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



LOGO EXCHANGE

January 1990

Volume 8 Number 5

CONNECTIONS

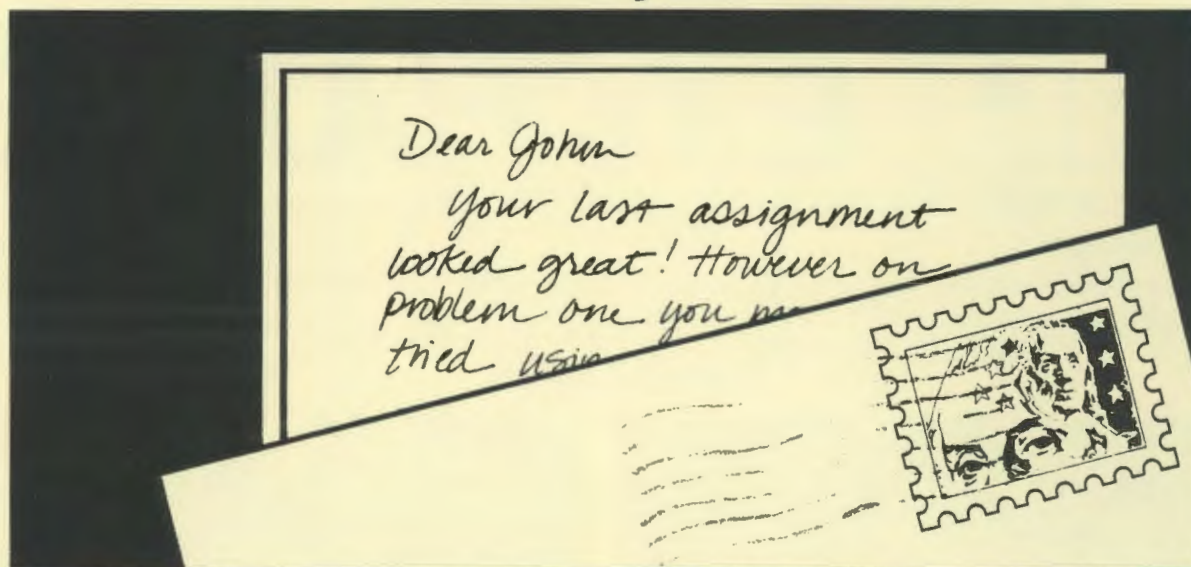


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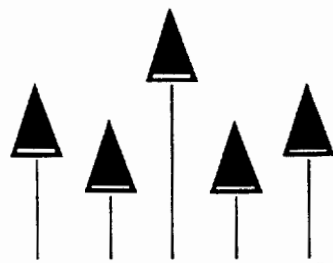
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From the Editor

Connections...and then what?

The decision to have several "theme" issues during this publication year seemed an exciting idea last spring when I first made the announcement. I have since discovered that a commitment to theme issues can be stressful to the editor. What if, I worry, no articles on the theme are submitted? What if articles that were promised don't arrive by the deadline? And what will the columnists produce? Will they be able to maintain the tone of their column while still connecting to the theme of the issue as a whole.

If you received the October "Just for Beginners" issue, then you know that most of the material in that issue was indeed appropriate for beginners. That issue certainly gave me confidence that it was possible to produce an issue devoted to a theme without acquiring too many more gray hairs. However, my anxiety about this current issue increased dramatically when I returned from a professional trip only to find that not only were several of the columns late, but two of the promised articles had not arrived. Within a couple of days I was breathing again as one of those articles arrived via express mail and the other via email from half way around the world. At the last moment the issue fell beautifully into place – with more material than the journal could hold!

I think you will find that there is a richness in the collection of material in this issue that would be hard to match anywhere: from classroom connections through technical information; from research to teacher training. But more than the specific projects and ideas discussed in these pages are the issues raised. Thinking about those issues caused me to reflect on the changes in the role of Logo in computer education over the past decade.

Some 8 or 9 years ago, I first introduced Logo to my school system via a special project in one of our elementary schools. We had only a few computers scattered through our system and this project was an opportunity to try something new. It wasn't long until Logo spread throughout our grade schools and into our secondary schools. Even though we continually added equipment and copies of Logo, our resources were limited. One computer to a classroom was an unusual luxury; more often 2 or 3 classrooms shared a single computer.

