 3/86), Spain (7/86), UK (3/86, 2/87), USSR (1/86)

Australia - Australia (1/86, 3/86, 5/86, 7/86, 9/86, 11/86, 1/87, 3/87, 5/87)

Asia - Hong Kong (1/86), India (12/86, 2/87), Japan (3/86, 5/86, 7/86, 10/86, 2/87), Malaysia (9/86, 10/86, 2/87), People's Republic of China (1/86, 9/86, 4/87), Taiwan (1/86)

Africa - Burkina Fasso (9/86), Cameroon (9/86), Gabon (9/86), Ivory Coast (9/86), Kenya (11/86), Kuwait (7/86, 9/86), Liberia (7/86, 1/87), Senegal (1/86, 3/86, 5/86, 7/86, 1/87, 3/87, 5/87), Togo (1/87)

North America - Canada (3/86, 5/86, 7/86), USA (1/86, 3/86, 5/86, 7/86, 9/86, 11/86, 1/87, 3/87)

Logo is obviously being used in education worldwide. Different countries emphasize different uses of Logo:

• As a way to computer awareness or literacy with the aim of modernizing the productive base.

• To prepare secondary and university students in programming and related skills for work in the informatics industry.

• As an educational aid to improve students' skills in academic subjects from primary to university level.

• As an aid to developing creativity and thinking skills.

• To introduce changes in the content and methods of education.

Educational, financial, and cultural influences affect Logo's movement into a nation's schools. Many countries (e.g., France, UK, Israel, USA, Hungary, and Australia) have installed a large number of computers into the secondary schools (although computers in primary education are very sparse indeed). Other nations, such as Bulgaria, Soviet Union, India, Argentina, Senegal, Singapore and Spain, have plans to install a large base in the near future. A third category would include countries that generally reserve the use of computers in secondary schools for those studying technical and vocational applications (e.g., West Germany, Japan and China).

The vast majority of the world's nations fall into a fourth category of having negligible computer usage, mostly due to economic factors. Thus, the vast majority of students in the world have no access at all to computers. However, the presence of computers in private schools and the fear of being left behind has caused even the poorest countries to think about installing computers in their public schools. The above international LX articles give a strong indication that Logo has the international track record to influence policy makers throughout the world.

If you or a friend are using Logo in an international setting, please contact your respective continental director in order that experiences throughout the world can benefit all Logo users.

FD 100!

Fernis

#### Africa & Middle East by Fatimata Seye Sylla

Laboratoire Informatique et Education Ecole Normale Superieure BP 5036 Dakar, Senegal, West Africa

There is a tremendous amount of effective collaboration between Logo users throughout the world. This is happening through the *Logo Exchange*, exchange programs, and sharing of materials as well as moral support. However, I wish there were more collaboration among African and Middle Eastern Logo users.

There have been steps toward collaboration between Kuwait and Senegal through Logo thanks to Logo Computer Systems Inc. (LCSI) in Montreal and Mr. Baha Yacoub, general manager of the company Al Alamiah software in Kuwait. Mr. Baha Yacoub recently wrote to inform us that he had shipped to the Senegalese Logo project one Arabic MSX unit with a printer which has a built-in disk drive. Also enclosed with it were a Sakhr Logo Package with an English manual and an exercise book. MSX Sakhr Logo is an Arabic version of Logo developed by Al Alamiah Software (see the ILX July 1986).

This Arabic Logo system will be very important for the Senegalese project as we started training teachers in schools of education such as Ecole Normale Superieure. These schools of education train teachers in all the curriculum subjects they will be teaching later: mathematics, geography, history, science, French, English, Spanish, Arabic, German, ... We started our teacher training with French Logo and this was very appealing for all the teachers except the Arabic teachers who are not using Latin characters. This is one reason that makes us feel that this MSX Sakhr Logo will be very helpful.

Another reason is that a new Islamic Engineering school is being built with Arabic funds, here in Senegal. One of the Senegalese leaders already has contacted our project to study with us how they would introduce computers in their educational programs using an Arabic language or software. When we receive the MSX Sakhr Logo then we will be apple to demonstrate an Arabic system to him.

