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

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# LOGO EXCHANGE

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JANUARY 1988

VOLUME 6 NUMBER 4

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The winter at Valley Forge was one of the worst times during the war. Food, clothing, and other supplies did not reach the camp. This was the reason why many men died of illness.



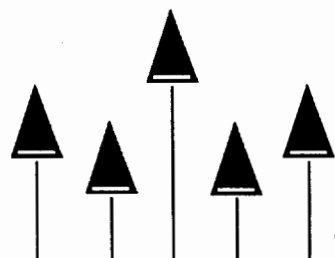
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International Council for Computers in Education



Publications





# LOGO EXCHANGE

VOLUME 6 NUMBER 5

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

JANUARY 1988

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## From the Editor

**This issue** brings you the first news from the SIGLogo officers. Recall that *LX* is now the journal of the ICCE SIGLogo and membership in this SIG carries with it a subscription to the *Logo Exchange*. Your temporary officers have met and drawn up ByLaws which will be published in a future issue. Take a moment to read the brief biography of each officer — I'm sure you will feel that they are excellent representatives of the Logo community. As indicated in the "Meet the Officers" article, the Bylaws will be voted on at NECC this summer and permanent officers will be elected. If you are interested in becoming an officer, please let one of the temporary officers or myself know — you don't have to be at NECC to run for office. Your participation can only strengthen the organization.

How about Logo activities in your local area? Is there a local Logo user's group? What are they doing? We'd love to publish news of meetings, conferences, or other activities so that the community of Logo users world-wide can become better acquainted. The International Column provides us with windows on what is going on world-wide — how about some news from the United States and Canada? Your comments don't have to be in polished form — just send the news to me and I'll collect them in a SIGLogo column in a future issue.

Let's make this new year (this IS the January issue!) a year that is rich in Logo activities. For myself, I would hope to see Logo broaden it's scope to a wider audience. I would like to see young people of every age using Logo as an integral part of many subject areas. I would like to see more teachers empowered and excited by the potential of the Logo environment. I would like to see universities find Logo an acceptable language for introducing computing to adults, both young and old. I would like to see the scope of Logo broaden through such vehicles as Lego/Logo or music Logos.

What are your wishes for this new year with Logo? What can you do to make those dreams come true. Join with us to make SIGLogo a vehicle for communication and change throughout the Logo community.

*Sharon Burrowes Yoder*

Cover: This month's cover is again part of a 12-event animated timeline of the Revolutionary War done by fifth graders at the Lafayette School in Wayne, NJ. Steven Petreoski, Andrew Rubin, Sean Vij, and Jason Meyer have documented the conditions at Valley Forge. Arlene Schoenberger was their teacher and Gary Stager their Logo consultant.

## Monthly Musings

by Tom Lough

### Incidental Learning

A couple of years ago, when our son, Kyser, was in his "terrible two's," I firmly decided that I would never ever take him to a toy store. How could I possibly expect him to deal with the overwhelming array of attractions? How could I resist wanting to buy him [and me!] one of everything?

As happens to most parents, I have experienced a mellowing of my position since then. As it turns out, I really enjoy taking him on an outing to our local toy store now that he is four years old. He is able to deal very well with the flood of toys. [I still have my share of trouble, though!]

During the days of Christmas shopping, we went to the toy store for a final reconnaissance, to make sure that we knew exactly what to ask ole Santa for. Kyser asked to be placed in the shopping cart, and I happily obliged. [He is much easier to manage when in the cart rather than when "on the loose."] At that moment, I realized that I had an opportunity to facilitate some special learning.

I held the cart still until he discovered that he would have to tell me to move. He soon learned that I responded only to a limited set of commands. Yep, you guessed it. Forward, back, right, and left.

Can you imagine the scene? The four-year-old lad bellowing out sequences of FORWARD FORWARD FORWARD RIGHT RIGHT FORWARD FORWARD FORWARD STOP and the father bending to obey, propelling the shopping cart into the next aisle...

Lots of things happened during that shopping trip. Kyser reinforced his concepts of the left and right directions [they are still a little "shaky"]. He realized that the RIGHT and LEFT commands resulted in a turning of his shopping cart, with no other motion. He learned how to use combinations of FORWARD or BACK and RIGHT or LEFT to get to the next toy display. In other words, he was immersed in a personal world of FORWARD, BACK, RIGHT, and

LEFT and he used the commands to accomplish personal goals.

***"Shopping is a feeling."***

—True Stories

Something happened to me also. I realized

once again the importance of providing opportunities for children to set and reach meaningful goals, and of always being alert for learning opportunities in daily life.

When we returned home that afternoon, he asked me on his own to set up Logo on the computer so he could practice.