In the early 1980's, most computer equipment was quite expensive, dramatically limiting the number of computers a school could afford. However, the software was also very

limited. The choices were often between poor quality CAI and BASIC programming. During those years, I recommended to my school system, as well as to many others with whom I consulted, that it was appropriate to use *only* Logo in their computer education program. Logo provided an open ended environment that would work with any age level, could be used with a limited amount of equipment, and was relatively inexpensive in a day when few school systems provided money for software. (If only we had had LogoWriter or Logo PLUS then, my advice would have been even more appropriate.)

But times have changed. The software available for school computers is rich and varied. Generic tools such as word processors and databases are widely available for all age levels. Problem solving software abounds. There are simulations that allow exploration in a variety of subject areas. Newer products such as HyperCard provide Logo-like environments. Further, as you will see in this issue of *LX*, Logo itself can be linked with all manner of other technologies and Logo text and graphics can easily be exchanged with text and graphics from other pieces of software. Logo no longer stands in isolation as one of the very few pieces of excellent software as it did 10 years ago.

So what of the next decade for Logo? Logo "purists" would have us continue to insist that Logo in and of itself will revolutionize education and that there is no need for other pieces of software. Increasingly, I believe, those purists are standing alone. Those of us in the Logo community need to be open to new Logo-like environments – places that provide the same kinds of exciting learning experiences that Logo has provided in the past. Does that mean we abandon Logo? Certainly not. Logo is still the best tool for many learning activities, as you will clearly see in the pages of this issue.

So, as you read through the pages of this *LX* think about what you believe the role of Logo and *LX* should be in the future. Read with care the last part of Glen and Gina Bull's "Logo & Company" column and cast your vote for or against their concept of *Learner-Based Tools*. Spend some time thinking about where Logo fits in the broader scheme of things – and then share your thoughts. Glen and Gina and I would all love to hear your opinions.

Sharon Yoder

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Monthly Musing

Connections: The Process of Procedures by Tom Lough

I have learned to enjoy and appreciate telecommunications and electronic mail. For example, I send this column to Sharon by email each month. When I call up the mainframe computer, it signals that it is ready for operation by sending a single word to my computer screen:

```
CONNECT
```

Seeing that word appear always excites me, because I realize that I will be in electronic touch with other Logo colleagues in the next few moments.

When I am writing this monthly column, I always have a similar sense of excitement, because I realize that I will be in touch with thousands of other Logo colleagues when the words I write become part of an issue of *Logo Exchange*. That excitement of connecting is one of the major reasons I started *LX* in the first place. So you can imagine what it meant to me for the theme of this issue to be "Logo Connections."

I began thinking about connections within Logo. One of the first things that occurred to me was how procedures are connected to each other in a superprocedure. If we have a superprocedure such as

```
TO HOUSE
  SQUARE
  TRIANGLE
END
```

it is clear that SQUARE and TRIANGLE are connected by virtue of the sequence in which they are called. In particular, the end of the SQUARE procedure is connected to the beginning of the TRIANGLE procedure by the calling sequence of the HOUSE superprocedure.

Sometimes it is necessary to connect procedures a little differently within a superprocedure, such as the following.

```
TO HOUSE
  SQUARE
  FORWARD 50
  RIGHT 30
  TRIANGLE
END
```

In this case, SQUARE is connected to TRIANGLE through the intermediate commands of FORWARD 50 and RIGHT 30. Commands such as these prepare the way for the next procedure to carry out its instructions.

Many teachers feel that they are connected to their students like this.

```
TO EDUCATE
  TEACHER
  STUDENT
END
```

The TEACHER procedure is connected directly to the STUDENT procedure. First the teacher does something, followed immediately by the student.

Others may suggest that such a procedure should be written as follows.

```
TO EDUCATE
  TEACHER
  FORWARD 50
  RIGHT 30
  STUDENT
END
```

In this case, the action of TEACHER is connected to STUDENT by the intermediate commands of FORWARD 50 and RIGHT 30. Commands such as these prepare the way for the next procedure to carry out its instructions.

The Logo HOUSE example was probably clear, but this one may be somewhat muddled. Could FORWARD 50 and RIGHT 30 represent any aspects of the education process which connects the teacher and the student?

Perhaps these commands might represent an adjustment in the mind of the student. Or, maybe they could indicate the passage of some time. Perhaps they stand for the effect of intangible qualities, such as patience or trust or caring.

