



LOGO EXCHANGE

Summer 1992

Volume 10 Number 4

In this issue:

What's inside the Turtle: Logo Ideas!

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—Tom Lough

Reform efforts in the early 1980s were barely more than reorganizations and reapplications of existing ineffective and inaccurate beliefs and practices. —Judi Harris

It's not as "in" to be a Logo advocate as it once was. Many who used to share Logo ideas now write about hypermedia and telecommunications. —Sharon Yoder

The American education system tends to place more value on the scientific, the mathematical, and especially the factual (read "testable") aspects of learning. Thus, our system fails to nurture the whole person.—Eadie Adamson

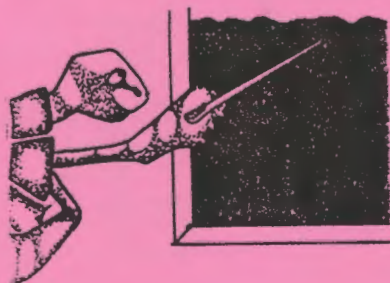
These assignments don't let teachers either stand and lecture, or stand aside and just watch. Rather, teachers must serve as counselors, models, guides, assistants, prompters, and assessors. Fortunately, these are roles well known to Logo teachers.

—Mark Horney

In the preoccupation with getting the facts, the imaginative and creative aspects of schooling are being left by the wayside.—
Eadie Adamson

If it is teaching that binds us all together, as Cuban suggests, what are the uncertainties, the dilemmas, and the moral issues that drive your action? —Sandy Dawson

Whatever approach you use, it is critical that students analyze geometric situations rather than rely only on visual feedback. Do this with care. The visual nature of Logo is also one of its most important strengths.
—Clements & Meredith





LOGO EXCHANGE



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

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LOGO EXCHANGE

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From the Editor

by Sharon Yoder

The Anniversary Ends...

This final issue of the tenth anniversary year of the *Logo Exchange* is a fascinating mixture of concrete ideas for use in your classroom and discussions of current issues in education.

As you read, you will be confronted with some thought-provoking ideas. Sandy Dawson asks us to think about the relationship between the values of the university system, university professional schools, and the schools in which many of us teach. Judi Harris takes a look at Logo and change, and asks us to think about restructuring. Mark Horney explores a different *mode* of teaching than usually occurs in a secondary programming class. Even a letter to the editor from Orlando Mihich directly addresses some of the significant problems in our educational system. The philosophical issues raised in these articles should keep you thinking for some days to come.

Interestingly, very little in this issues talks about the traditional topics of teaching Logo for Logo's sake or teaching Logo to learn mathematics. Even the classroom-oriented articles have an unusually strong integrated-curriculum flavor. Eadie Adamson talks about LEGO and art, Glen and Gina Bull address textual analysis with Logo, and Dorothy Fitch takes us on an Olympic journey across discipline areas.

But We Move On...

Indeed what could be more appropriate for the end of the 10th year? The "hype" of the early 1980s is gone. Logo has settled into classrooms throughout the country and the world. In many universities, Logo is a standard part of teacher training. Logo is no longer viewed as "revolutionary."

Those of us who have worked with Logo for many years know the power behind the ideas that Logo represents. We know about the fundamental philosophy that permeates a "Logo environment." When colleagues begin to talk about cooperative learning, constructivist philosophy, and restructuring, we can quietly nod our heads, knowing that we have been thinking about these ideas for some time. Perhaps we have even implemented these ideas in our own classrooms. The new "fads" in education may look like reincarnations of what the early proponents of Logo advocated. Those "revolutionary" ideas don't look as revolutionary 10 years later.

As we move toward more educational change in

the 1990s, those of us with experience in Logo should put our thoughts and skills to work supporting those seeking fundamental changes in our educational system. We must resist the temptation to be annoyed with colleagues who criticized our Logo work, but are *now* really "into" cooperative learning. We can smile knowingly when someone tells us about their excitement over *HyperCard* projects that encourage students to gain ownership of their work. After all, we've been doing that with Logo for years. We can be supportive and offer suggestions when our school begins to think about restructuring. Remember—we have wanted educational change all along. It's not so important *how* it happens. Rather, it's important *that* it happens. We who understand the Logo experience have much to offer—we *can* help.

With Your Help

But *you* can help *me* too. Just as you are finishing up your school year, I will be putting together the first issue of *LX* for the fall. I definitely need your assistance. It's not as "in" to be a Logo advocate as it once was. Many who used to share Logo ideas now write about hypermedia and telecommunications. I need *your* ideas—short or long. Tell me what has worked. Tell me what hasn't worked. Don't worry if you have never written an article before. My job is to help you put your ideas into a form that others can use. Send me some art that your students produced. We can put it throughout the pages of *LX*.

I hope you'll take a few moments of your precious summer to share with me. I look forward to hearing from you. Send any and all material to

Sharon Yoder
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Letter to the Editor

In the last issue of *Logo Exchange*, Mr. Jose Valente laments that

It could be that Logo is still being used extensively in the United States and Canada but its users do not bother to publish their work or choose to participate in conferences.

I don't disagree completely with Mr. Valente, but it takes just one look at *LX*, and some other publications to see that Logo is still alive in this country.

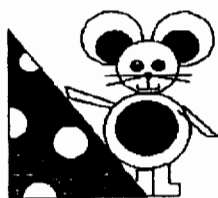
In my opinion, the problem is not with Logo, or mathematics, or science, or any other subject for that matter, but with the way our public schools are run. We are lacking the enlightened leadership that could make a difference. Our public schools are run like sweat shops, assembly lines. The teacher is faced with oversized classes, too many periods per day, administrative duties, and a hopeless bureaucratic system. The teacher is not considered a professional who needs, and is

encouraged, to participate in conferences or to write papers. The teacher is [considered to be] the one responsible for all the bad things happening to public education. Teachers in my school don't even have access to a copy machine. Personal aspirations are totally ignored, and the politically motivated and myopic administration operates on its own, insuring its survival.

If something good is done for the students and public education in general, then it is done, and in most instances "paid for," by the teacher.

I am glad that in the course of his travels abroad A. J. (Sandy) Dawson felt "the high regard in which teachers are held, and the recognition of just how complex the teacher's job is." He definitely traveled far away from here!

Orlando Mihich
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Jersey City, NJ 07304



About This Issue's Graphics

The graphics found throughout this issue (above, pages 9 and 21) of *Logo Exchange* were products of seventh-grade students at Forest Park Middle School in Franklin, Wisconsin. Judy Brandt writes:

"[All students] are required to take nine weeks of Logo programming. The students are taught basic techniques for creating Logo designs and are asked to work on several projects applying those techniques. Students work in pairs to write procedures that create spin designs, school initials, and seasonal graphics such as pumpkins, snowmen, and bunnies. Poetry and music are added to seasonal graphics creations.

As a culmination of the Logo course, each pair of students is required to create an original Logo design. The design must include colored graphics, text, and the

creators' names. This original creation is displayed at the Fine Arts Fair held at school each spring for students and their families.

Students have great fun working on Logo projects. They learn how to work cooperatively and respect others' ideas. They become more organized and better problem solvers. Every pair of students can and does create a project commensurate with their abilities. Students and teacher alike take great pride in their creations."

Judy Brandt
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What's in a Word?

by Tom Lough

Have you ever played Balderdash? It's an interactive word game in which players first write and then try to guess the definition of rather obscure words. The results can be hilarious. For example, at a recent game, suggested definitions for toft (construction site) included "contraction for 'tossed often'" and "a snooty way to pronounce 'Taft.'"

How about some Logo Balderdash? What definitions would you write for *logothete*? Go ahead, jot down several. Better yet, have your students join in the exercise. How creative a definition can you dream up?

I discovered *logothete* as a result of a recent browse through the section on "Writing" in the "W" volume of an encyclopedia. For whatever reason, I was curious to know what the encyclopedia said about writing.

I learned that counting devices, such as rock drawings and sticks and pebbles, were used thousands of years ago to convey information. Some drawings, called ideographs, expressed ideas without any reference to a language.

The encyclopedia went on to say that a decisive step in the development of real writing occurred when humans learned to express ideas indirectly. They developed signs that stood for the words in their language and not the ideas the words represented. These signs are called *logographs*, and this kind of writing is called *logography*.

Wow! Just think of it! Logography marked the beginning of writing as we know it today!

Those of you who are familiar with me can easily imagine my burst of energy and enthusiasm as I searched and researched every dictionary and reference book I could find. In short order, I found several mentions of *logography*. But I also found *logothete* and these additional gems.

- *logodaedaly*—playing with words
- *logogriph*—a puzzle involving anagrams
- *logomachy*—contention about words
- *logotype*—a single piece of type on which two or more separate letters are cast

(You're not going to believe the next one, but it really is in the dictionary. See for yourself!)

- *logorrhea*—the habit of talking too much

Well! We certainly have enough material here to develop several ideas. I want to focus on just one idea however: Logography was the beginning of real writing.

I would like to extend this idea to suggest that Logo is the beginning of real thinking. When I see the change that Logo makes in the way students (and teachers) think, I believe that this suggestion is true. What word would you suggest for that? *Logocogy*?

Let me close before logorrhea sets in.

FD 100!

PS: I recently consulted a rhyming dictionary seeking words that rhymed with Logo. *Mogo* and *zogo* were among the words listed. I have not been able to find these two words in any dictionary yet. If any of you would like to join me in a search for their definitions, I would appreciate your help. (How can you write a poem about Logo if you don't know what the other rhyming words mean?) Or, even better, let's play Logo Balderdash! Send me your made-up definitions and those from your students for *mogo* and *zogo*! I'll talk the editor into providing a suitable award for the most creative suggestions. Mail your suggestions to me no later than September 20, 1992.

PPS: By the way, a *logothete* was an administrative official of the Byzantine Empire. Just thought you'd want to know.

Tom Lough
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To explore a medium, to work with it, to try to express something seen or felt or heard is to come to understand, on some level, that visions are made real when they are transformed into perceptual realities and given intelligible form. This does not mean that young people's explorations must culminate in fully realized embodiments or even in objects with intelligible form. What is important is the effort to define a vision and to work on giving it expression. An understanding of the struggle, a sense of having been inside it even for a moment, cannot but feed into an awareness of the privileged realities artists create. To know how to attend to such realities is to open oneself to altogether new visions, to unsuspected experiential possibilities. It is to become personally engaged in looking, from an altered standpoint, on the materials of one's own lived life, and in imaginatively transmuting (from the fresh standpoint) the fragments of the presented world.

Maxine Greene
*Imagination and
 Aesthetic Literacy*, (p. 187)

In an editorial in a recent issue of *The Computing Teacher*, Dave Moursund noted the absence of any reference to art in George Bush's America 2000 proposal. In this article I want to consider the relevance of art in the development of the "whole" person and to look briefly at ways Logo and LEGO TC logo can be used to encourage creativity and artistic awareness in the classroom.