And, oh yes, I bought him something at the toy store . . . a turtle, natch!

FD 100!

Tom Lough  
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## Logo Ideas

### Playing with Polygons

by Eadie Adamson

Last year we were all so excited about exploring LogoWriter that we neglected some simple but classic Logo problems, other than that of drawing squares and rectangles to make cities. This year I decided that I wanted my students to have the problem-solving experience of discovering polygons and then making a tool page of shape procedures to use in other projects I had in mind. (More about those projects in a later column.)

Following Polya's steps to problem solving (mathematician George Polya's *How to Solve It*, referred to in Papert's *Mindstorms*), I introduced the idea of solving a problem by looking at what you know, where you might have seen something like it before and how it is like the new problem, thus narrowing down what you need to know. This kind of thinking is central to solving many Logo problems. I wanted my students to start seeing the possibilities of building upon what they already knew as they worked on their programming this year.

First I drew a square and an equilateral triangle. Then I asked my students to tell me what makes a square. Next we considered in what ways an equilateral triangle is like a square and in what ways it is different.

My next question was: Keeping in mind the idea that we have seen something like it before, how much do we already *know* about how to make an equilateral triangle in Logo? (We can determine the length of a side, since all are equal. We know the number of sides.) What do we need to find out in order to make a perfect equilateral triangle? (We need to find the angle.)

I suggested a way to use the computer to solve the problem. We had determined that the angle was what we needed to find, the rest we knew. We decided to solve the triangle problem as a group, using our demonstration monitor. I suggested starting by working in the Command Center with a line like this (waiting to write a procedure until we were sure of the angle):

```
CG REPEAT 3 [FORWARD 50 RIGHT 90]
```

Using the turn for a square helped to illustrate that what is correct for a square is too small an angle for a triangle. Next we tried a smaller turn than 90, then a larger turn, so we could see the result. I suggested we check what would happen with a turn of 180. By now most of the students had concluded the number we were looking for would fall between 90 and 180. With LogoWriter we could delete the number just used, change the

angle, and press Return. The old shape would be erased and the new one drawn. (Other versions of Logo have different ways of repeating a line so that it is unnecessary to type it repeatedly.)

With the turtle hidden, it is easier to see if the angle chosen is correct. The shape should close completely, especially if you want to be able to fill it later. Sometimes it is helpful to point out (or to encourage someone else to observe) that too little turn will not close. Although sometimes creating wonderful shapes, too much turn will cause the final line to cross over the first line, provided turns are no more than 180.

We tried another way to check if the shape was perfect. First we put the turtle in the center of the screen using the Home command. Then we typed SHOW POS. A list [0 0], the coordinate position of the turtle, was reported to us (SHOW is a command in LogoWriter that puts information in the Command Center.). After trying a new angle for a triangle, typing SHOW POS helped us to be sure that the turtle had returned to where it started. If, after typing SHOW POS, the report is not [0 0] it was clear that the angle was not correct, and we needed to try again.

I had to get my students comfortable with the idea of using SHOW POS to get a report of the turtle's position. I gave them just a simple explanation of the first number indicating position in left-right direction, and the second meaning up-down.

Once the perfect angle was found, we wrote a procedure with a variable size with which to experiment. I allowed time to explore designs before challenging my students to find the other shapes.

Later we would use SHOW POS after using LogoWriter's turtle-move keys to position the turtle. Using SHOW POS you can find a starting position for the turtle to begin drawing. First place the turtle, then type

```
SHOW POS
```

You will see a list representing the current turtle position in the Command Center. Then type

```
PU SETPOS [ the list reported by SHOW POS goes here ] PD
```

before drawing a shape. (This also a neat trick to use with the LogoWriter Flashing Sign idea when you want more than one sign to flash at a time. Can you figure out how to use SETPOS to do this?)

We used a polygon worksheet (see the end of this article),

## Logo Ideas

first to find a pentagon and a hexagon, then to find all the regular polygons up to a 20 or 36-sided figure. Although I'm not overly fond of using worksheets, we needed to keep track of what we were finding, and I also wanted students to be able to draw some conclusions from their results. Additionally, they could paste these sheets into their notebooks (we store our disks in a hard-backed composition book, keeping notes and disk together).

This worksheet provides a good opportunity to assign a little research into the naming of polygons, since all the shapes on the worksheet are not named. See how many notice the "rule of 360" hinted at by the "x" and "=" on each line of the worksheet. I also asked my students, after they had found a number of shapes, to try to come to some conclusions about the sets of numbers they had collected. Is there a relationship between the repeats (number of sides) and the angles? (There is an inverse relationship: angles get smaller as the number of sides increase.)