It really doesn't matter if we can't figure out what they mean. The important thing is that we should think about the connections between teachers and students as something special. And if musing with a Logo procedure helps, then so much the better. **FD 100!**

Tom Lough, Founding Editor
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Logo Ideas

There are connections...and then there are connections.

by Eadie Adamson

connection: a junction; a joining; a shared space
Preliminary definition (EA)

How do you define the word **connection**? Logo connections come in many forms. For instance, Logo can be used to control many external devices. They are fun to explore and play with. Of all the possible connections of this type, the one most fascinating for my students has been the Lego-Logo connection.

My students were all familiar with LogoWriter and had used LogoWriter to write their own motion games. When they began working with Lego TC logo in the classroom, it was natural for many of them to want to exercise control over these cars or conveyor belts or turtles, in the same way in which they had controlled the LogoWriter screen turtles in their game programs.

It didn't take long before one student began working to adapt the Lego procedures for moving the Lego floor turtle. Ted wanted to use the arrow keys rather than the commands provided on the Lego "Turtle" page. He wanted the program to work just the way one of his motion games had worked. He named his own page of turtle stuff "Teds.Turtle" and, since he knew what he needed to do and saw the connection with his previous experience, went to work very independently. His initial program used the arrow keys to move the turtle forward, back, left and right. To do this he needed to know the ASCII value of the arrow keys. He checked this by typing in the Command Center:

```
show ascii readchar
```

He then pressed Return, followed by the arrow key he wanted to program first. The ascii value of the key in question appeared in the Command Center. (**Readchar** is a primitive which reads a character pressed at the keyboard.) Ted could then access the key by addressing, for example, the up-arrow key as **char 11**. His initial program was constructed fairly quickly. Each arrow key was to send the Lego floor turtle in motion, either moving forward, back, left, or right. Ted planned to use the ready-made procedures (**tfd**, **tbk**, **tlt** and **trt**) provided on the TURTLE page on the Lego disk to help him with this part of the program. Ted's program looked like this:

```
to turtle
name readchar "key
if :key = char 11 [tfd 10]
if :key = char 10 [tbk 10]
if :key = char 8 [tlt 2]
if :key = char 21 [trt 2]
turtle
end
```

Next Ted's attention turned to the touch sensors on the front of the turtle. He incorporated them into his "turtle" program:

```
to drive2
listento 6
if sensor? [tbk 15 tlt 5]
listento 7
if sensor? [tbk 15 trt 5]
end
```

He inserted **drive2** into his turtle program so that it read like this:

```
to turtle
name readchar "key
if :key = char 11 [tfd 10]
if :key = char 10 [tbk 10]
if :key = char 8 [tlt 2]
if :key = char 21 [trt 2]
drive2
turtle
end
```

Now the turtle was smart enough to back away from an obstacle, then turn a bit before proceeding.

This was only the beginning for Ted, though. He proceeded to redesign the turtle slightly (it had been built following the instructions which come with the Lego TC logo kit) by adding lights which turned on when the turtle was used. Then Ted decided the turtle's lights should operate as warning lights: some should go on when the turtle moved forward, others when the turtle moved backward, and the appropriate lights should be lit when the turtle turned.

Further Connections

Ted's variation on the classic "instant" program gave me some other ideas, which brings up a further Logo connection: creating and programming for an audience. While completing

a project such as Ted managed to do can be satisfying, Ted ultimately got more satisfaction from showing it to his classmates, especially those who had not yet used LEGO TC logo. This year one of my classes will build the floor turtle, make an "instant" program for it, and then have a chance to teach our kindergarten students how to use it. This prospect of a further audience will give my students an additional goal towards which to work. We might also plan a "Lego Show" and invite their parents to attend, something that happened very informally last year.