Many scientists will agree that much of their innovative work depends upon flashes of insight and uses of their imagination as they develop new ideas and theories. The visionary scientist uses imagination as a catalyst for insights. Our focus in education is veering away from recognizing and valuing the creative aspects of learning in favor of science and math education geared towards producing testable results. In the preoccupation with getting the facts, the imaginative and creative aspects of schooling are being left by the wayside. I would suggest that there are uses of Logo and LEGO logo that can play to the playful and imaginative aspects while at the same time involving students in intellectual inquiry.

The Subject Is Art

Eadie Adamson

Logo First

Last year a colleague at Dalton, Rosemary Keller, and I were discussing the need for her fifth-grade math students to expand their aesthetic sense. We were looking for some simple exercises to encourage their thinking in this direction. Inspired by the exhibit of the Russian Constructivist painter Kasimir Malevich at the nearby Metropolitan Museum, we developed some activities based on the simple square.

Working with *LogoWriter*, we spent some class time together considering the properties of squares and contrasting squares and rectangles. We followed this by developing procedures to draw squares and rectangles using variables, an aspect of Logo that these students had not encountered previously:

```
to square :size
  repeat 4 [forward :size right 90]
end

to rectangle :height :width
  repeat 2 [forward :height right 90
    forward :width right 90]
end
```

We asked the students to consider the possibility that an abstract picture could create emotions in the viewer simply by placing objects in states of balance or imbalance. To serve as concrete examples of this idea, I collected a series of examples of paintings that mainly used squares. What happened next was surprising to us, although, in retrospect, it probably should not have been.

The students were given the assignment of using only their square procedure (using color to fill as they desired) and to create a picture that created some kind of feeling or emotion. To our surprise, many students responded by working with the shape and creating a representative object: a car, a train, a face of a person. We realized that we had hit upon an area in which our students had been sensitized only to concrete representation. The idea of abstraction was completely foreign to them and somewhat uncomfortable. While we were surprised at their response, we also realized that this idea was important to explore in more depth. These students *needed* to be encouraged to play about with shapes in a free manner, to be encouraged to think playfully about arrangement of shapes without a surrounding context from the "real" world.



Rosemary decided that some hands-on work away from the computer might help. We moved the exploration from the computer to the classroom, using as the instructions this excerpt from James Clayson's *Visual Modeling With Logo*:

Cut out some different sized squares from a sheet of colored paper and think about placing the squares on a large piece of white paper. First, try to arrange the squares so that your design feels unbalanced and looks wonky. Next, rearrange the squares to create a balanced design.

What kinds of changes did you make? What about creating an arrangement that looks sad and another that looks euphoric? Each design used the same squares. What made them different? Their placement. (p. 18)

In the classroom, students used paper cutouts of squares in all colors and sizes. They placed these on a sheet of white paper and worked out interesting arrangements. This time they were explicitly told not to try to make something "real." Once an interesting design was found, students traced the pattern of the shapes onto the paper, adding notes about the color combinations they wanted to use. These formed the working drawings that they then used at the computer.

Since we were working with *GS LogoWriter*, there was a wide range of colors and hues that could be used. This also left us the option of considering the effects of colors simply by changing colors of the various squares.

The second time around, the project was much more successful. A collection of simple but pleasing Logo drawings were created. Asking our students to think about art and aesthetics in the context of their mathematics class extended their thinking in new directions.

And Then There's LEGO Logo

So what does robotics have to do with art? Quite a lot! Since the 1960s, artists have actively explored the uses of technology in art. This was the heyday of kinetic sculpture and light art, both of which use electronic controls either as a simple power supply or as a way to produce sophisticated programmed motion, sometimes involving interactions with the environment via sensors. What could be more natural, therefore, than to consider using *LEGO TC logo* in this way? As one of my students commented, holding up an experimental piece he was putting together, "I really see this as art." So do I!

What is exciting about the new potential for computer control of external devices is the incorporation of Logo as the control language. The ability to carry on experiments with motors, lights, sensors, sound, and








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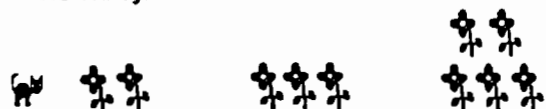
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Fluffy is a happy cat who loves to play in the flower garden. His favorite game is hiding from Wolf, the big dog next door. Sometimes when I walk by, he jumps out and grabs my foot. That scares me for a second I love fluffy.



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computer control adds an exciting new dimension and creates a meeting place for the arts and the sciences in the classroom. Students can model the practice of many contemporary artists who work in this medium with the assistance of engineers and scientists. We can build on students' knowledge of Logo and at the same time encourage the use of imagination in building their objects. Thus, as in the mathematics exercises with Logo, we can enlarge the vision of the technically and scientifically inclined students. At the same time, through approaching *LEGO TC logo* as art, we can reach out to the technophobes, offering them a *reason* to explore engineering and technology in a manner meaningful to them. By approaching *LEGO TC logo* as a kinetic sculpture medium, rather than as a machine-making math-science oriented medium, a teacher can encourage experimentation, a sense of play, a feeling for design in form and space and time, as things move, and remove from consideration the idea of merely creating a replica of an everyday machine.

There are many ideas to explore when looking at robotics as an art medium. When I began using this approach in my work with students, I decided to look at four major categories:

- Kinetic art. We used LEGO pieces, including such ideas as building automated drawing machines that could produce their own artworks.
- Optical art. We used the LEGO motors and Logo commands for rotating optical designs. We built platforms of various kinds to house the motors and support the designs. Optical designs could be created with Logo or could be duplicated from books on optical art.
- Color theory. As we built rotatable objects and added colorful pieces to them, we discovered that the mixing of colors could be studied in surprisingly different manner. Mixing colors by motion, we could use colored optical designs or colored paper and study both the transformation of the design and color-mixing through motion.
- Light art. Using the LEGO lights, we could build and program light displays. Abstract pieces could be developed, as could pieces imitating neon signs. Optical fibers placed against lights allowed us to explore the possibilities of transfer of light from one source to another.

This is an exciting and rather special direction to take with Logo and LEGO. Many teachers have found, as I have, that this approach is refreshing and stimulates interest in students who have not been turned on by machine technology. It is clear that there is room for more than one approach to using robotics.

Moholy-Nagy wrote, "Art, the sphere of articulate

intuition and feelings, is indispensable to a balanced life, indispensable to creative design" (Passuth, p. 357). The American education system tends to place more value on the scientific, the mathematical, and especially the factual (read "testable") aspects of learning. Thus, our system fails to nurture the whole person. Visual, perceptual education is neglected and yet, says Rudolph Arnheim, "Once it is recognized that productive thinking in any area of cognition is perceptual thinking, the central function of art in general education will become evident" (p. 296).

Why not give art a try?

Acknowledgment: It was from a casual conversation with Cathy Helgoe of Lego Dacta, that the LEGO art project began. Cathy's input and assistance, especially in the formative stages of this work, has been indispensable.

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Logo: Context, Not Contents

by Judi Harris

[Editor's Note: This article is written in response to a question raised by Gary Stager, a Logo advocate and computer consultant from Wayne, New Jersey. Gary wanted to know whether Logo had functioned as a "Trojan horse" for educational change in America's schools. Judi responds in the following article.]

Every reform was once a private opinion, and when it shall be a private opinion again, it will solve the problem of the age.

—Emerson, 1841

In 1983, *A Nation at Risk* told us what we already knew. "School reform isn't enough," it said. Why? Reform efforts in the early 1980s were barely more than reorganizations and reapplications of existing ineffective and inaccurate beliefs and practices. The results of an intensive seven-year study of the K-12 system were also published in 1983. In *A Place Called School*, John Goodlad boldly used a new word in his calls for school change: *restructuring*. Less than 10 years later, educational restructuring might well be called a national movement.

Restructuring is more radical than reform. As is indicated by the Latin derivation of the word *radical*, restructuring strikes at the *root* of institutional and instructional structures, causing true transformation. The *context*, not the *content*, of what we teach and learn in our schools is the target for such change. Yet when the *context* of the learning environment changes, the *content* has no choice but to change along with it. Technological infusion can be used as a practical, persuasive way to help shift educational context. Many of us first encountered that idea in the pages of *Mindstorms*.

Logo is all *about* changing context. It is not surprising, then, that Logo fan(atic)s are often proponents of educational restructuring, whether or not they consciously label themselves as such. The question of whether Logo has served as a Trojan Horse in school reform efforts is concerned with cause and effect. In other words, has Logo really made a difference in our schools without most people expecting it to do so?

To address this question, let us consider first how educational reform is now being pursued. Recent calls for school restructuring share several common themes (Lewis, 1989):

- They are student- and teacher-centered
- They suggest changing the ways that students learn and teachers teach, requiring both to assume greater initiative
- They affect both curriculum and instruction
- They require releasing many current reforms and centralized bureaucracies
- They allow and encourage higher expectations of teachers and students
- They make necessary a central vision to which all members of an educational community subscribe. (p.6)

These ideas are not new to Logophiles. Did Logo directly help to bring these views to light on a national scale? Probably not. But observations of institutionalized education similar to those that led Papert to write *Mindstorms* are what are leading many educators today to consciously consider systemic change. Perhaps Dr. Papert was pessimistic when he wrote that "the education system will not be able to bring itself to decide on radical change in education" (Stager, 1991, p. 1).

It would seem that just such transformations are what educational restructuring efforts are all about.

But what is necessary to catalyze such bottom-line change in our schools? The current-day Russian revolution permits us to consider the following possibility. Perhaps radical, pervasive contextual shifts cause and are caused by a conscious change of *mind* on a mass scale. The optimist would say that just such a conscious choice for endemic change in our schools is what is fueling the restructuring movement. Educators are becoming self-reflective practitioners. As such, they cannot be *duped* into change. They are seizing the point of power and *deciding* to restructure their classrooms.

Isn't that what happened to many of us when we first encountered Logo the language and Logo the educational philosophy? We were *empowered*, and we were able to similarly empower our students. Logo didn't and doesn't do anything by itself. But it did give teachers who were already experimenting with learner-based, exploratory teaching/learning contexts a physical, methodological, and philosophical *focus* and *community*. The Logo "movement" is an attempt to help teachers consciously change the *context* of their beliefs about education by providing them with a qualitatively different experience of teaching and learning.

It was actually most convenient that Logo philosophy came along in a new mechanical "package" (the microcomputer) at a time in educational history when notions of school restructuring were beginning to coalesce. It was probably this temporal advantage, combined with Logo's low threshold, high ceiling, and extensibility, that helped it to find its way into so many K-12 schools. A technological time window of opportunity opened as we became increasingly dissatisfied with educational reforms being "more of the same." A new way of seeing the problem (a new context) was required. What better way to see a new "solution" than that which could be made available on a new machine?