Each student may want to find all the shapes on their own. One of my fourth grade students was obsessively determined to find every single shape on the worksheet and spent extra time in the computer room working on the project. In fact, it was difficult to get him write procedures until he had found *every* polygon.

If you have another agenda, though, and don't want to spend an enormous time on what eventually becomes a somewhat repetitive task, you might want to assign shapes to different teams. Each team could have the task of finding several and reporting to the group. The reporting task should include discussion of how to solve the problem: who just guessed and was right, who tried a number and had to narrow it down, who found another shape by accident.

Some shapes which you might think would be perfect, such as a nonagon, turn out to be less than so. LogoWriter rounds to four decimal places, so occasionally you cannot get a perfect [0 0] position. I showed my students how to watch the numbers SHOW POS reported, and how to narrow down their guess to as near [0 0] as possible. We used a general rule of thumb: the second number is less than zero if the turtle has not yet neared the center, more than zero if the turn has been too large.

Some of my students began experimenting with decimal places to find the perfect shape. Eventually we used SHOW 360/13 (or whatever sided figure we needed) to find the angle ahead of time. When even that wasn't perfect, some students made excursions into added decimal places, a nice opportunity to talk about decimals outside of math class!

This project prompted some students to "invent" or almost "invent" the all-purpose "poly" procedure:

```
TO POLY :SIDES :SIZE
  REPEAT :SIDES [FORWARD :SIZE ->
    RIGHT 360/:SIDES]
END
```

You may or may not want to take this digression, although I find that for some age groups it makes a nice kind of summation for the polygon project.

From here the exercise may take its own turn, depending upon the interest and ability level of your students. Incrementing (adding to) variables in a recursive procedure allows wonderful growing shapes to be drawn rapidly. It might be a nice next step to show your students if they begin writing TRI 5, TRI 10, TRI 30, and so on. For example, a "new" way to do just that for them is:

```
TO TRI :SIZE
  REPEAT 3 [FORWARD :SIZE RIGHT 90]
  TRI :SIZE + 5
END
```

Use of negative numbers can be introduced to change direction. Stop rules might be needed next. Islamic design or tessellation could be included as well.

### For the POLY-WISE:

If you're working with LogoWriter, try having all four turtles draw mirror images of the designs. If there is a procedure for left and a procedure for right for a given shape, which turtles need negative inputs for the angle to create a four-directional design? If you have only a procedure which turns right, can you still have the four turtles draw in mirror image? I had fun playing with this idea myself. Here's what I came up with, based on a POLYR and POLYL pair of procedures:

```
TO POLYR :SIDES :SIZE
  REPEAT :SIDES [FORWARD :SIZE ->
    RIGHT 360 / :SIDES]
END
```

```
TO POLYL :SIDES :SIZE
  REPEAT :SIDES [FORWARD :SIZE ->
    LEFT 360 / :SIDES]
END
```

Now get all four turtles to work!

## Logo Ideas

```

TO FOUR :SIDES :SIZE
  TELL 0
    POLYR :SIDES :SIZE
  TELL 1
    POLYL :SIDES (- :SIZE)
  TELL 2
    POLYR :SIDES (- :SIZE)
  TELL 3
    POLYL :SIDES :SIZE
END

```

Now make it fancier. First move the turtles so the design is more centered:

```

TO START
  RG
  TELL ALL
    HT
    PU
    RIGHT 90
    FORWARD 19
    LEFT 90
    FORWARD 20
    PD
END

```

Add a little recursive trick (can you predict what this does?):

### Attention SIGLogo Members

#### SIGLogo Meets at NECC '88

SIGLogo members will hold their annual meeting at NECC '88 in Dallas, TX, on June 15, 1988 from 7:00 - 9:00 PM. The agenda and meeting place will be announced later. Plan now to attend.

#### Mailbox too Full?

The sale of mailing labels brings ICCE additional income for its activities (and to pay its staff). However, if you feel your mailbox is a little too full, you may request that we remove your name from the list from which mailing labels are generated and sold. Please notify Bill Park at ICCE, University of Oregon, 1787 Agate St., Eugene, OR 97403-9905.

```

TO POLYSPI :SIDES :SIZE
  IF :SIZE > 45 [STOP]  ←You could set a max
    FOUR :SIDES :SIZE   here with another
                        variable.
  POLYSPI :SIZES (:SIZE + 5)
  FOUR :SIDES (:SIDES - :SIZE)
END

```

Type START to position the turtles, then try POLYSPI with 6, 7, 8 or 9 sides and a starting size of 5. What do you get? Where might you add a turn to make a still more complex design? Experiment with changing colors too!