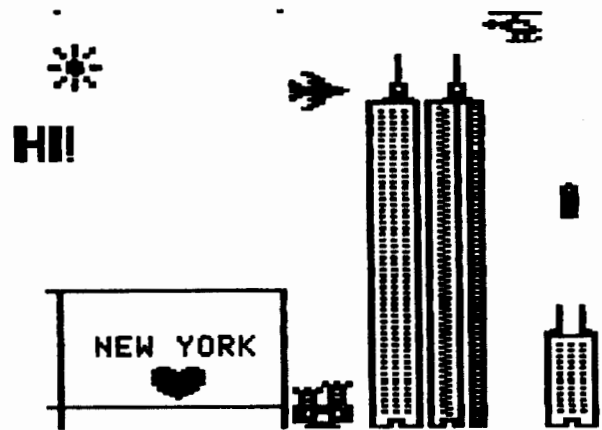
Although Ted had not begun his project with this in mind, having an audience was an important component of his work. Increasingly I think that the further extension of creating a project with an audience in mind is a connection we often fail to make, although it can be the best Logo "connection" of all. Part of the idea of working with Logo has been to build a sharing community. Too often this may happen in a particular classroom, but the sharing stops there. Why don't we, instead, spend just a little more effort and take the small amount of time to share our Logo work with other classes? Our school encourages, through a "Big Brother" program, a kind of sharing with older children helping occasionally in younger children's classes. As I observed these interactions last year, I began to think that this was the best of all connections, children helping and sharing with other children.

A Different Kind of Classroom Connection

Last year I noticed during one of my regular visits to "play" with LogoWriter with the kindergarten class that the boys were beginning to learn to read and write simple words. At about that time my fourth grade classes were creating projects of city scenes with flashing signs, thus "connecting" a LogoWriter programming idea with signs they see in the real world. Aha! a Logo connection idea was formed: the fourth grade boys could design special sign pages which could be activated by some of the words the kindergarten boys were learning.

Originally, when the fourth grade and I talked about the idea, we all thought we would simply create the programs and then lend them to the kindergarten to use. This, however, would have deprived the older boys of the pleasure of truly sharing their work. I suggested to them that when their projects were ready we might arrange for the kindergarten to visit our class so that the sharing could take place individually. What an incentive this was! Creative ideas sprung up everywhere (See the illustrations with this column.). We needed to plan how we were going to present each program or page of commands. In addition to polishing up their project — because they now had a real audience in mind — the boys became truly

concerned about making it easy for the younger children to understand what to do. They decided to make cards to sit at the top of each keyboard on which they would print in big letters the words to type to get a sign to flash or, in some cases, to start an animation.



Some of the boys thought the visiting day would *never* come! Finally we arranged a morning visit, half of the kindergarten class at a time. That gave each of the older boys one or two younger boys to work with. After a reasonable period of time, we played "musical chairs" of sorts: each of the younger boys moved to the computer on the left and began to work with a different older boy.



All too soon the class time for the younger boys ended. The older boys still had a little time left. I decided that a debriefing would be most helpful. I asked them to think about the experience and to think about what surprised or disappointed them, what happened that they didn't expect, and how they felt about it. The boys made some wonderful observa-

tions: the younger boys liked things they had thought were "too dumb" to be bothered with such as simply using the turtle-move keys to move an object about on the screen; they were able to do things such as creating shapes – that the boys had thought would be too hard; they found that they needed to figure out what to do with the boy who "wouldn't behave" (!); what they expected the kindergarten boys to enjoy the most was often what they were least interested in doing. This kind of closure on the experience gave us a chance to reflect together on the problems of being a teacher in a Logo environment.



TODAY IT IS COOL AND WINDY

This Logo connection was so successful that these same students have asked if they can do something similar this year! Not surprisingly, the kindergarten teacher has also asked if we can plan more sharing. This has made me think more about sharing with other classes as well. Interactive or rebus stories could be created and shared with first and second grade students, for instance. Older students could "write" stories told to them by younger children and then use LogoWriter to illustrate, animate and/or automate the tales.

Question: Do all Logo connections have to be hardware connections? Not for us!! What about you? How do you define connection?

Eadie is a computer coordinator at The Allen-Stevenson School, an independent school for boys in New York City.

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Lego-Logo For Elementary

Introducing Lego-Logo to Elementary Students

by Kwok-Wing Lai

The recent advent of inexpensive robots to the elementary classroom has great educational potential. It has been suggested by some educators (e.g. Bitter & Gore, 1986; Neighbours & Slaton, 1987; Pearce, 1987) that computer controlled machines enable learners to carry out investigations involving both heuristic (a rule of thumb that often, but not always leads to a solution) and algorithmic (procedures guaranteed to result in the solution of a problem) problem solving, and apply them to situations involving feedback control. Particularly for young learners, robot oriented activities provide a concrete, and a learner-centered environment conducive to concept development.