Logo is a philosophy manifested in mechanical form. Papert's ideas were expressed in an exciting product that appeared in the schools in a particular temporal window of reconstructionist opportunity. Logo is an example of a restructured way of teaching and learning that is as much an outgrowth of general societal trends as are the recent calls for educational restructuring. Logo can serve as a way to share and express a set of rather ethereal notions about "how education should be" in a more or less concrete way. As a microcomputer application, it may function for some individuals initially as a "personal Trojan Horse," as Marion Rosen has said, but as a national trend in education it probably only serves as an early *example* of one way in which we can restructure the K-12 environment. Logo may once have *seemed* like a movement unto itself only because it appeared approximately 10 years before more general calls for K-12 constructionist learning, and because it was linked to a physical, observable, namable, purchasable product.

The question of whether Logo *has* served as a Trojan Horse misses the point. Change cannot happen without conscious choice and direct action. Whether Logo *will* serve as one of many realistic *models* of the context of truly restructured education is what is really important. Our experience tells us that it *can*, along with micro-based science laboratories, computer conferencing, interactive hypermedia environments, and other such new, technologically-infused andragogical contexts. But *will* it? This simply-put question itself suggests the answer—the very basis for true transformation. The success or failure of educational restructuring will depend upon the collective, conscious exercise of our *wills* as educators.

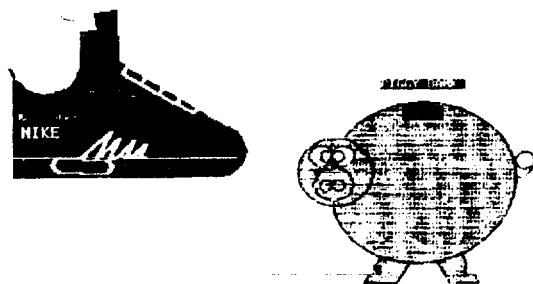
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Judi Harris works in the Department of Teacher Education at the University of Nebraska at Omaha as an assistant professor of educational technology. Her teaching, research, and service interests include Logo (of course), computer-mediated educational telecommunications, developmental sequencing in interactive hypermedia materials design, and the restructuring of teacher education paradigms.

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For more
information
about these graphics,
see page 3.



Light the Torch for Turtle Olympics!

by Dorothy Fitch

On Your Mark ... Get Set ... Go!

The 1992 Summer Olympics will soon be held in Barcelona, Spain. As athletes from around the world compete in a variety of events, help your students organize their own Turtle Olympics! Get started this spring with some Olympic Trials in your classroom.

Exploring the Olympics is a great multidisciplinary project because it can involve so many curriculum and skill areas:

- *Geography*—finding out where in the world all the countries are
- *History*—tracing the background of the Olympic games
- *Math*—measuring time and distance with precision
- *Physical Education*—learning sports terms, rules, and strategies
- *Music*—learning to recognize (and sing?) different national anthems
- *Art*—appreciating the grace and beauty of the athletic presentations
- *Social Skills*—understanding and practicing cooperation and teamwork
- *Personal Attributes*—determination, pursuing a dream, and striving for perfection
- *Problem Solving*—how can we do this in Logo?

Yes, I know this is supposed to be a Beginner's Corner, but there are ways to explore the Olympics with almost any age or ability level. These ideas use only rudimentary turtle graphics, yet they will challenge both the novice and experienced Logo user.

Olympics Primer (for those, like me, who can never remember what all the events are!)

These were the events of the 1988 Summer Olympics in Seoul, Korea. Use this information to give you ideas for creating your own Turtle Olympics.

Archery	Rowing
Baseball	Shooting
Basketball	Swimming and Diving
Boxing	Table Tennis
Canoeing	Taekwondo
Cycling	Tennis
Equestrian	Track and Field
Fencing	Volleyball
Field Hockey	Water Polo

Football (Soccer)	Weightlifting
Gymnastics	Wrestling
Handball (Team)	Yachting
Judo	

Gymnastics consists of:

- *Men's*—floor exercise, pommel horse, still rings, horse vault, parallel bars, horizontal bar
- *Women's*—horse vault, uneven parallel bars, balance beam, floor exercise, rhythmic gymnastics (ball, rope, hoop, clubs, and ribbon)

Track and Field consists of:

- *Track*—relays, sprints, hurdles, walks, runs, steeplechase, marathon
- *Field*—shot put; discus, hammer, and javelin throws; high jump; triple jump; pole vault
- *Men's Decathlon*—100m sprint, long jump, shot put, high jump, 400m sprint, 110m hurdles, discus throw, pole vault, javelin throw, 1500m run.
- *Women's Heptathlon*—100m hurdles, high jump, shot put, 200m sprint, long jump, javelin throw, 800m run.

Let the games begin!

Six Turtle Olympics Events

Event 1: TURTLE HURDLES

In this event, the turtle must jump over the hurdles without touching them. First draw some hurdles, spaced evenly across the screen. They might look like this:



Now, figure out how to get the turtle to jump a hurdle. You could give younger students the hurdles already drawn on the screen and challenge them to find a REPEAT instruction that will send the turtle over all the hurdles.

This sample JUMP procedure hops the turtle over one hurdle. The REPEAT instruction at the beginning causes the turtle to take little steps between hurdles for more realism.

```
TO JUMP
REPEAT 5 [FORWARD 2]
LEFT 90
```




```
FORWARD 25
RIGHT 90
FORWARD 25
RIGHT 90
FORWARD 25
LEFT 90
END
```

The final instruction for the Turtle Hurdles event might be:

```
REPEAT 7 [JUMP]
```

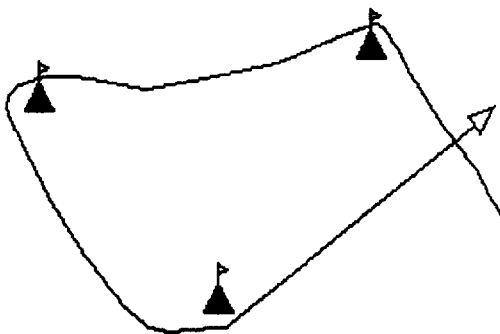
This printed example shows a turtle with its pen down, but for a "live" performance, you might prefer its pen to be up.



Event 2: TURTLE YACHTING

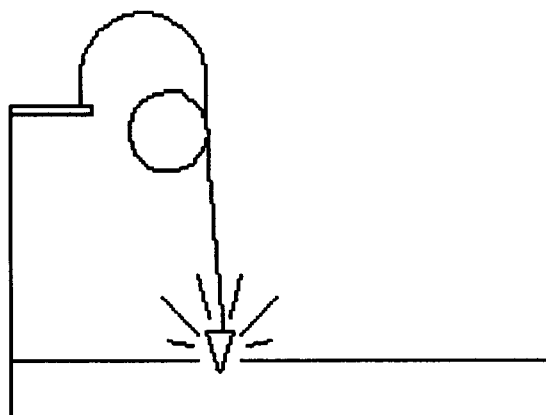
In yachting, sailors maneuver their boats around race courses marked with buoys. Each boat must go around the buoys in a counter-clockwise direction. Mark a course and have a race! Don't worry about the direction of the wind. Go for the shortest route between two buoys!

In competitive Turtle Yachting, players can count the number of commands to complete the course. Low score wins.



Event 3: TURTLE DIVING

It's time for the high dive! First, draw a swimming pool with a diving board. Then find an interesting way to get the turtle into the water. Here is a printed example of a dive, but you can create some amazing animations with a moving turtle! How about a reverse 2 1/2 somersault?



Event 4: ARCHERY

Archery is target practice for the turtle. We can draw some concentric circles, put the turtle to one side, and see how many commands it takes to hit the target.

You can use the following instruction to draw the circles. The turtle stays in the center of the circle to draw each one.

```
REPEAT 360 [PENUP FORWARD 40 PENDOWN
FORWARD 1 PENUP BACK 41 RIGHT 1]
```

The largest circle drawn by the preceding instruction has a radius of 41 turtle steps. Each of the other three circles is 10 turtle steps smaller in radius than the one before. Change the numbers accordingly to draw all the circles. Of course, there are other ways to draw circles. Use the one that makes sense to you!



The ARCHERY procedure places the turtle to the left of the target at a random vertical position. It might aim at any of the circles.

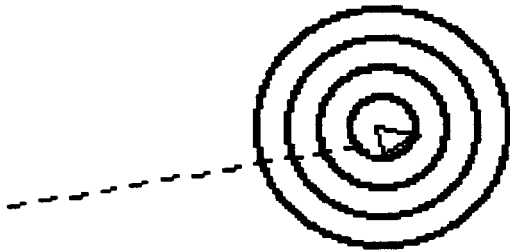
```
TO ARCHERY
PENUP
SETXY -120 (50 - RANDOM 100) (or use
SETPOS LIST -120 (50 - RANDOM
100))
SETHEADING 90
MAKE "X XCOR
MAKE "Y YCOR
END
```



The goal is to use just two commands to send the turtle to the center of the target: one command to turn the turtle to the left or right, and one to move it forward. If the turtle doesn't hit the center target, students can use the following procedure and type **AGAIN** to try once more.

```
TO AGAIN
SETXY :X :Y      (or use SETPOS LIST :X
                  :Y)
END
```

The turtle won't draw the dotted lines shown in the following picture. Here they show where the turtle traveled with its pen up.



Event 5: GYMNASTICS

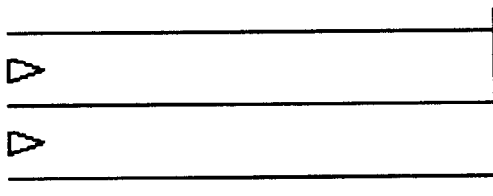
Here is another animation project. Draw a piece of gymnastics equipment and choreograph a routine for your limber turtle. This turtle is taking a break on the balance beam. You're on your own here—just use your imagination!



Event 6: 200-TURTLE-STEP SPRINT

A race is best done with more than one turtle! We'll use two turtles, but you could add a few more. If your version of Logo has just one turtle that you can stamp on the screen, it is possible to run a race simulating multiple turtles. You experts can figure out how!

First, set up a race course. This one is short, and we need just two lanes. The finish line is at the right.



The procedures below run a simple race with multiple turtles. Each turtle moves forward a random amount between 0 and 9. Then we check to see if the turtle has reached the finish line, where its **XCOR** will be greater than 100. Use the number that is appropriate for your race course. The procedure is recursive (it calls a copy of itself) so that the race will continue until a turtle has won.

```
TO SETUP.SPRINT
TELL 0
PENUP
SETPOS [-100 -10]
TELL 1
PENUP
SETPOS [-100 20]
END

TO SPRINT
TELL 0
FORWARD
RANDOM 10
IF XCOR > 100 [WIN STOP]
TELL 1
FORWARD
RANDOM 10
IF XCOR > 100 [WIN STOP]
SPRINT
END
```

Get the winning turtle to do a dance so you can see the result of a close race!

```
TO WIN
REPEAT 18 [RIGHT 20 WAIT 3]
REPEAT 3 [HIDETURTLE WAIT 10
          SHOWTURTLE WAIT 10]
END
```

Other Olympian Ideas

- Draw a picture of the field or court where a sport is played.
- Use Logo to draw flags of countries represented in the Olympics.
- Teach Logo how to play a country's national anthem.
- In the 200-turtle-step sprint, use shapes that look like a rabbit and a turtle and have a rematch between the Hare and the Tortoise. Who will win this time? Change the random instructions so that the tortoise always has a better chance of winning!
- Draw an Olympic torch.
- Create a bulletin board of Olympic pictures.
- Combine several events on screen for a full Olympic presentation.