Here are some other neat polygon ideas, adapted from the new LogoWriter Primary materials:

- Make a robot construction set from polygons.
- Decide on the appropriate polygons.
- Write procedures with variables OR, if your students aren't ready for variables, write each shape in a small, medium and large size (decide together how big each will be).
- Combine the shapes on a single page.
- Name the page ROBOTTOOLS.
- Save the tools on everyone's disk.
- Now choose a new page for the robot, name it ROBOT. Type GETTOOLS "ROBOTTOOLS to load the shapes into the workspace.

Design a friendly robot! If you've used SHOW POS, try using turtle-move keys and SHOW POS, then writing PU SETPOS (etc.) to position each part. Don't forget to name the robot.

If your students need a rectangle, you might suggest piling several squares on top of one another, then filling with the same color.

Extend the idea by writing a robot story. Connect the pictures and the pages or write the story around the robot picture. What kind of robot adventure might your class think up? What about a scrambled adventure? Make the story interactive by asking the reader to make choices.

Send us your best pictures and stories. Maybe your page will end up on a *Logo Exchange* cover!

Eadie Adamson  
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**An ICCE Copy Me! Page**

Logo Ideas

## POLYGON WORKSHEET

Following the same method we used to find the angle for a triangle, find the angles for a PENTAGON (5 sides) and a HEXAGON (6 sides). Fill in the chart below but keep the repeat numbers in order (3, 4, 5, 6 and so on). Supply names for whatever shapes you can.

SHAPE:	REPEAT:	x	ANGLE:	=
<u>TRIANGLE</u>	_____	x	_____	=
<u>SQUARE</u>	_____	x	_____	=
<u>PENTAGON</u>	_____	x	_____	=
<u>HEXAGON</u>	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=
_____	_____	x	_____	=

- Now experiment with these shapes. Here are some ideas:
1. Can you write a variable procedure for each? Call the variable :SIDE.
  2. Can you use a pentagon and draw a flower with five petals?
  3. Can you make a windmill with triangles?
  4. Can you add a triangle to each side of a pentagon to make a star?
  5. Use three of the above shapes to create a design.

## Testudinal Testimony

### Research on Variables, Algebra, and Logo: Part I

by Douglas H. Clements

To begin this column, we will present a "classic" algebra problem. Don't stop reading just because algebra isn't your "thing." Later in the article, we will see how the difficulties involved in solving algebra word problems relate to the learning to Logo. And now, the problem:

Write an equation using the variables S and P to represent this statement: "There are six times as many students as professors at this university." Use S for the number of students and P for the number of professors.

Soloway, Lochhead, and Clement (1982) found that their university students frequently erred on this problem. Most of these students wrote:  $6S = 1P$  (be honest to yourself at least, did you?). The researchers claimed that throughout their schooling, students develop limited, special purpose translation algorithms (e.g., trivial word-to-symbol matching). Such algorithms work for many textbook problems, but do not involve a true understanding of algebra.

On the "students and professors" problem, students used two flawed strategies. In the first, they simply assumed that the order of the key words in the problem statement could be mapped directly into the order of symbols appearing in the algebraic equation. In the second, they confused the semantics of the equation. They interpreted the reversed equation,  $6S = P$ , as stating that a large group of students are associated with a small group of professors. The letter P stood for "a professor" rather than "the number of professors." The equal sign expresses a comparison or association, rather than an equivalence. Thus, to these students, the equation indicated that there were more S's than P's. Their "equation" is actually a passive picture representing the different sizes of the groups. (Davis, 1984, would say that instead of using an equation frame, or script, the students had used a label frame, as one might in the following situation:  $100 \text{ cm} = 1 \text{ m}$ .)

In contrast, the correct equation,  $S = 6P$ , expresses an active operation being performed on one number (the number of professors) to yield another number (the number of students). It does not describe the sizes of groups literally. It describes an equivalence relation that would occur if one were to make the group of professors six times larger. In one student's words, "If you want to even out the number of students to the number of professors, you'd have to have six times as many professors" (Soloway et al., 1982, p. 175). This student viewed the equation in a procedural manner—as an instruction to *act*. In brief, the incorrect answer is a *description* of a situation, whereas the correct answer represents a *prescription* for action.

Based on this idea, the researchers asked: Would students placed in an environment which induced them to take a more active view of equations make fewer errors? A computer programming environment was the clear choice. A program is a prescription for action. Students from a computer programming course were asked to write either an equation or a computer program to represent statements similar to the "students and professors" problem. As predicted, they got significantly more problems correct when writing a program than when writing an equation. Similarly, they were more likely correctly to read a program than an equation.