Finally, in terms of our own research with young children, we will be able to step into both French and Arabic schools. There are many other things we will be able to do with this system; for example, work with Moslem adults who are mainly French illiterate.

Again, many thanks to Mr. Baha Yacoub of Al Alamiah Software Inc. for this Arabic system and to Ms. Effie Maniatis of LCSI for her continuous support of the Senegalese project. Right now, she's working on a proposal to get funds to provide us with the French version of Logo Writer so that Logo teachers can start using it in their schools.

Another kind of collaboration is taking place between Logo users in the United States and the Senegalese Logo project through books. Last summer, during the Logo 86 conference, Margaret Minsky gave me a copy of *Logo Works* (McGraw-Hill book Company in 1986) which she co-authored with Cynthia Solomon and Brian Harvey.

Three of the challenging Logo programs presented in this book are being investigated and adapted by the Senegalese Logo research team for their teaching needs within the Senegalese school curriculum.

The three programs are:

(1) SENGEN, a sentence generator which "builds up sentences from vocabulary lists of nouns, verbs, adjectives, connectives, and so on. It then assembles its selections according to some rules of grammar."

(2) ARGUE, a dialogue program. "It expects you to type a statement in the form of *I LOVE LEMONS* or *I HATE DOGS*. ARGUE comes back with contrary statements. For example, if you make the statement "I LOVE DOGS," the programs responds

I LOVE DOGS I HATE CATS

(3) MATH, a sentence generator which makes up math sentences in the form 3 + X = 5 and asks for the value of X.

What is interesting about the Senegalese teachers' work on these three programs is seeing how they develop new ideas of teaching the curriculum subjects through Logo. When these teachers get together, some real *mindstorming* takes place; the results will be published upon completion.

These kinds of collaborations between Senegal, Kuwait, Canada and the United States widen our research field and give us courage to pursue our goals. Today in Senegal our research laboratory is being more and more valued; recently, the Senegalese government decided to provide the secondary schools with 200 microcomputers and our laboratory is in charge of investigating how these computers should be introduced.

In addition, the Senegalese government will write a proposal to the government of Kuwait to receive more computers and some funds for our Logo Laboratory. One can see that the above mentioned collaborations are giving our project credibility as well as expertise and equipment.

#### Australia

by Anne McDougall Faculty of Education Monash University Clayton, Victoria 3168 Australia

Logo has played various roles in software development projects here in Australia. In this column I shall review several of these, and outline the role and importance of Logo in each case.

The first software development work in Logo in this country was done by Tony Adams. After "warming up" by writing procedures to interface the Australian Tasman robot turtle to the new MIT and Apple Logo versions in 1981, he began in 1982 the design and development in Apple Logo of a research environment in which children's Logo work could be captured, examined, and analysed. This included writing dribble file procedures which stored the commands typed by the user but were transparent to the user. Although this work has been superceded now by the dribble facilities available in Logo II, Tony's system was used in several research projects between 1983 and 1986. Its development is described in some detail in "The Logo Language as a Tool in Education and Research" (Adams, T., unpublished Master of Applied Science thesis, Royal Melbourne Institute of Technology, 1986).

During 1982 Tony spent a semester on study leave at Monash University, during which he gave some lectures on Logo as part of a Masters level course on Educational Software Development. Many of the students taking the course were teachers from humanities and social science backgrounds, so Tony presented the list processing features of Logo rather than turtle geometry. For one student, Susan Zammit, a teacher of French, these lectures sparked off some ideas for computer use in foreign language teaching. Susan had never used a computer before, but with some help she modified some list processing procedures from a book (Learning Logo on the Apple II, McDougall, Adams & Adams, Chapters 7 & 8) to prepare computer-generated worksheets for her French students. The exercises included sentence and paragraph generation, sentence jumbling, and coding games. They could be prepared with any vocabulary of phrases typed in by the teacher, so they could be made relevant to other material being covered in readings or in class at the time. This project is described in detail in "Computers and Foreign Language Teaching" (Zammit, S., unpublished Master of Educational Studies Project, Monash University, 1984).