- Coordinate your Turtle Olympics projects with related activities in the gym class.

Good luck with your Turtle Olympics, and may the best turtle win!

Dorothy Fitch has been director of product development at Terrapin since 1987. A former music educator, she has also directed a computer education classroom for teachers and students and provided inservice training and curriculum development for schools. At Terrapin, she coordinates soft-

ware development, edits curriculum materials, writes documentation, and presents sessions at regional and national conferences.

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***Logo: Massive Parallelism for the Masses**

email announcement from Mitch Resnick
mres@altdorf.ai.mit.edu

*Logo, the first massively-parallel programming language designed especially for nonexpert programmers, is now available for the Connection Machine (model CM2).

With *Logo (pronounced starlogo), even people with limited programming experience can create and experiment with massively-parallel simulations. *Logo is particularly well suited for "artificial life" simulations, since it is easy to use *Logo to program thousands of "artificial creatures." For example, you can write programs for thousands of individual "ants," and then observe the colony-level behaviors that emerge from the interactions.

Many other types of simulations are also possible. *Logo has already been used to simulate the interaction of cars in a traffic jam, the interaction of atomic particles in a fission reaction, and the interaction of buyers and sellers in an economic market.

*Logo is an extension of the popular Logo programming language, which is now used in about one-third of all elementary schools in the United States. Many students learn Logo programming through "turtle graphics"—they create drawings by giving commands to a graphic "turtle" on the computer screen.

*Logo extends this idea by allowing you to control thousands of graphic turtles at once. In addition, *Logo makes the turtles' world computationally active so that you can write programs not just for thousands of turtles

but also for the thousands of "patches" that make up the turtles' environment.

You can use the *Logo turtles in several ways. As in traditional versions of Logo, you can use the turtles to draw on the screen. But there is also a new form of turtle graphics: You can create graphics out of the turtle themselves. For example, you can arrange hundreds of turtles into a circle, and then tell the turtles to move so that the circle shrinks or expands. More significantly, you can treat the turtles not as "graphic turtles" but as "behavioral turtles." For example, you can make the turtles "sniff" around the world, and change their behaviors based on what they sense.

*Logo (including documentation and sample programs) is available by anonymous ftp from Thinking Machines. Contact Mitch at the above electronic mail address.

*Logo was designed and implemented by Mitchel Resnick of MIT, with help from Ryan Evans (of MIT) and JP Massar and Mario Bourgoïn (of Thinking Machines). Students from Boston-area high schools used *Logo (and provided useful feedback) during the development process. Work on *Logo has been supported by the MIT Media Laboratory, Thinking Machines Corporation, the National Science Foundation, the LEGO Group, the McArthur Foundation, and Nintendo Japan.

Professionals Talking With Professionals: Is It Really Happening?

A. J. (Sandy) Dawson

I struggled putting this column together. I couldn't settle on a topic, because I was preoccupied with problems and concerns I was facing both in the administrative post to which I had just returned at Simon Fraser University, and with the questions graduate students were posing to each other and grappling with in the course on the philosophical and psychological foundations of computers in education that I was teaching electronically. In the former case, as the director of the SFU teacher education program, I was concerned with how to get professors from my faculty talking with teachers who were supervising the practice of our student teachers. In the latter case, the graduate students, all of whom were classroom teachers even if they were on a year's leave to do a master's degree, were trying to figure out how to incorporate computers into their classrooms in ways that honored a constructivist orientation to the teaching and learning process, as advocated by so many university-based educational writers.

While all these thoughts were rolling about in my mind, I read Larry Cuban's (1992) AERA Presidential Address, in which he argues that

Over the last century, at least three overlapping cultural values have created conflicts. The university culture, prizing the values of reflection, rigorous analysis, and scientifically produced research, competes against values within a professional school of applying disciplinary knowledge to practical situations in order to prepare the next generation of teachers, administrators, and researchers. Both sets of values embedded in university structures compete against another set of values within schools. There action is prized. The knowledge that is admired is concrete, relevant, drawn from experience, and applied to the practical dilemmas of teaching and learning (Clifford & Guthrie, 1988; Goodlad, 1990). (p. 8)

Then I realized that my preoccupation with my teaching concerns and with my administrative work were one and same. In my administrative work, I was trying to reconcile competing values systems between professors and teachers, and the graduate students were trying to do the same thing in the opposite direction when they attempted to reconcile their own prac-

tice with prescriptions for practice coming from university professors, myself included!

Well, it certainly helped to see that I had only one problem, not two!

Moreover, maybe I had at least an opening for my column. But where was I going with it, and how was it relevant to readers of *Logo Exchange*? Write some more, I thought, and maybe it will all be revealed. Instead of writing, however, I read some more from Cuban's (1992) article, and he posed what for me was the crucial question:

How can we create intellectual communities among practitioners and professors that develop shared standards of teaching practice, and engage in sustained conversations over dealing with our common moral dilemmas? (p. 9)

In restating the question in a different way, Cuban provides one answer to it:

What joins together teaching from kindergarten through graduate school is that it is, essentially, uncertain, action driven, ridden with dilemmas, and morally based. (p. 9)

Okay, I thought, if those are the items that join teaching at all levels together, what does that mean in terms of action. If teaching is to be the point of contact between, say, professors of mathematics and professors of mathematics education, or between teachers of mathematics in schools and professors of mathematics and mathematics education, how do we get these people talking to one another? In dealing with this question, let me quote Cuban one last time, he argues that

serious scholarly examination of the uncertainties, ambiguities, and moral dilemmas of teaching students at different levels of formal schooling is precisely one basis for assembling intellectual communities among educators. Such collaborative inquiry into core teaching activities common to all levels of schooling invigorated by respect of professors for wise practitioners and of practitioners for thoughtful professors could forge coherent communities of researchers, professional educators, and practitioners. (p. 9)

When reading this, it occurred to me that what Cuban was advocating was very much akin to suggestions that classrooms should be places where teachers and learners inquired together, and thereby created shared meanings. I asked myself if that is what I was doing in the graduate class I was teaching. Moreover, I wondered if I could in fact hope to achieve that end when the face-to-face contact between and my students and me was restricted to three meetings during the semester, all other contact being made by computer-mediated communication. I also asked myself if what I was doing administratively allowed my colleagues at the university to talk with, rather than at, my colleagues from the schools.

In the administrative case, we are fortunate at SFU that half our faculty is composed of excellent classroom teachers seconded for a two-year period from local districts. Pairs of these individuals work closely with a professor and 28 student teachers in ways which hopefully allows all to "forge coherent communities of researchers, professional educators, and practitioners." Though far from perfect, this system does work most of the time, but the question of how to involve teachers in the field in this discussion is still unresolved.

In the teaching situation, the graduate students in the course are very open and honest about the restrictions within which they have to operate, and how these restrictions limit the viability of ideas they receive from me and through their readings. There is no doubt, at least in my mind, that the course is a dialogue among professionals. Through the electronic means of communication to which most of us have to adapt, it is possible to put forth one's ideas, one's hopes, and one's fears, to make confessions about having tried something and finding it wasn't viable (sometimes much to one's chagrin), and still to have the sense and feeling that one is talking to a real human being and not some disembodied robot.

When I next write a MathWorlds column, I will be able to report on how it all worked out with the course and with my administrative activities. But better than that, I would like to report on how readers of this column have dealt with these issues in their own professional settings. How have you established and maintained ongoing dialogues with that part of the educational community with whom you normally are not in contact? If you are a classroom teacher, how do you interact with the university community in your area? If you are a college or university instructor, how do you interact with classroom teachers in your district? If it is teaching that binds us all together, as Cuban suggests, what are the uncertainties, the dilemmas, and the moral issues that drive your action? Do you think these are different for teachers of mathematics and of

computers in education than for teachers of other school subjects?

This year *LX* celebrated its 10th anniversary. I do not recall the kind of questions posed in the preceding paragraph even being voiced 10 years ago. Indeed, I don't recall, except in isolated situations, that teachers and college and university instructors were encouraged to talk with one another. More often than not, the latter's way of working was to talk *at* the former. Next to children in schools, teachers were probably the most talked at group of people in the world! And it is no wonder that teachers talk at children, because that is what happened to teachers when they were in college. But this is 10 years later, and new ways of working are being suggested, explored, and investigated.

So, to cap off this 10th anniversary issue of *LX*, I invite readers to share their experiences with these new ways of working with professional colleagues. Tell us how this is happening in your school, in your district, in your mathematics classroom, in your computer lab, with the children in your charge.

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- Goodlad, J. (1990). *Teachers for our nation's schools*. San Francisco: Jossey-Bass.

After a year's administrative leave, Sandy Dawson returned to his duties as director of the Professional Development Program at Simon Fraser University in Vancouver, Canada, in January, 1992. Along with Rina Zazkis, Tom O'Shea, and David Pimm, he will be hosting Mathematics Education Month at Simon Fraser University this July.

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Experiments With Language and Letters

Glen L. Bull and Gina L. Bull

A scientific investigation often involves collection of data followed by analysis of the data. Often scientists look for a pattern or a trend. Scientists soon found that, when graphed, the distribution of many natural phenomena falls within what has been termed a "bell-shaped curve." For example, if a class collected oak leaves in the fall, the chances are that most leaves would be of medium size, with some larger ones and some smaller ones on either side. This type of curve is called a "normal distribution."

Other types of distributions may be found in other circumstances. For example, when dice are thrown, over time each number on a die (1 through 6) should come up about the same number of times. While the number that will appear on any one throw cannot be known in advance, the percentage of times each number appears should be about the same over time. When graphed, this type of distribution should be roughly rectangular.

Children performing experiments in elementary classrooms are, as a result of technology, now gaining access to sources of data that a few years ago were available only to scientists. For example, the Jason Project allows children to observe and control an undersea robot. The Macintosh LC computer comes equipped with a sound digitizer that makes it possible to analyze and graph sound waves. Educational technologies such as these are generating rich sources of data for scientific exploration and investigation in the classroom.

However, there is one source of data available to every classroom without the necessity of a field trip or expensive equipment. Words and letters themselves form a corpus of materials for classroom scientific experiments. Students can become linguistic investigators by examining the composition of words and documents. This type of linguistic analysis has figured prominently in a number of different kinds of scientific investigations.