Recently some programmable systems are available in the market where users can assemble their own models and machines and interface them with a computer. For example, the Lego Technic Control Set (Lego Australia Pty. Ltd., 1987) allows users to build fairly complex models by using regular Lego elements and special elements such as motors, optosensors, counting discs, light bricks, electric cables, steering elements, and wheels available in the set. These models could then be interfaced with a computer by using an interface box (or card) and operated by a programming language such as Logo. Since many elementary students are already familiar with Logo and Lego, a learning environment could easily be set up to help them acquire a deeper understanding of machines and control technology, and improve their skills in planning and co-operation, manipulation, measurement, logical thinking, and evaluation.

Lego-Logo and Problem Solving

Problem solving skills and strategies are best learned in a concrete situation. The problem learners tackle in a Lego-Logo learning environment such as building a sliding door is concrete and relevant to their life experience. Therefore problem solving strategies could be easily introduced and practised. In my own study (Lai, in press) I worked with a group of New Zealand elementary students (aged 10 to 11) and introduced problem solving skills and strategies to these learners as we were building Lego models. In the eight sessions (one and a half hours each) they were encouraged to practise Polya's (1957) problem solving procedures of understanding the problem; planning; implementing; and evaluating solutions.

Lego-Logo and Metacognitive Awareness

Current research in learning suggests that effective learning depends on having knowledge of the repertoire of one's cognitive abilities and being able to regulate one's cognition, e.g. planning, checking, and evaluating learning strategies and outcomes. Brown, Campione, & Day (1981) contend that learners need to be aware of the importance of applying problem solving strategies to enhance understanding. The Lego-Logo learning environment provides an opportunity for the teacher to introduce metacognitive awareness to the learners, and also encourage them to exercise self-reflection by asking themselves metacognitive-sensitive questions such as "Am I on the right track" or "Do I need more information to solve this problem".

Lego-Logo and Cooperative Learning

A Lego-Logo environment also encourages cooperation. Not only the hands-on experimentation encourages a lot of sharing and discussion among group members, different roles learners need to play in this environment also enhance their appreciation of the need to work together in order to solve their problem. In my study four major roles (model builder, programmer, questioner, record keeper) were assigned to the members in each session.

How to start?

Some basic concepts of control technology need to be explained at the outset. Students need to understand that a computer could easily communicate with an external device such as a printer or a motor, by using a port (usually) located at the back of the computer. The best way to start is to give a demonstration by connecting the computer to the interface box (basically a switch system where a single bit of data coming out from the computer turns a switch on or off) and then hook a small device such as a light bulb or a motor to the interface box. The Lego interface box has six output bits and two input bits where you could output data from, and input data to the computer. A simple Logo procedure could be written to operate this device. Commercial program such as Control Logo (Logo augmented with a library of special control procedures) could make life even easier. Students only need to learn a few commands. The following is a procedure I used in the first lesson of my study, written in Control Logo:

```
To Demo
Turnon 0      (a motor connected to Bit 0 is turned on)
Wait 40      (the motor keeps going for 40 units of time)
Turnon 3      (a light bulb connected to Bit 3 is turned on)
Wait 40      (keeps going for 40 units of time)
Turnoff [0 3] (both the motor and light bulb are turned off)
Turnon [2 4]  (another motor and light bulb are turned on)
```

```
Wait 40
Turnoff [2 4]
End
```

If the students are familiar with Logo they should have no problem in understanding this procedure. In my own study about half of the students had no Logo experience and they found little difficulty learning to write Logo programs. Students will be very excited at this point but time should be allowed for adequate discussion on the use of problem solving strategies in learning. Also, they should be reminded to monitor their learning process.

To further familiarize the students with the use of special Lego elements, it is helpful for them to build the first one or two models under the guidance of the teacher. In my own study students were asked to build a traffic light system to control a cross road traffic, and to build a washing machine by following instructions provided by the Technic Control Set. An example of the procedure of the traffic light system is listed below. In this model two sets of traffic lights are placed perpendicular to one other, directing traffic at an intersection. In Set A the green light bulb is connected to Bit 0, amber to 1, and red to 2. In Set B the green light is connect to Bit 3, amber to 4, and red to 5.

```
To Traffic
Turnon [0 5] (The green light on Set A and the red Set
Wait 200      light on B are turned on)
Turnoff 0
Turnon 1      (The amber light on Set A is now on)
Wait 80
Turnoff [1 5] (The red light on Set B and the amber light
Turnon [2 3]   on Set A are now off; the red light on
Wait 200      A and the green on B are on)
Turnoff 3      (The green on B is off and the amber is then on)
Turnon 4
Wait 80
Turnoff [2 4] (The red light on A and the amber on B are off)
Traffic
End
```