Susan's ideas are being developed by a team at Monash University into packages for use in teaching other foreign languages as well. Currently the project is ready to start school trials with prototype programs written in Logo II. This work is described more fully in a paper, "A Software Development Project for Foreign Language Learning" (D'Aloisio, J. et al., in Salvas, A. and Dowling, C. [eds.], *Computers in Education: On the Crest of a Wave?*, Computer Education Group of Victoria, 1986). For technical reasons the final implementation of the programs will almost certainly be in another computer language, probably BASIC, but the original ideas for the programs arose directly out of Susan's experience with Logo list processing - and would never have happened if she had been introduced to programming using BASIC.

Another student from the same software development course, Bob Taylor, a geography teacher with a good deal of experience in curriculum development, planned to write a computer simulation to accompany other materials he had developed on the topic of water use. This topic can be very important for residents of Melbourne, depending on rainfalls and the levels of the city's reservoirs from year to year. Although there are many Australian native plants adapted to survival in our dry summers, the typical garden in suburban Melbourne has a lawn and a considerable collection of European shrubs and flowers, the survival of which depends on the householder watering them with hundreds of litres of water every summer. From time to time water restrictions of various levels of severity are imposed: gardens may not be watered with fixed sprinklers, only hand-held hoses, or only within certain hours of the day, for example. Bob's program was to simulate reservoir levels and effects on these of various patterns of water usage and restriction levels, to enable students to examine these processes and the related decision making involved.

Bob battled, working mainly on his own in BASIC, to develop his idea. He was not so much restricted by the language he was using as by the technology (memory size, graphics capability) of the school computers at the time, and by his own lack of programming experience. His work is described in a paper "Software Development by a Classroom Teacher" in the previously cited book, Computers in Education: On the Crest of a Wave?. Subsequently Bob has been able to arrange for the development of the programs he needs to be assigned as a project for a team of four software engineering students at the nearby Chisholm Institute of Technology. And here is where Logo comes into this story. The team, after carefully examining Bob's requirement, selected Logo as the most suitable implementation language (of those available on school computers) for the project. They developed the programs in Logo on an IBM PC, and subsequently modified them for the Apple IIe.

I find it exciting to think about the different roles Logo has played in these projects; as a language in which software can be written to study the language itself, as an idea generator and prototyping language, and a final implementation language. I suspect Logo is proving to be more versatile in this regard than even its developers imagined.

Europe by Richard Noss London University Logo Group Institute of Education Department of Math, Statistics & Computing 20 Bedford Way London, England WCI HOAL

#### Aesop's Tortoise and the Logo Turtle

Chronis Kynigos from Athens, Greece writes: In Aesop's fable, the tortoise wins the race because the hare falls asleep midway, due to its super-confidence. But is this the only reason? Perhaps the tortoise has some deeper qualities, such as consistency, taking one step at a time, and concentrating on each move and realizing that there is more to a race than the finishing line. Does Aesop's tortoise have anything in common with the intrinsically-minded Logo turtle? Will the Logo turtle win its race in the country where the fable was born?

Its been around three years now since Logo appeared in Greece. Up till now, its appearance has been restricted to some experimental applications in the state system, and in a few private schools. These fall into two categories: 1. Logo as one of the computing languages children must be taught, as part of their education on information technology, and

2. Logo as a technological means of teaching the present mathematics curriculum, by methods akin to the ones applied in the existing educational system.

Recently, an experimental Logo program has started in the Psychico College elementary school in Athens, where I have also been undertaking some research in children's learning of mathematics (based at the Institute of Education, University of London). The school program was designed with an eye to the future; from the beginning, it had to be one which would be guided and developed by the teachers in the school, without the presence of an "expert."

The program began last year with a series of preparatory seminars, hands-on workshops, and the gaining of familiarity with Logo by teachers. During that year, 20 elevenyear-old children participated in a Logo club outside the regular curriculum. From the beginning of the academic year 1986-87, all the children in the school have gradually been introduced to Logo. The central aim of the program is for Logo to become a classroom tool in the hands of both teachers and students, for encouraging and actively exploring the social and cognitive aspects of learning.