For example, analysis of word composition and sentence structure has played a role in the debate over the authorship of Shakespeare's works. In war, the frequency distribution of symbols in secret messages has provided a key tool used in cryptographic analysis. The distribution of letters has also played a role in efforts to design an improved keyboard, because ideally the most frequently used keys should be placed on the home row.

Generating a Frequency Table

It is possible to count the words and letters in a document with a pencil and piece of paper. However, a computer can simplify the task. In fact, an important stimulus underlying the development of early computers was an effort during World War II to decode encrypted messages. Logo is well suited to such tasks. For example, the following table displays the count of all the letters in the Gettysburg address, as analyzed by a Logo text-counting program.

Table of Letters in
the Gettysburg Address

A = 102	N = 77
B = 14	O = 93
C = 31	P = 15
D = 58	Q = 1
E = 165	R = 79
F = 27	S = 44
G = 28	T = 126
H = 80	U = 21
I = 68	V = 24
J = 0	W = 28
K = 3	X = 0
L = 42	Y = 10
M = 13	Z = 0

Setting the Initial Values to Zero

The first step in creating a Logo program that counts the letters in a document is to initialize the variables, A through Z, by setting the count associated with each letter to zero. One method of creating such a procedure would be to write a procedure with one line for each letter:

```
TO INITIALIZE.LETTERS
  MAKE "A 0
  MAKE "B 0
  MAKE "C 0
  etc.
END
```

However, it is possible to create a three-line procedure that will reset the letters to zero without entering a line for each letter of the alphabet. There is a number associated with each letter, known as its "ASCII value." (ASCII stands for "American Standard Code for Infor-

mation Interchange.) The ASCII value of "A" is 65, the ASCII value of "B" is 66, and so on. Try typing in the following line in Logo:

```
PRINT CHAR 65
```

The letter that appeared on the Logo screen after you pressed the Return key should have been "A." The following two procedures make use of the ASCII values of letters to set the initial count associated with each letter to zero. Instead of writing MAKE "A 0, it is possible to write MAKE CHAR "65 0. Because the last letter, Z, is character 90, a recursive Logo procedure can be written that sets the ASCII values for letters (65 through 90) to 0.

The procedures described in this column were written in LogoWriter and tested on Apple, IBM, and Macintosh computers. However, with minor modifications they should work in any version of Logo. (*Troubleshooting Tip:* The "+" in the last line of INIT.LETTERS must contain a space between the plus sign (+) and the 1, or an error message will result in some versions of Logo.)

```
TO RESET.COUNT
  INIT.LETTERS 65
END

TO INIT.LETTERS :NUMBER
  IF :NUMBER > 90 [STOP]
  MAKE CHAR :NUMBER 0
  INIT.LETTERS :NUMBER + 1
END
```

Displaying the Table

Some means of displaying the number of times each letter appears in a document is also needed. The following procedures will produce such a table. (*Troubleshooting Tip:* Parentheses must be placed before SENTENCE and after :NUMBER in the SHOW.LETTERS procedure. Use of square brackets instead of parentheses will generate an error message.)

```
TO DISPLAY.COUNT
  CT
  SHOW.LETTERS 65
END

TO SHOW.LETTERS :NUMBER
  IF :NUMBER > 90 [STOP]
  PRINT (SENTENCE CHAR :NUMBER "="
    THING CHAR :NUMBER)
  SHOW.LETTERS :NUMBER + 1
END
```

After entering the procedures to reset the table of

letters to zero (RESET.COUNT and INIT.LETTERS) and the procedures to display the table (DISPLAY.COUNT and SHOW.LETTERS), enter the following commands:

```
RESET.COUNT
DISPLAY.COUNT
```

Logo should display the following table. (Note: We enhanced our DISPLAY.COUNT procedure so that the table would print in two columns. As a programming challenge, you may want to develop a similar modification yourself, or you can look ahead for our method, described in the "Enhancements" section later in the column.)

A = 0	N = 0
B = 0	O = 0
C = 0	P = 0
D = 0	Q = 0
E = 0	R = 0
F = 0	S = 0
G = 0	T = 0
H = 0	U = 0
I = 0	V = 0
J = 0	W = 0
K = 0	X = 0
L = 0	Y = 0
M = 0	Z = 0

Counting the Letters

Once procedures to reset the count and display a table of values have been developed, the actual procedure to count the letters is required. The following procedure accepts a word as its input and counts the number of letters in the word. It adds one to the count of each letter in the word.

```
TO LETTER.COUNT :WORD
  IF EMPTY? :WORD [STOP]
  MAKE "CHAR FIRST :WORD
  MAKE :CHAR 1 + THING :CHAR
  LETTER.COUNT BUTFIRST :WORD
END
```

Try typing the following to test the LETTER.COUNT procedure:

```
RESET.COUNT
LETTER.COUNT "HELLO
DISPLAY.COUNT
```

The following table should appear. The letters H, E, and O appear once in the table while the letter L appears twice.

A = 0	N = 0
B = 0	O = 1
C = 0	P = 0
D = 0	Q = 0
E = 1	R = 0
F = 0	S = 0
G = 0	T = 0
H = 1	U = 0
I = 0	V = 0
J = 0	W = 0
K = 0	X = 0
L = 2	Y = 0
M = 0	Z = 0

Analyzing a Document

If the `LETTER.COUNT` procedure works properly, you are ready to create a procedure to count the letters in an entire document. The `TEXT.COUNT` procedure takes the first word in a document, counts the letters in it, and continues until it has exhausted all the words in the document:

```
TO TEXT.COUNT :DOCUMENT
  IF EMPTY? :DOCUMENT [STOP]
  MAKE "WORD FIRST :DOCUMENT
  LETTER.COUNT :WORD
  TEXT.COUNT BUTFIRST :DOCUMENT
END
```

After entering the `TEXT.COUNT` procedure, try typing

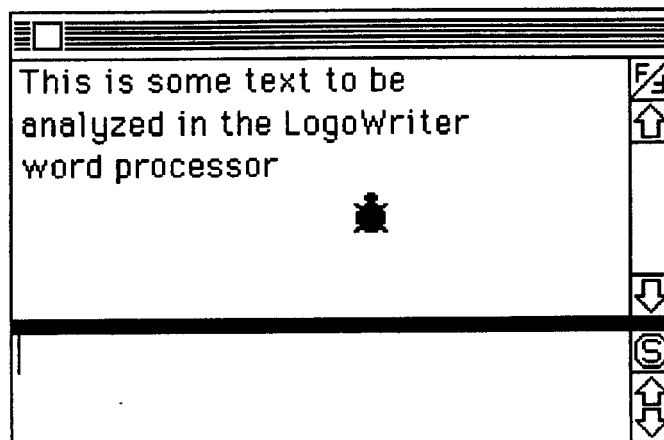
```
RESET.COUNT
TEXT.COUNT [This is a list with
  several words]
DISPLAY.COUNT
```

What letter appears most frequently in the resulting table?

A = 2	N = 0
B = 0	O = 1
C = 0	P = 0
D = 1	Q = 0
E = 2	R = 2
F = 0	S = 5
G = 0	T = 3
H = 2	U = 0
I = 4	V = 1
J = 0	W = 2
K = 0	X = 0
L = 2	Y = 0
M = 0	Z = 0

The `TEXT.COUNT` procedure can also be used to analyze the letters in a document typed into the *LogoWriter*

word processor. In order to do this, first type in the text to be analyzed:



Then select the text and copy it to the *LogoWriter* clipboard. This can be done with the *LogoWriter* function keys, but the easiest way is to use a *LogoWriter* procedure. The `SELECT.TEXT` procedure moves the cursor to the top of the text window, enables the select function, moves the cursor to the bottom of the text window, and copies the selected text to the *LogoWriter* clipboard:

```
TO SELECT.TEXT
  TOP
  SELECT
  BOTTOM
  COPY
END
```

Type some text into the *LogoWriter* word processor, and then type

```
RESET.COUNT
SELECT.TEXT
TEXT.COUNT CLIPBOARD
DISPLAY.COUNT
```

The procedures should count the letters in the text in the *LogoWriter* word processor and display the results in a table.

Analyzing Data From a Separate Text File

The `DISPLAY.COUNT` procedure erases the text in the word processor in order to display the table of results. When we typed in the Gettysburg Address, we did not want to retype it again after the analysis table was displayed. To avoid this, we typed Lincoln's speech on a separate *LogoWriter* page, which we named Gettysburg. Then we returned to the *LogoWriter* page containing the `LETTER.COUNT` program and used the

LOADTEXT command to copy the text of the Gettysburg page to the LETTER.ANALYSIS page:

```
RESET.COUNT
LOADTEXT "GETTYSBURG
SELECT.TEXT
TEXT.COUNT CLIPBOARD
DISPLAY.COUNT
```

Even though the DISPLAY.COUNT program erased the Gettysburg text copied to the LETTER.ANALYSIS page when it displayed the analysis table, the text of the address was still preserved on the separate Gettysburg page. The LOADTEXT command can be used to load the text from any text file, not just another LogoWriter page. Because most word processors have the capacity to save a document in a text format (sometimes called an "ASCII file"), the letter analysis program can be used to analyze documents created with other word processors as well. (Note: Most other versions of Logo also provide some method for accessing a text file.)

Enhancements

We soon found that our program ran into problems when it encountered punctuation such as periods and commas. Therefore, we modified the LETTER.COUNT procedure so that it checked to see if a character in the text was a letter before adding it to the count. All the uppercase letters fall into the ASCII range between 65 and 90 and all the lowercase letters fall into the ASCII range between 97 and 122, so this provided a convenient means of determining whether a character was a letter or some other symbol, such as a punctuation mark.

```
TO LETTER.COUNT :WORD
IF EMPTY? :WORD [STOP]
MAKE "CHAR FIRST :WORD
IF LETTER? :CHAR [MAKE :CHAR 1 +
  THING :CHAR]
LETTER.COUNT BUTFIRST :WORD
END

TO LETTER? :CHAR
OUTPUT OR UPPERCASE.LETTER? :CHAR
  LOWERCASE.LETTER? :CHAR
END

TO UPPERCASE.LETTER? :CHAR
OUTPUT AND (ASCII :CHAR) > 64 (ASCII
:CHAR) < 91
END

TO LOWERCASE.LETTER? :CHAR
OUTPUT AND (ASCII :CHAR) > 96 (ASCII
:CHAR) < 123
END
```

We also found that it was handier to display the results of the analysis in a table of two columns so that it would fit onto a single LogoWriter screen. Here's how we accomplished this enhancement:

```
TO DISPLAY.COUNT
CT
SHOW.LETTERS 65
END

TO SHOW.LETTERS :NUMBER
IF :NUMBER > 77 [STOP]
INSERT (SENTENCE CHAR :NUMBER "="
  THING CHAR :NUMBER)
TAB
PRINT (SENTENCE CHAR 13 + :NUMBER "="
  THING CHAR 13 + :NUMBER)
SHOW.LETTERS :NUMBER + 1
END
```

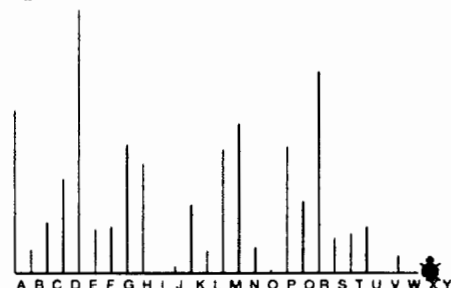
One other enhancement added was a STARTUP procedure to reset the count of letter frequencies to zero when the program first starts:

```
TO STARTUP
RESET.COUNT
END
```

We are sure that you will develop enhancements and modifications to adapt the text analysis procedures to your particular interests and needs as you experiment with them.