To construct this traffic light system, the students first of all had to figure out how a traffic light system worked. At this point they were encouraged to represent their problem in different ways, e.g. using a diagram. When they have figured out the logic of the system they could start building the model by dividing the tasks into sub-tasks. Then finally they programmed the system to make it work. In this process the learners had ample opportunity to plan, to use different strategies to tackle their problem, to share their ideas, and to evaluate their work. My experience is that students are very

keen to experiment and build their own models. The role of the teacher is only to encourage them to use a problem solving approach to design and build their own models, but not too much intervention.

It is no doubt that a Lego-Logo learning environment is highly motivational to young learners. In my study both girls and boys were enthusiastic about the project and no gender difference was observed in groups. The environment was stimulating because the participants were able to control their learning process and the concreteness of the problem tasks enabled them to relate to what they had encountered before. It was also clear that this learning environment was conducive to acquisition of knowledge in control technology and skills in problem solving. It also promoted metacognitive awareness. The cooperative atmosphere encouraged the participants to acquire knowledge in a more active and constructive way, as well as sharing ideas and helping each other. The following comments may give you some ideas of what they reacted to this learning environment:

I've learned that when you're working with Lego that it is possible to make anything. Because if you think hard you will be able to make anything work...

I have learned how to work with Logo a lot better than I used to and learned how to solve problems quicker than I used to ...

[I learned] how to work together as a team and to cooperate together and to decide in thing together.

Working in a group is a lot easier because you've got other people in your group who may know more than you. It was pretty good when I got stuck because somebody always seemed to know the answer

...problem solving that will help me in future...to understand the problem...to see the problem and to [fix] it out

If there is so much fun in building a Lego model, and if so much could be learned, why don't we give our students a try?

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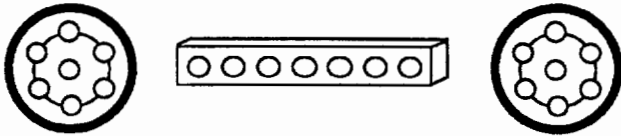
About the Cover

The pictures on this month's cover were taken during the Science and Whole Learning Workshop at the Media Lab at MIT. See page 15 for the article which describes the work done there.

Beginner's Corner

Back to the Future—The New Generation of Floor Turtles!

by Dorothy Fitch



Once upon a time...

When Logo was developed in the mid-1960's at MIT, there was no familiar turtle shape that lived on the computer screen. In fact, back then there were hardly any computer graphics monitors at all, at least not affordable ones! In those dark ages, computers often looked more like a combination computer/printer. What you typed at the keyboard was printed on paper, not on a computer screen.

So in the beginning, Logo commands were given to an object shaped like half a basketball—a robotic floor turtle. You could tell it to go forward or backward and turn it left or right. It had a pen to draw with and commands you could use to pick the pen up and put it down. The graphics world of Logo at that time was three-dimensional and larger than life. Kids could gain a real sense of movement and directionality. Their "buggy" commands had vivid and dramatic consequences. Group planning and cooperation was imperative. And talk about excitement in the classroom!

A turtle by any other name...

By the time Logo entered schools *en masse*, it had taken advantage of new technology – microcomputers and color graphics monitors that could show a turtle on the graphics screen. Wow, what progress! This certainly made things more convenient and less costly; there were fewer classroom management issues to deal with and fewer wires to trip over.

Progress in one sense, to be sure. But what are we missing now? The turtle on the screen is more distant from us and quite unapproachable. We can't walk around it and view it from different perspectives. We can't follow it or pace out distances to help us estimate. And we can't see how it moves and turns. The screen turtle zips from place to place and turns so quickly we can't tell whether it is going clockwise or counter-clockwise; we can't even tell it if makes 16 complete revolutions before stopping! The screen turtle is intangible, made up

of little bits of phosphor, not *real* things like gears, building blocks and motors.