The setting is as follows. There is one computer room, with ten Apple IIc's; we use Apple Logo II. One Logo period a week is allocated for each class of 30 children, during which they work in groups of three, with their own teacher encouraging an informal educational atmosphere according to the aims described. The children are aged from 8 to 12 years and the school consists of roughly 700 children.

The system depends on a working framework within which a free educational atmosphere is sought. I should point out that the Greek educational system is highly centralized and extremely formal; so it will come as no surprise that the informal atmosphere we seek does not arise automatically. On the contrary, the teachers are taking the problems associated with introducing Logo extremely seriously; slowly but surely much is being achieved.

The educational aims of the program are to 'encourage active thinking, initiative (in thinking, creativity and decision making) and cooperation'. Each class is set up as follows: The children are split into freely formed but permanent groups of three, each group using one machine, disk and writing book. There is free collaboration and groups are responsible for presenting results. The role of the teacher is to provide an educational environment rich in opportunities for encouraging the development of the educational aims.

A major component of the work is based on 'Investigations' and collaboration, aimed at developing a 'question and encouragement' technique (no 'answers' or formal 'teaching'). These investigations consist typically of a 4lesson Logo project, which is either totally up to the group or is based on an initial idea or drawing set by the teacher. Thoughts, activities, results, and manner of collaboration are recorded by the children. Every four or five weekly periods, each group is responsible for giving in a report which consists of a printout of drawings and commands / procedures, a group essay on activities, thoughts, collaboration, further ideas, and conclusions.

At the time of writing, the program has been going on for 5 months so it is very early for any useful description of the progress made, partly due to the unavoidable complications of using computers. However, there is increasingly encouraging evidence that a hopeful start has been made; the main objective for the present being to overcome the novelty factor and to increase the degree to which the computers and Logo are used for real educational needs. It is certainly encouraging that these needs are seen by the teachers; after all, they were expressed partly as an outcome from the pilot Logo club and partly through discussions with Greek educationalists and the teachers themselves. (On a recent visit to the school, I found one of the most promising aspects to be the growing conviction on the part of some of the staff that the Logo work is leading children towards a more questioning and investigative attitude, and the teachers towards a more pupilcentered approach across the school curriculum -- Editor)

In any case, the Logo program for the time being has much lower ambitions. It is aimed at starting a sound and easily acceptable initiative which at the same time, will be oriented to future educational expectations (active students, initiative, cooperation). At the same time, we are trying to leave the door open for any possibilities or opportunities as they might arise either from the development and results of research in this field, or out of major educational policy decisions. And of course, we have the most encouraging -- but least surprising -- factor: the children love it!

For additional information on Logo in Greece, you may write to:

Chronis Kynigos University of London Institute of Education Dept. of Math, Statistics, and Computers 20 Bedford Way London, England WC1 HOAL

#### Minsky's Book Now in Spanish

Marvin Minsky's book, The Society of Mind: Human Intelligence in the Light of Artificial Intelligence, is now available in a Spanish edition. How does the mind work? Minsky suggests that the mind is a "society" that arises out of the interaction of very small agents that are themselves mindless, similar to life itself, which is made up of inanimate components. His book presents a fascinating journey into the depths of our inner realm. For ordering information, contact Emecé Distribuidora, Alsina 2062, 1090 Buenos Aires, Argentina.



#### by Barbara Randolph

Just for fun, wouldn't it be great to have a LogoPals clubhouse where you could drop in any day after school? If we str--e--t--ch our imaginations, what might we see happening there? Robots roaming around being commanded by turtles on screen? An artists' corner filled with masks from all over the world or bright and jazzy computer graphics or mobiles hanging from the ceiling? How about dancers learning the new "turtle steps" together? Perhaps an entire city built of LEGO with all its moving parts run by the Logo "brain" center? Or kids typing messages and sending them via modem to their LogoPals in Tokyo or Rio de Janeiro or New Mexico? It's fun to imagine the possibilities, isn't it? Anyone who's interested, send me your ideas for a LogoPals clubhouse, just for fun!