Graphing

At the beginning of the column we mentioned that natural phenomena typically generate a bell-shaped curve, while the graph from data generated by rolling dice should produce a rectangular graph. A graphical display provides another method of analyzing data. Here is a graph of the distribution of letters in the Gettysburg address. This graph quickly reveals that the letter "E" is by far the most frequently occurring letter in the Gettysburg address. What consonant appears most often?



Distribution of Letters in the Gettysburg Address

We are going to leave development of the graphing procedure as an exercise for the reader. However, we would point out that the basic pattern for the code is:

1. Draw a line representing the count for the first letter.
2. Move the turtle over.
3. Repeat until all the letters have been graphed.

The original SHOW.LETTERS procedure (before it was modified to display a two-column table) used by DISPLAY.COUNT provides a good starting point for construction of a graphing procedure. The second and third lines in the procedure can be replaced by

```
LINE THING CHAR :NUMBER
```

where the LINE procedure is simply

```
TO LINE :DISTANCE
FORWARD :DISTANCE
BACK :DISTANCE
END
```

Of course, you will want to move the turtle over after drawing each line.

Summary

After the basic Logo text analysis tools have been constructed, there are a number of different questions that an inquiring class can investigate. Is the distribution and frequency of letters that appear in a science textbook different from the distribution of letters found in a newspaper article? The distribution of letters in English differs from the distribution of letters which appear in other languages. A class might investigate, for example, how English and Spanish differ. Half the class might develop a code the other half attempts to decode, using frequency analysis as one tool in the decryption effort. One activity a class might attempt is to design a more efficient keyboard, based on the frequency of distribution of the letters of the alphabet. The types of activities addressed will depend upon the interests of the class and the teacher.

Some telecommunication services have archives of documents stored on-line. If a school has access to such a service, it may be possible to download the text of historical documents for analysis.

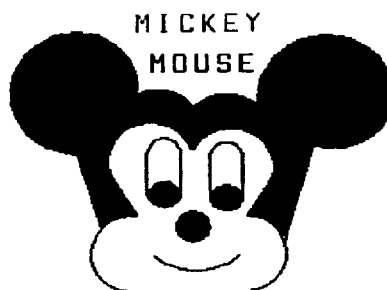
The basic LogoWriter letter-analysis tools can be extended by construction of other text analysis tools. Common measures often found in language analysis programs include procedures to measure the average lengths of words, sentences, and paragraphs. These counts are readily implemented in Logo. A more

ambitious program might also analyze the distribution and count of words in a document.

This type of linguistic investigation can generate trivia questions such as, "Which three letters do not appear in the Gettysburg Address?" (Answer: X, Y, and J) However, a more serious purpose is the process of allowing students to collect and analyze data just as actual scientists do. It also allows a class to ask questions whose answers the teacher does not know in advance, permitting true collaboration. Does the distribution of letters and frequency counts in historical documents differ from more modern ones? A class can collect and analyze data to discover the answer. In real science, unexpected results are possible, provoking interest and further questions. With the aid of Logo analysis tools, the materials for a linguistic investigation are present in every classroom.

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*For more
information
about these graphics,
see page 3.*



Knowing All the Angles: An Update

by Douglas H. Clements and Julie S. Meredith

A group of middle-school students new to Logo are working on the last corner of a square.

- A: Try 40 to get it round to there.
 A: Right another 40.
 A: Right another 40.
 B: Not too many 40s remember.
 A: Right 40 again.
 A: Right 40 again.
 B: No, 30, 10.
 A: Right 10.
 B: Left say 5.
 A: Left another 5 just to be on the safe side (Simmons & Cope, 1990, p. 137).

These students participated in one of two studies by Peter Cope and Malcolm Simmons from Scotland. They investigated the students' knowledge of turns and angles. Like the research we reported here previously (see *Logo Exchange*, Volume 5, Nos. 8 and 9), the results paint a discouraging picture. Are the results you get from your students similar? What has worked for you? In this article, we'll see that researchers would benefit from studying the effects of classroom-based teaching ideas.

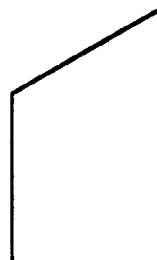
Where's the Angle?

Cope and Simmons (1990) first investigated the skills of students with between three months and six years of experience with Logo. Their teachers claimed that these students could all draw squares and triangles, with many being able to draw more complex figures. When the researchers sat down with the students, almost all could indeed draw a square. Only 24%, however, could draw an equilateral triangle.

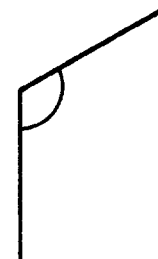
Fred typed the instruction:

FD 200
 RT 60
 FD 200

The turtle drew this. Mark the 60 degree angle that the turtle turned through.



Guess how big the angles are. Write the number of degrees in the space. (Two other diagrams were included with this item).



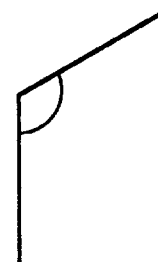
Fred typed the instruction:

FD 200
 RT 60
 FD 200

The turtle drew this (not the dotted line). Mark the 60 degree angle that the turtle turned through.



Guess how big the angles are. Write the number of degrees in the space. (Two other diagrams were included with this item).



The students fared poorly on four simple turn and angle tasks as well. These four tasks follow, along with the students' responses.

On the first item, no student was correct; 75% marked the interior angle. On the second item, 97% estimated the size of the 90° angle, but only 12% correctly estimated the size of all three angles (60°, 90°, 120°) to within $\pm 10^\circ$. A full 36% gave the size of the external angle as their estimate.

On the third item, 8% marked the correct external angle when the dotted line was supplied. In comparison, 66% marked the internal angle.

On the fourth item, 20% now estimated the size of the angles originally given in the second task to within

10°. Still, 42% incorrectly marked the external angle.

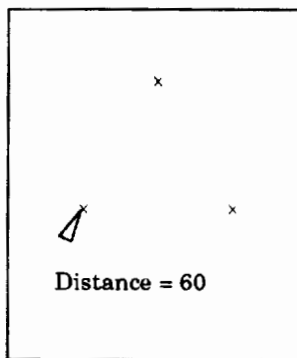
Cope and Simmons conclude that unstructured use of Logo will not benefit students. Even if students are competent at producing effects on the screen, they may be confused about turns and angles. Anything other than 90° may be a problem. Students can often appropriately change the heading of the turtle. But when the turtle leaves a path, confusion can occur. As Simmons and Cope note, "Other angles become candidates for the numbers which the child has entered into the computer and these angles are more obvious than the angle turned by the computer" (p. 381-382).

We also know from this and other research that students can maintain their limited and erroneous ideas for years.

Getting There in Small Degrees

Cope and Simmons (1991) then built two Logo microworlds to help students build more useful ideas. The microworlds were simple to use—students could correct errors easily and they received better feedback.

The first microworld asked students to construct a square or equilateral triangle by connecting three or four stars on the screen. Students could ask the computer if their present heading was correct. A correct side was reported as a "bulls eye." If the side missed, everything was reset, allowing the students to try another turn immediately.

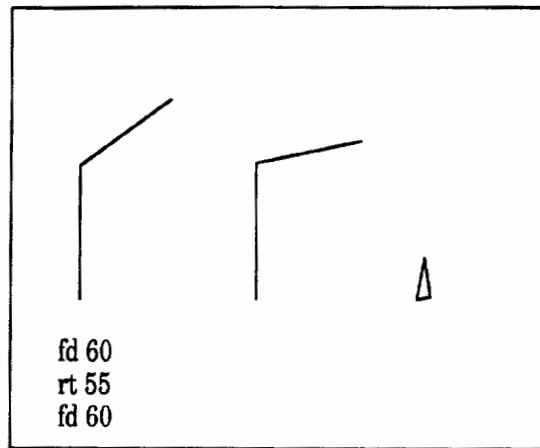


Not surprisingly, turns were easier on the square. In addition, students improved their results on the square on their second try.

Most students knew to use 90° for the square, but the researchers didn't assess whether they thought the 90 referred to the turn or to the measure of the resulting angle.

Some students tried 60° for the triangle, but this might have been because the length of the side was 60 turtle steps (an unfortunate choice).

The second microworld showed the students one angle and the code that produced it. Next to this was a different angle, which the students were to redraw:



Students did not improve on this task, even over several trials.

Surprisingly, students did *not* revise their guesses based on their previous guess—not even to the extent of saying their turn was too large or too small. Instead, they used the visual feedback of the turtle's heading. They repeatedly turned in small increments, even when the amount yet to turn was substantially larger. Thus, the almost universal strategy was to start with small turn, visually check its effect, and continue using small turns until the heading "looked right."

Out of 26 groups, 19 never used the first, coded angle to help them estimate the second. Of the 7 groups that did use this information, only 1 used it for all the problems. For example, with a coded turn of 65° and a target turn of 30°, one group said:

A: If that's 65, what's that?
B: Try 30. (p. 138)

Some confused angle and rotation, as indicated in this conversation about the same problem:

A: If that's 65, try 70, try 85.
B: No, not 85, 45.

This group has a target rotation of 80°, and they just tried 60°.

A: We got 60, so try 40, rt 40.
B: Rt 40.
A: No, it's not quite the same.
B: If this doesn't work, it should have been 30.

This group was thinking about the internal angle rather than the amount of turn. Instead of increasing their estimate, they tried a smaller number, because they were trying to draw a smaller angle.

Only one group ever used their knowledge of 90° turns to estimate the 80° turn.

Thus, even with the microworlds, students' strategies were dominated by visual feedback. They ignored the additional feedback, probably because it required analysis.

The authors expected that students would learn about turns and angles. They hadn't expected that limited problem-solving strategies would get in the way to such a formidable degree.

Turning Things Around

How, then, can we turn this situation around? How can we help students build stronger ideas about turns and angles? Cope and Simmons give several suggestions. First, teachers should help children understand and predict the behavior of the turtle during introductions of Logo.

They also suggest that teachers use a microworld in which the external angle is marked in some way. (Others tried this already, however, and in at least one study the students just played with the visual effect this produced!)