Isn't it time to have the best of both worlds – a turtle on the screen and one on the floor? Original-style floor turtles are still available, but today there are also many more options for connecting robotic devices to Logo. These robots can assume a variety of shapes and they have more capability and features.

What will robotics do for my students?

Whether you are using robots to introduce Logo to younger children or to explore computer science and engineering with older students, these devices can open up a new exciting world for you and your class.

For younger children, robots provide immediate feedback in a way that makes sense to them. Some children don't readily or immediately identify with a two-dimensional object on a computer screen. They learn through imitation and variations of the familiar. By following the turtle as it moves around the floor, they gain a sense of direction (and confidence) that will help them when they use the Logo screen turtle.

Intermediate students learn how gears work, how to follow construction plans, how to write and refine a Logo procedure to perform a task, how to plan an original project. They invent machines, create new tasks, solve problems. They get excited about learning, they stick to their task until it is completed, they get involved. They become inventors, designers, experimenters and scientists.

Robotic devices teach older students about precision, debugging, decision making, estimating, electronics and much more. Robots are an exciting introduction to the world of programming and engineering. Students begin to understand the important roles that robots can play, from performing rote jobs in industry to assisting the physically handicapped.

What does a robotics package include?

We're going to describe Terrapin Robotics, a product designed by Technology Services Institute of Connecticut with programs written in Logo by Terrapin. These kits are designed to be easy to use for beginners, yet complex enough for sophisticated programmers.

The kit comes with an interface box, which has its own low voltage DC power supply that plugs directly into an outlet. The interface box has an On/Off switch for controlling the motors, and a 16-pin connector that plugs into the internal

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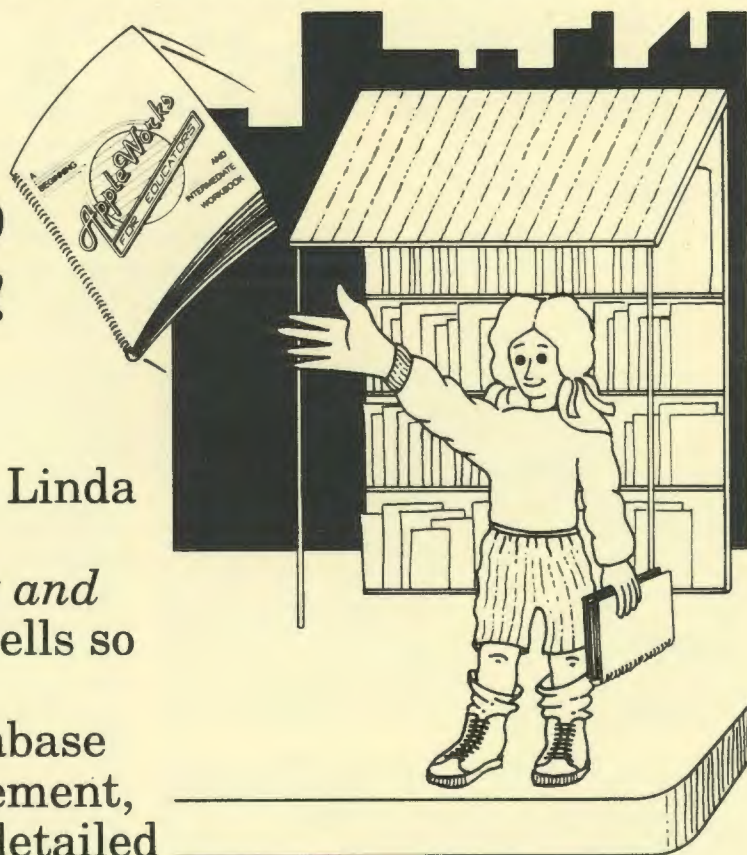
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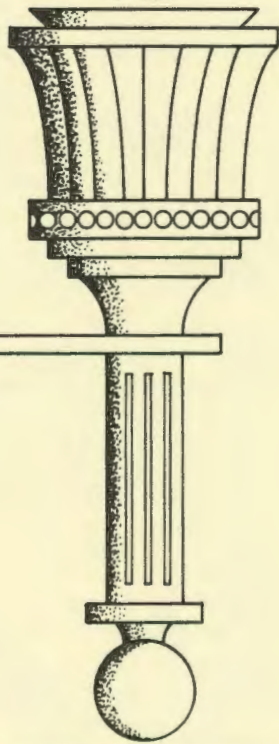
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