#### Programming and the Variable Concept

Why would programming facilitate solving problems involving variables? Soloway and his colleagues suggested the following reasons:

- *Unambiguous semantics of programming language constructions.* That is, while symbols are often open to a variety of interpretations in mathematics, programming languages require that only one interpretation be associated with each symbol.
- *Explicitness required by the syntax of programming languages.* For example, the equation's "6S" could be construed as "six students." In contrast, programming's "6 \* S" is more likely to mean the operation of multiplication.
- *Viewing an "equation" in a programming language as an active input/output transformation.* That is, in programming there is an input that is operated on to produce an output.
- *The practice of decomposing a problem into explicit steps.*
- *The practice of debugging programs* (equations in a mathematics course are rarely "run").

Although many programming advocates emphasize the importance of debugging, videotapes revealed that the other factors, such as the input/output idea, were more important in this case.

#### Other Encouraging Reports

Results similar to Soloway et al.'s have been reported, using both Logo and BASIC. Researchers have found that programming enhances the understanding of variables for students from the primary grades to high school, even in comparison to other treatments (Carmichael, Burnett, Higginson, Moore, & Pollard, 1985; Findlayson, 1984; Hart, 1982; Milner, 1973; Oprea, 1985). In one study, four average-ability fourth graders were presented with six sets of tasks during individual pre-treatment interviews (Nelson, 1986). They then used Logo to solve problems involving rectangles, formulas and equations, and number sequences. After this experience, the tasks were presented again. Two students used literal symbols in an improved manner. During the pre-Logo interviews, they had used a correspondence between the letters of the alphabet and the positive integers to assign values to literal symbols in equations (i.e.,  $A = 1$ ,  $B = 2$ , etc.).

## RESEARCH ON VARIABLES, ALGEBRA, AND LOGO — CONTINUED

However, after Logo, they determined each literal symbol's value correctly. All the students could use literal symbols in formulas after Logo, whereas none could before.

### Varying Variables

Nelson (1986) also reported that students exhibited different perceptions of the uses of literal symbols in Logo programming, such as names for memory locations, missing numbers in equations and formulas, missing dimensions of rectangles, and recursive symbols. It may be useful to think about how the concept of variable *can* vary in the Logo environment. Sutherland (1987?) identified the following categories:

- *One variable input to a procedure* (not operated on within the procedure)
- *Variable input as scale factor*
- *More than one variable input to a procedure* (often used to avoid expressing a general relationship between variables within a procedure)
- *Variable input operated on within a procedure*
- *Variable input to a general superprocedure which calls a variable subprocedure*
- *Variable within an assignment statement*
- *Variable input to define a mathematical function in Logo*
- *Variable in a conditional expression*

### Varying Contexts

A related question is: Will students be able to use the variable idea if the *context* varies? That is, will they be able to generalize the idea as used in Logo to other situations?

After providing Logo experiences, Lehrer and Smith (1986) asked third grade students how to modify a procedure which drew a square with sides of a constant length so that it could take a variable input. Almost all the students (96%) correctly modified the procedure. Then they were asked what a variable was. The responses of 38% were tied to a specific procedure; 29% were tied to Logo (but not a single procedure); 13% were general ("it is something that varies, like a name, number, anything"); and 29% made no response. Thus, most of these third graders' conceptualizations were bound to the Logo context, with little generalization.

Noss (1985) studied the learning of children in grades 3, 4, and 5 for 18 months. Exploratory interviews were conducted to answer two questions: How many children use the Logo ideas of naming and inputs to facilitate the conceptualization and symbolization of the concept of algebraic variable? In what ways are children able to use their Logo-based experience to assist the process of formalization?

Questions were posed so as to encourage children to construct a formalism, rather than interpret existing symbols. For

example, one item stated, "Peter has some marbles. Jane has some marbles. What could you write for the number of marbles Peter and Jane have altogether?" Another showed a square and asked, "What could you write for the distance all around it."

Six of eight children interviewed were able to suggest names for the unknowns. Interesting, the two who were not able to do so had not used variables in the context of Logo to any extent. One, when prompted to think of Logo, was able to say only, "We make up procedure names." Thus, it may be that any conceptual connections was based on the idea of naming inputs to procedures, rather than the idea of naming *per se*. Children had more difficulty with the marble item than items involving length or other continuous quantities, possibly because their use of variables in Logo rarely involved discrete quantities.

One limitation is that children were interviewed by the person who always came to the school to work with them on Logo and that the task was posed as one of formulating rules for other children who had learned Logo. Nevertheless, only one child began work by using the "dots" (colon) convention for naming variables. Three others adopted it while working. Nicola apparently began answering the marble question without considering Logo, but used her Logo knowledge as an aide to expression:

**Nicola:** You could use the input again (she had not previously referred to inputs).

**Interviewer:** Alright, show me how.

**N:** (writes) :Peter + :Jane = all the marbles

**I:** Can you read it out?

**N:** Peter plus Jane equals all the marbles. You use those two as the inputs, with as many marbles as you want to.

**I:** So what are the dots in front of Peter and Jane?

**N:** They're to represent that it's an input.

**I:** But this isn't a Logo program is it?

**N:** I know, but if it was... just to say that it's an input.

**I:** So what does the input actually mean there then?

**N:** That you can type in however size you want it or how many you want it. How ever many they want. How many they want Peter to have, and how many they want Jane to have.