Speaking of LogoPals, here are some new students who are looking for penpals:

Jenny Geha (Toledo, Ohio, USA): I am ten years old and I like dancing and music. I'm a Logo beginner in the fourth grade. I would like a penpal from the western United States or Europe.

Rocky Klauser (Pennsauken, New Jersey, USA): I like video games, especially the flight simulator. I like baseball, too. I'm nine years old.

Moran Farhi (Kfar Hittim, Israel): I love to draw in Logo, especially airplanes and helicopters, because I love everything connected with aviation. I am a sixth grade boy, aged twelve years old.

Maureen Carney (Wauwatosa, Wisconsin, USA): My favorite hobbies are collecting stickers and playing tennis and soccer. My favorite things in Logo are working with the printer and making shapes. I would like my penpal from Kansas.

Kerry Emminger (Orchard Park, New York, USA): I study Logo at Nativity School. I also like track. I'm a third grader and am eight years old. Please send me a penpal from Portugal.

Sarah Petro (McKees Rock, Pennsylvania, USA): I'm in the sixth grade and I like to use Logo. I would like a girl penpal from England (soon) so we can write letters and trade programs.

Gina Gawrysiak (Milwaukee, Wisconsin, USA): My favorite hobby is hearing different ghost stories. I think Logo is lots of fun. My favorite activity in Logo is when you make a shape and change its sizes. I wold like my penpal from Canada.

Jon M. Strode (Toledo, Ohio, USA): I would like a Logo penpal from France because I can speak French. I'm a nine-and-a-half year old girl in the fourth grade.

Michael Noon (Orchard Park, New York, USA): My favorite sport is gymnastics. I am eight years old and in third grade. I am going to be a scientist in NASA. I want a penpal from Florida.

Sharon Bodnar (Pittsburgh, Pennsylvania USA): I'm in the sixth grade. I am in advanced Logo and I love it! I like making up my own programs. Please send me a Logo penpal from Arizona.

Bart Craver (Toledo, Ohio, USA): I'm in fourth grade and like Logo, football, soccer, skiing, and skateboarding. I would like a penpal from Switzerland. I'm nine years old. P.S. I like basketball too!

Would your students like to be Logo penpals? Have them write to me, telling their age and grade, hobbies and interests, and their favorite Logo activities. They can be matched with any of these boys and girls or others we have in our LogoPal network. Ages can range from primary school to high school levels. Children in the USA need to send a selfaddressed stamped envelope. Those outside the USA should enclose international postal coupons (purchased at the post office) for a 1-ounce or 28-gram reply.

LogoPals will be "open" all year round. If you have a special address for summer vacation or holidays, make sure you let your LogoPal know what it is. You can write to me at: LogoPals, c/o Barbara Randolph, 1455 East 56th Street, Chicago, IL 60637. I'd love to hear from you.

Special thanks to two new LogoPal "ambassadors," teachers Sister Mary Grace of Pittsburgh, Pennsylvania, and Carol Jackson of Orchard Park, New York, for their wonderful enthusiasm about Logo and for the encouragement they have given to their students as they participate in LogoPals.

P.S. This first year of LogoPals has been absolutely exciting for me, and so thanks, LogoPals, you're wonderful. I also have been fortunate this year to have had an enthusiastic and supportive (and not to mention patient) editor -- thanks, Tom! I'd especially like to acknowledge my number one LogoPal, Andy David, who has listened to my every waking thought about this project. Thanks, Andy, for being my faithful technical advisor and friend.

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

# A comprehensive guide to starting and running an electronic bulletin board system



Thousands of electronic bulletin boards on a myriad of subjects exist throughout the world. The ESSENTIAL GUIDE TO BULLETIN BOARD SYSTEMS offers a complete overview on what you or your organization need to begin and then run an electronic bulletin board.

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**Meckler Publishing Corporation** 

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by Patrick R. Dewey





# \*\* 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 its 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.