Microworlds such as those used in the researchers' study may help as well, but students still need considerable time to explore and experiment. Remember, the researchers' students only had *one* session with Logo!

Finally, Cope and Simmons suggested that students spend a long time using a floor turtle with the pen up before using it to draw figures. Such ideas need to be researched.

Whatever approach you use, it is critical that students *analyze* geometric situations rather than rely only on visual feedback. Do this with care. The visual nature of Logo is also one of its most important strengths. In Cope and Simmons' studies, as well as in myriad others, students' strong enthusiasm stemmed to no small degree from the visual nature of turtle geometry.

Researchers might be more successful with ideas developed by talented teachers. We would enjoy hearing about those you have constructed and will share them here. In addition, next time we'll describe our *Logo Geometry* activities dealing with turn and angle.

References

- Cope, P., & Simmons, M. (1991). Children's exploration of rotation and angle in limited Logo microworlds. *Computers in Education*, 16, 133-141.
- Simmons, M., & Cope, P. (1990). Fragile knowledge of angle in turtle geometry. *Educational Studies in Mathematics*, 21, 375-382.

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"Create a system that manages a game of Tic-Tac-Toe—accepting moves from other procedures, checking their legality, determining the winner, and publishing the results. Create at least one procedure that plays Tic-Tac-Toe without outside assistance. Finally, hold a round-robin tournament where your procedure competes against others from the class, using the environment of your game System."

This is an assignment I gave to advanced Logo students as an intense experience in list processing. It is, however, rather different from other assignments Logo teachers or students might be accustomed to handling. On the one hand, it is more directive than is normally expected within the confines of the student centered, exploratory Logo philosophy. On the other hand, it is substantially more ambitious and ambiguous than assignments in more teacher-centered computer science curriculums. Later I will argue that this is just the sort of assignment teachers should seek out, but first I'll explore some of the issues and challenges facing students within the learning environment this assignment creates.

The Game System

Just where to begin is the first question facing students in this assignment. Some will want to start creating Tic-Tac-Toe playing procedures. Others will start with the System for controlling those players. A few students may even see that the System and the Players must be created simultaneously so that each can be used to test the other.

However, none of these approaches is correct. The real starting point is in the last requirement of the assignment: holding a tournament. Holding a tournament using Players written by different programmers requires an agreement on just how the Players and the System communicate. Player Procedures must be given a game board to examine, and they must then pass their moves to the System. The System must understand what move a Player is proposing, judge its legality, determine if the game has been won, and if not, pass an updated game board to the other Player. Thus, the System and the Players must share a common data structure for representing the game and Player moves.

Ambitious Ambiguity

by Mark Horney

Finding a structure for the game board is not particularly difficult. In my class we chose a 10-element list:

```
[O B O B X B X B B FALSE]
```

We agreed that the squares of the Tic-Tac-Toe board were to be numbered from 1 to 9 in rows starting in the upper left and ending in the lower right. These numbers then indicated the square's position in the list. List positions hold an X if taken by the first Player, or an O if taken by the second. B is used for squares as yet blank. The FALSE (or TRUE) at the end of the list indicates whether the game has ended. Obviously there is nothing magic about this particular data structure, and others may be more or less advantageous.

At this same time, the students must also decide the exterior format of the Player procedure. This must be standardized since each System must know how to call the Player procedures, and how to pass each the list representing the game board and receive moves back in return. This is more difficult to resolve than was the game board decision because it requires students to commit to some procedure features and characteristics before they have sketched out their algorithms. Especially difficult will be the choice of how a Player indicates its move. Should it "return" its choice, or indicate it as some global variable, or use yet some other method?

Guiding students through the discussions and negotiations leading up to these decisions will be the most difficult task the teacher faces. Exactly what answers are given to these questions is irrelevant. The process of answering them, though, is critical because it gives students a genuine insight into the frustrations of "coordinated" programming. By that I mean the sort of process required on any large project where different programmers each work semi-independently on sections of code that must later be integrated into a working whole. This is different from what might be called collaborative programming, where teams work together on a single set of procedures, a process more familiar in Logo classrooms. Teachers must initiate and support this coordination, always keeping the process moving forward but refraining from imposing any solution. If they break down and start mandating answers, the value of this part of the lesson is lost.

After this initial decision making is over, the rest of the process of creating the System is relatively

straightforward and provides a good opportunity to practice Top Down programming. Students can take some variation of the set of System tasks previously listed, write procedures for each, and coordinate them with top-level procedures such as

```
to SYSTEM :Player1 :Player2
  Print RESULT :Player1 :Player2 [B B
    B B B B B B FALSE]
end
```

Within these procedures are numerous situations requiring students to manipulate lists—the underlying motivation for this entire project. Take, for instance, an OUTCOME procedure used to judge whether a game is over. Deciding if a game has ended in Cats is easy: examine each “square” in the list for any remaining B (lank)s. If none is found, the game is over and OUTCOME can return “Cats” or some such. Otherwise, OUTCOME must perform the more complicated task of determining whether either Player has achieved one of the eight possible winning positions. This process requires extensive manipulation of the board list to examine all the possible combinations of Xs or Os that win a game. This kind of extended exercise is just what students need for learning about list operations.

To test their System, students must also be working on Player procedures.

The Players

Students are much more interested in creating Player procedures than they are in creating the System. My students immediately began encoding their own knowledge of Tic-Tac-Toe into long lists of complicated rules governing what moves should be made in this or that situation. This activity is good in that the assignment is about lists, after all—and the more the better. But these lists are premature this early in the project. If students become too engrossed in creating complicated Player procedures, while at the same time working on the necessarily complex System (and the two tasks must proceed in parallel), they will likely end up with a muddle that is impossible to debug.

To combat this, the teacher must refocus students on the issue of reliability. No overt lecture on the subject is necessary, just some gentle probing, such as “Sue, how do you know that Bill’s System is fair, and how can he prove it to you? How can you prove that your System is fair in return?” As they react to these questions, students can be shown the advantages of writing some very simple Players—Players that function so predictably they are reliable tests of the System procedures. Perhaps it would be good to use something like LAZY, which takes the first available square, or FLAIL, which uses a random-number generator to choose.

After students have a functioning System that has been tested by both their own Players and the by the Players of others, they can move on to more sophisticated Players controlled by a host of different Tic-Tac-Toe heuristics. The rules generated earlier can now be reintroduced to serve as a natural introduction to concept of Expert Systems. That topic from artificial intelligence can be explored in depth, as can the concepts of game theory. This branch of mathematics concerns the logical analysis of game strategies. One technique used by game theorists is to construct a “Game Tree,” which represents a game’s every possible move. These trees can then be searched in a variety of ways to find winning combinations. While making the entire tree for Tic-Tac-Toe, with its 362,800 branches, is too formidable for realistic use here, subsections of it can prove quite insightful.

Another alternative for students to consider is the idea that aggregates of “dumb” procedures might work equally as well as complicated rules. An example of this is a Player I, called PATTON. PATTON combined three procedures: WINNER, LOSER, and FLAIL. Its heuristic was simple. First, look to see if there is a winning move on the board, and, if so, take it. If not, take any move that the other Player could win with on the next move. Otherwise, pick some move at random. The power of this simple procedure is amazing, as is how easily it defeats more complicated algorithms. It is also interesting to use variations of PATTON to explore issues such as whether trying to win is more important than avoiding loss. This can be done with a comparison of a Player OFFENSE, using WINNER and FLAIL, and DEFENSE, using LOSER and FLAIL.

These Players illuminate a key concept for students: PATTON may be simple, but it is also flexible and flexibility is very useful, especially when experimenting with heuristics in an environment where no perfect algorithms exist. This is, of course, the key advantage to bottom-up programming.

One other Player technique for students to see is a learning procedure. My students were amazed when I introduced SOCRATES. This Player, like PATTON, used WINNER and LOSER, but instead of relying on FLAIL, SOCRATES counted up the number of victories and defeats resulting from its moves in the past and chose those moves that had been most successful. At the beginning of a tournament, SOCRATES was no better than a WINNER-LOSER-LAZY aggregate, but eventually it could learn to beat almost anyone.

Creating Players and running tournaments can go on for a long time, and there is no real reason to end this part of the assignment. Eventually, new assignments will push Tic-Tac-Toe aside, but there should always be time to test out hot new Players.



The Advantages of Ambitious Ambiguity

This assignment has what I call "ambitious ambiguity." Such assignments have characteristics I think are critical for the work asked of Logo students, if not all students. First, ambitious assignments are *intensive*. That is, they give students a great deal of experience for a given level of effort. The focus of the Tic-Tac-Toe assignment is list processing, and to complete it students must extensively manipulate lists in a wide variety of circumstances. The intensity of this activity is enhanced because students are working on a single large assignment rather than on several smaller assignments. This avoids the time lost in switching from assignment to assignment.

Second, ambitious assignments are naturally *collaborative*. There's so much to do that seeking and giving help is almost mandatory if anyone is to succeed. At the same time, no matter how much of the work is shared, there is always enough left for everyone to demonstrate his or her own effort and creativity.

Speaking of which, *creativity* is the third characteristic. It evolves from the ambiguity of these assignments, which allows all individuals the freedom to explore their own visions of how the work should be done. In the Tic-Tac-Toe assignment, creativity is encouraged on two different levels. The assignment is sufficiently vague about technical details that procedures can be implemented in many quite divergent fashions. At a higher level, students are encouraged to examine different heuristics for meeting their goals.

The last characteristic is *interdependence*. It is not enough for the Tic-Tac-Toe assignment to just teach students about list processing. Assignments must work simultaneously in several different areas. This not only makes more efficient use of limited class time and scarce computing resources, but it also binds together the disparate parts of our fragmented curriculum.

Because of these four characteristics, I think that ambitiously ambiguous assignments are good for Logo teachers to seek out and use. There are some costs, however, primarily in the role of the teacher. These assignments don't let teachers either stand and lecture, or stand aside and just watch. Rather, teachers must serve as counselors, models, guides, assistants, prompters, and assessors. Fortunately, these are roles well known to Logo teachers.

Mark Horney spent 13 years as a middle and high school teacher before moving to the University of Oregon to complete a degree in educational computing. He currently works as a researcher investigating electronic studying and the applications of hypertext.

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Paradigm Software Announces The Pearl Controller

The Pearl Controller is a serial interface device that connects the LEGO Interface Box to any Macintosh computer and is driven by either *HyperCard* or Object Logo 2.6. Prior to now, computer control of LEGO devices was restricted to Apple II and MS-DOS computers. The Pearl Controller works with existing LEGO hardware, instructions, wiring diagrams, and curriculum material. Following the growing Macintosh presence in the educational markets, the Pearl Controller allows users not only to preserve previous hardware and curriculum investment but also to fully utilize the Mac's interactive environment.

Object Logo 2.6

Object Logo is an object-oriented development environment based on Logo, with a compiler and a stand-alone application generator. Version 2.6 includes

support for the Pearl Controller and features new primitives for background task processing that are unique to Object Logo. Version 2.6 also emulates *LEGO TC logo*, enabling students to run their Apple II programs with little or no modification.