The interviews provided evidence that children made such connections between Logo work and formalizations of rules, and that children constructed names that represented a range of numbers (rather than a single, specific number, as is the natural tendency of children). For instance, Julie proposed that she "make a word for" certain numbers in the problems, even though "You don't know what they [the numbers] are." It appears that children used the metaphor of typing in a value at the keyboard to help them conceptualize a range of numbers, while only necessarily considering one at a time. Again, the two children who had not used Logo variables extensively were the two most likely to demonstrate a "specific number" misconception. One, for example, made up labels, but seemed confused by the idea that the value would vary. He resolved his problem by assigning

## RESEARCH ON VARIABLES, ALGEBRA, AND LOGO — CONTINUED

specific numbers; he wrote

A	B	C	D	E	F	G	H	I	J
1	2	3	4	5	6	7	8	9	10

and said, "Now... we can have a certain number up to... we can have any number up to... we can go up to 26."

Some students began with Logo-influenced formulations, and, with prompting, moved toward more abstract algebraic ones. For instance, in a problem in which the number of green blocks was always four greater than then number of red blocks, one boy moved from:

```
IF :REDS = 10 [ MAKE :GREENS 14 ]
to
MAKE :GREENS FOUR MORE THAN REDS
to
G. = R. + 4
```

Thus, he seems to have used knowledge of Logo as a catalyst in moving from a descriptive, specific-number statement to a generalized algebraic equation.

Noss concluded that Logo can benefit children in the development of the concept of variable. However, he emphasized that this does not mean that children necessarily have gained specific information about variables or algebra. They may have, however, gained a conceptual framework—based on intuitions and "primitive conceptions" from Logo experiences—upon which later algebraic learning can be based.

Lawler (1986) has shown how the idea of the systematic incrementing of variables developed in a Logo context and was subsequently extended to other contexts. His 8-year-old son, Robby, had been introduced to variables through extensive work with a POLYSPI procedure. This work had emphasized the notion that focussing on the systematic changes of a single variable was a fruitful way to understanding the results from complex interactions of several variables. Robby next explored the effects of changing the inputs to an INSPI procedure (in which the amount of turn is incremented, rather than the distance). He used the idea of incrementing a (potentially interesting) variable to explore the variety of designs produced with this procedure.

Perhaps most interesting is Robby's later experience with a paper-cutting puzzle. Briefly, in this puzzle one tapes two loops perpendicularly and cuts around their middles. Surprisingly, a square is produced. Robby did not stop there, however. He joined and cut three circles. After a while, he found that two rectangles were produced. Four circles yielded four squares. Five produced two identical non-planar shapes and so on. Robby then hit upon an idea: "Hey! I've got a new theory: the odd-numbered circles make two and the evens all stay together." When asked how he had gotten the idea for the exploration, he explained, "It's just like what we did at Logo with the shape

families. I changed one thing, a little at a time" (p. 78). So we see that Robby saw the earlier Logo activities as the embodiment of the powerful idea of systematically incrementing a variable. When asked to provide his theory, he constructed a seven circle puzzle, expecting—and demonstrating—that this did indeed produce two figures. Hypothesis testing had emerged from a "non-theoretical" but orderly investigation of interesting effects. Lawler claims that incrementing variables had become a method of determining "what's what."

In summary, students' ability to generalize their Logo-based notion of variable may depend to a great degree on the depth of their Logo experience and the support given them in making the abstraction and generalization. This is not surprising, considering research results from other domains. Nevertheless, there is some evidence that Logo provides an "entry" to the use of the powerful tool of algebra.

It is also no surprise that research has uncovered many difficulties and misconceptions experienced by students. The next column will discuss such problems along with research-based suggestions for helping students deal with them.

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## LOGO BOOK REVIEWS — WITH SARAH JOYCE

TEACHING WITH LOGO: Building Blocks for Learning. By Molly Watt and Dan Watt. xix and 364 pp.; diags., appendices, bibliogr., index. Menio Park, California: Addison-Wesley, 1986

The use of Logo in schools has received increasing attention in recent years. Among the many publications on this topic is this book by Molly and Dan Watt which is not only a practical guide for teachers and parents but also a description of a philosophy of teaching.

Logo is an interactive activity by means of which the students learn through discovery. It is the authors' intent that this book be approached in a similar fashion. The reader is invited to explore the suggested activities as would his or her students. Thus, readers should not only learn about Logo but should also become acquainted with their own learning style. In addition, the reader is treated in a manner that is friendly, casual and *always* supportive. Throughout this process, the authors appear to be modelling the teaching methods used in their own classrooms and, in so doing, provide an excellent example of good pedagogical practice.

The Watts are well qualified to undertake a book such as this. Dan Watt acquired experience as a programmer when a research assistant at M.I.T. during a sabbatical leave from his seven year teaching position. While at M.I.T. he continued his association with the classroom by working regularly with a small group of fifth grade students. Molly Watt, on the other hand, came later to the field of computers in education after many years as a public school teacher. One of her educational emphases is to ensure a supportive learning environment for students.

## LOGO BOOK REVIEWS — CONTINUED

The combination of their learning and teaching styles helps to make this a well thought-out and practical book. Both authors are enthusiastic, dedicated and reflective teachers who have twelve years of Logo teaching experience between them.

"Teaching with Logo" is beautifully produced and easy to read. The book is organized around the learning experiences of five hypothetical grade five students and their teachers (the Watts) as they proceed through a series of clearly presented classroom activities. The diary entries which were kept by the students after each lesson are included in the text. This format and the style - large child type printing - not only models a method for teachers to observe and listen to their students' ideas, but demonstrates the Watts' commitment to child-centred education. The teachers' notes, which are also included, provide the Watts a vehicle for emphasizing certain teaching strategies.

The book has nine chapters and an Afterword. The brief introductory chapter describes twenty ideas such as recursion, the Total Turtle Trip Theorem, debugging, naming and variables, which the authors identify as being 'embedded' in the Logo language. This chapter also acts as a guide to the use of the book.

The next seven chapters lead students to the point where they are programming at an intermediate level using five common starting points in Logo. Chapter 8 provides specific suggestions for teachers and chapter 9 contains a set of activities for use by advanced students. The Afterword summarizes some hopes, dreams and problems regarding the future of Logo use in schools, and underscores the need for improved understanding of the potential and of the limitations of Logo. Diagrams and illustrations are clear, comprehensive and enhance the text. An annotated bibliography on Logo is included together with a list of other sources which have guided the philosophical and educational point of view of the authors. The procedures in the book are written in Terrapin/Krell dialect of Logo, but there is also an appendix providing a listing of these procedure for LCS1 dialects of Logo for Apple, I.B.M. and Atari.

The main strength of the book lies in its practicality. It is written as a guide and the authors never lose sight of their audience. They are teachers first, proponents of Logo second. Although there is a chapter devoted specifically to the role of the teacher, this topic is also addressed throughout the book. The teachers' work and thoughts in both the computer environment and the classroom environment are described. There are, for example, guidelines for running classroom meetings, a checklist for students to ensure that they have understood the expectations of the teacher, a demonstrated method of maintaining class records and finally, each chapter concludes with an example of

## LOGO BOOK REVIEWS — CONTINUED

teachers' notes on the individual students. This attention to instructional details enhances the value of the book for both teacher and the parents.

This book does not see the introduction of Logo into the classrooms the sole answer to many of the ills present there. It includes assessments of both the potential and limitations of Logo. The Watts see Logo as a growing culture that needs to be developed and enriched and one of the aims of this book is that it be a contribution to this culture. It is a welcome addition to it.

It is tempting to read completely through the book without using a computer but its intent, as in Logo itself, is to allow teachers to learn through self directed projects and explorations. It is, therefore, more beneficial for the reader to work through the Logo examples on a computer whilst reading. The authors' claim to incorporate the instructional role of the teacher, but some readers who are unfamiliar with Logo may find this insufficient and may run into difficulties. These, however, are attributable to the nature of Logo itself rather than any deficiencies in the authors' presentation. At this point, an ally in the computer culture would be an asset.

To one who has experienced a great deal of frustration in both trying to learn Logo and in understanding its place in education, this book has shown what a computer learning environment can be when organized and operated by enthusiastic, dedicated and caring teachers. It models a complete and detailed teaching method which would not be difficult for the average teacher or parent to follow. Anyone who has thought about the nature of Logo and its place in education will appreciate the reflections and the insights in the book. Others will gain a great deal from the honest appraisal of its potential.

This well written and attractively produced book achieves its aims. It is valuable not only for its contribution to the understanding of the teaching of Logo but also for its contribution to the understanding of the meaning of teaching. It will educate readers who are eager to become involved with the teaching of Logo and will prove a useful addition to their libraries.

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## LogoPals

### "MIX, STIX, and Logo Penpals"

by Barbara Randolph

A new opportunity now exists for Logo educators and students who would like to teleconference with others who are working with Logo. MIX is a new educators information exchange with two conferences of special interest to Logo users. Its "Logo Conference" has been set up especially for Logo educators.

Logo students can participate in STIX, a student information exchange. Ardu Erlich, a junior high school teacher in St. Paul, MN, is the moderator. She's inviting Logo students to use their modems to become involved in Logo Penpals. The letters you write will include some fun projects and the programs you write for them.

Those who are interested can write to: MIX, EMS-McGraw Hill, 9855 West 78th Street, Eden Prairie, Minnesota, 55344 (USA) and inquire about a subscription to MIX. (Or you can call 1-800-622-6310). I would like to thank Grif Wigley, the editor of MIX, and Ardu for informing us about these new Logo electronic mail activities.

Logo students worldwide who would like to write to each other via the postal mail can become one of our LogoPals. Have them write a letter, telling their favorite Logo programs and projects, their hobbies and interests, and their age and grade. They can be matched with other girls and boys in our LogoPal network. Requests for penpals from certain places will be accommodated when possible.

Children in the USA are requested to send a self-addressed stamped envelope. Those students outside the USA should include international postal coupons (purchased at the post office) for a 1-ounce or 28-gram reply. To save on postage, a teacher can send one package containing a group of letters.

Write to: **LogoPals**  
c/o Barbara Randolph  
1455 East 56th Street  
Chicago, Illinois 60637  
USA

If you would like to establish correspondence with another teacher and class in the United States or in another country in the world, then join the Logo Class Penpal Network. You will be able to share Logo teaching ideas, procedures and possibly create projects to work on together. To obtain a free application kit, send a long stamped self addressed envelope to:

**Logo Class Penpal Network**  
University of Virginia  
Curry School of Education  
Ruffner Hall  
Charlottesville, Virginia 22903  
USA

Take advantage of these opportunities to communicate with other Logo teachers and learners. We have so much to share with each other—and it's fun too!

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

## Meet the SIGLogo Board

**SIGLogo** is the Special Interest Group for Logo-Using Educators of the ICCE. As a subscriber to the *Logo Exchange* you become a member of this newly formed group. SIGLogo is governed by a Board of Directors that includes the President, Past-President, President-Elect, Vice President and Communications Officer. ICCE appointed three acting officers to draft the SIGLogo Bylaws. Peter Rawitsch, from Guilderland Center, New York, is the Acting President. Gary S. Stager, from Wayne New Jersey, is the Acting Vice-President. The Communications Officer is Theodore M. Norton, from Pelham, Massachusetts. These three individuals bring diverse Logo backgrounds to the SIGLogo Board.

**Peter Rawitsch** teaches first grade in Glenmont, New York. He tells his students that "you can do anything in Logo" and provides them with opportunities to make their dreams come true. Peter co-founded the Albany-Schenectady-Troy Logo Users' Group (ASTROLUG) three years ago. He is co-editor of the ASTROLUG newsletter, *Pendown*. Peter has taught Logo courses at the State University of New York in Albany. He enjoys using songs to illustrate Logo concepts and ideas. He is working on creating new visual and musical learning models.

**Gary S. Stager** is the Director of Training for the Network for Action in Microcomputer Education (NAME). NAME provides computer training and support to over 70 school districts in New Jersey. Gary's interest in the curriculum applications of Logo has led him to develop a variety of tool procedures and microworlds. He has presented his work at LOGO '86 and the East and West Coast Logo Conferences. His session "If There Had Been Logo...I Might Have Learned Math," focused on providing children with a learning environment to explore and manipulate mathematical concepts. Gary is currently getting ready to host the second annual New Jersey Educational Computing Conference on March 25th and 26th in Somerset.

**Theodore M. Norton** holds a doctorate in political theory from New York University and is currently earning a second doctorate in Cognitive Studies of Computers in Learning, at the University of Massachusetts-Amherst. He has taught social theory, cultural criticism, and history at Vassar College, Hampshire College, and New York University. Ted is interested in computing, cultural issues, and education; his work with Logo has helped him focus his research in these areas. He looks forward to the day when Logo will support the rich visual and sound resources offered by some of the newer microcomputers. He welcomes continuing discussion on Logo as philosophy of education.

The first business meeting of the Board members was held in early December near Albany, New York. Using the Bylaws of the SIGTE as a model, they proposed that the purpose of SIGLogo is to "support and promote the use of Logo as a tool for learning and as a language for computer science." A copy of the complete Bylaws will appear in a future issue of the *Logo Exchange*. Members of SIGLogo will have an opportunity to vote on the Bylaws this June at NECC '88 in Dallas, Texas. Peter, Gary, and Ted welcome your thoughts and concerns about SIGLogo. Members can write to them at the following addresses.

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