For more information these products, contact

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Just for Beginners

by Michael D. Moynihan

Introduction

For the last five years a Logo project involving mathematically able primary (elementary) boys and girls aged 9-12 years has been in operation in Ireland. Briefly, the main aim of the project is to use Logo to develop mathematical skills and concepts that will benefit them in later life. The project coordinator is Dr. Sean Close, of St. Patrick's College of Education in Dublin. Tutors from the various centers in Ireland meet from time to time in Dublin to discuss ideas. Under the chairmanship of Dr. Close, this group organizes the Irish National Logo Competition. Declan Donovan and I act as tutors on the Logo course in Cork. The reader may be interested to know that Cork is situated in the southern end of Ireland. The word "Cork" comes from the Gaelic "corcaigh," which means a boggy or marshy place! Indeed, much of the old part of the city lies below sea level and floods quite a lot!

Like the other Irish centers, we enter the children for the International Computer Problem-Solving Contest. We were fortunate to have a number of children ranked over the last three years and to have produced an ICPSC Logo Division winner in 1988 and 1989. The Cork Center also produced the overall winner of the Irish National Logo Competition for 1988, 1989, and 1990.

In this article, I would like to share some of my ideas with teachers who might be just beginning to use Logo in the classroom. I have taken as an illustration a simple triangle procedure and will attempt to show some of the things that can be done with it.

Terrapin Logo for the APPLE II is used throughout, but procedures can be easily modified for other versions of Logo.

A Simple Triangle?

First, take this TRIANGLE procedure:

```
TO TRIANGLE
;MICHAEL MOYNIHAN
HT
REPEAT 3 [FORWARD 50 RIGHT 120]
END
```

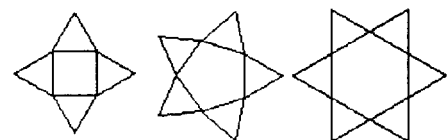


The procedure works fine, but it will only draw a triangle of size 50. While this may be acceptable for now, remember that you may need triangles of different sizes later on and that with a little thought awkward editing can be avoided. Incidentally, I find that the children like to see their names in procedures. They put it in as a remark in the second line. A remark is indicated by a semicolon (;).

From my experience, it is better that a child be introduced to the idea of a variable as soon as possible. A variable takes a colon (:) before it. Thus, I will edit the TRIANGLE procedure as

```
TO TRIANGLE :SIZE
;MICHAEL MOYNIHAN
HT
REPEAT 3 [FORWARD :SIZE RIGHT 120]
END
```

This revised procedure provides much more flexibility. The child no longer has to worry about the size of the triangle because the size can now be indicated when calling the procedure. For example, TRIANGLE 30 will now draw a triangle of size 30. Now use other values for :SIZE and see what happens! What happens if the screen is not cleared after each new triangle is drawn?



When planning to draw any given design, always look out for the basic one. It is useful to know where the turtle begins and ends. For the procedures 4.TRI, 5.TRI, 6.TRI, 8.TRI, 10.TRI, and 12.TRI, the original triangle is on the right-hand side, with the turtle on the bottom. Therefore, when planning 4.TRI, for example, realize that you draw a triangle, go forward, and turn left through 90 degrees. You could also, if you wish, use a MOVE procedure to move forward. Examine the procedures carefully and make sure that you understand them.

```
TO 4.TRI :SIZE
;MICHAEL MOYNIHAN
```



```

REPEAT 4 [TRIANGLE :SIZE MOVE :SIZE
  LEFT 90]
END

TO MOVE :SIZE
;MICHAEL MOYNIHAN
FORWARD :SIZE
END

```

The same method can be used to draw 5.TRI, 6.TRI, 8.TRI, 10.TRI, and 12.TRI. Of course, you could also have 3.TRI, 7.TRI, 9.TRI, and many more!

It is also worth remembering that if you wish to start and end at the same point, the turtle must go around through an angle of 360 degrees. Therefore, taking 4.TRI as our model, 4 times 90 degrees equals 360 degrees; that is, the number of REPEATs multiplied by the angle of turning equals 360 degrees. Perhaps you could now complete the procedures for 5.TRI and the others just mentioned.

Are You Their Master?

Working through these procedures should lead to the conclusion that maybe one procedure would suffice for all the previously mentioned designs. Yes, a master procedure, perhaps called TURN.TRI, could be written. In this procedure, another variable :ANGLE, as well as the usual variable :SIZE, may be introduced. The master procedure could look like this:

```

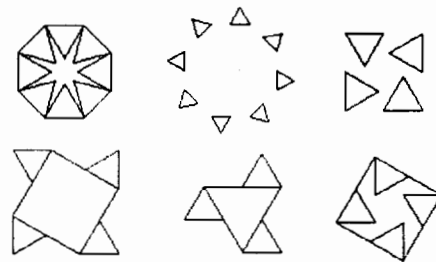
TO TURN.TRI :SIZE :ANGLE
;MICHAEL MOYNIHAN
REPEAT 360 / :ANGLE [TRIANGLE :SIZE
  MOVE :SIZE LEFT :ANGLE]
END

```

For example, TURN.TRI 20 90 is the same as 4.TRI.

With this method, you can explore many designs with ease. However, you must first thoroughly understand the particular before moving on to the general. Do not be afraid to experiment. You don't know how much you will learn! Edit your procedures to turn RIGHT instead of LEFT. What happens if you move forward more than the size of the triangle? What happens if you move with the pen up? I am sure you can think of other things to do.

In conclusion, I have included some exercises. The designs should appear exactly as they are on the page! Good luck!



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Boats, Bridges, and Bailiwicks

by Edwina Walsh

I teach an elective computer course that students take for one semester (two quarters) or a full year (four quarters). The course is open to all students, including ESL and special education students.

Because there is no prerequisite for the course, the class includes both advanced Logo students and students who have never used Logo before. The work in the class must be both possible and interesting for both groups. It must have a sufficiently low threshold to enable students to get on-task immediately and a sufficiently high ceiling to keep them challenged throughout the course. That is why I use *LogoWriter* and why I suggest a theme for each quarter.

During the first few days of each quarter, the class and I plan a theme together. From that point on, students work on projects individually or with partners while I work with individuals or small groups.

The theme of the first quarter this year was a famous house. Advanced students have probably made a house at one time or another, and beginning students do not find it intimidating.

In an initial class discussion, we list questions that one might ask about a famous house. The list includes questions about when, where, and why the house was built; what famous people are associated with the house, and what the style of architecture is. Using the school or



town library, students do research on their house to find the answers to these questions.

Second, students bring to class a picture of the house they have chosen. Usually, they ask the librarian for a photocopy from a book or encyclopedia, but it may be a postcard. Using this picture, students number the parts of the house in the order in which they will draw them with *LogoWriter*. For example, number one might be the frame of the house, number two the roof, and number three the door.

For extra credit, students write for further information to the city where the house is located. In the past, students received colored pictures of the Hearst Castle and the House of Seven Gables.

Third, the students write a history of the house. Beginning students simply type the story on a *LogoWriter* page. Advanced students use the flip side to write a program to display the story in sections or on separate pages.

Finally, the students draw their house on the computer. I give credit for every *LogoWriter* skill used in the drawing: color, sound, animation, text. I give extra credit for using something different that has been not done before in the class. We call such contributions "enhancements"; and every time we have a class showing, there are always new enhancements.

I encourage students to start with a menu such as the following:

THE TAJ MAHAL

- A. History
- B. Picture
- C. Notes about the author
- Q. Quit

YOUR CHOICE?

Not every student includes a menu, but every student does create an interesting and colorful product.

The theme for our second quarter is famous bridges. Students must follow the same four steps: doing research, getting a picture, writing the history, creating a *LogoWriter* drawing. Students have created some bridges as elaborate as the double-tiered George Washington Bridge in New York City and as simple as a covered bridge from a drawing sent to a student by her grandmother. Some of the bridges have traffic moving in two directions, a rising sun, or stars in a night sky.

The project for the third quarter is a famous ship. My favorite was an old river steamboat, but our longest project was the launch of a spaceship.

All these projects can be related to language arts or social studies classes. Throughout the year I encourage students to include poetry, anecdotes, and personal

essays in their projects. Students may use the same assignment for another class if it is appropriate.

Students who don't want to do any of these projects may do any project of their choice provided it uses *LogoWriter* skills. These students have completed such projects as creating a microscope and telescope, and developing a complete lesson on the parts of a computer.

Throughout the year I continue to teach new *LogoWriter* skills in small groups. Some of the students finish the year with some advanced skills, such as list processing; others learn graphic drawing, text, and animation. Everyone leaves with a sense of accomplishment, a better understanding of the power of the computer, and an appreciation of the art of a computer programmer.

Edwina Walsh makes *LogoWriter* the core of the computer classes she teaches to seventh and eighth graders. She likes to use *LogoWriter* with other sources such as laser discs and digitized graphics, and encourages her students to use *LogoWriter* for projects in curriculum areas. Edwina also gives teacher workshops in *LogoWriter*.

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Pulling It All Together: A LogoWriter Game Project

by David Rockwell

Dice spin across the video screens. Titles for fake real estate are being pumped out on a nearby printer. Students carefully cut up sheets of freshly printed \$10 and \$20 bills. A raid from the Vice Squad, however, would turn up nothing more than a noisy, but busy, class of students using LogoWriter to create their own versions of a real-estate-style board game.

The idea of creating board games grew from the following goals. I wanted to allow my students to:

1. Synthesize and apply their Logo skills in a new, more open-ended, problem-solving context.
2. Engage in cooperative planning and problem solving requiring team work, whole class participation, brainstorming, debriefing sessions, and peer evaluation.
3. Engage in a computer activity that held some relevance for them beyond earning a grade on teacher-assigned skill activities.

The students were already familiar with the following LogoWriter skills and concepts:

- Logo primitives for creating turtle graphics, filling and shading, adding word processing text, and labeling
- Use of the REPEAT command
- Use of SETX, SETY, and SETPOS
- Use of GETPAGE (GP) commands
- Use of the SHAPES table to create, stamp, and animate shapes
- Activation of multiple turtles on the screen (TELL 1 2 3 or 4)
- Use of the RANDOM command.

I prepared a guide sheet to help the students get started, and they were paired into teams. Each team would make an on-screen game board with property spaces grouped by color or shaded pattern. They would then add other spaces, such as transportations, utilities, chance, and go-to-jail by stamping shapes from the SHAPES table. The four turtles would be used to create two spinning dice and two tokens that could be moved around the board. A series of property-card pages would be created to match the colors or shapes on the board and provide the needed information for each space. These would be shared with the rest of the class. Those who had time at the end of the project could

design money to be printed and used for playing the game, make animated introductory pages for their game, and write directions for playing the game.

The monitor screens were soon alive with turtles tracing rows and grids of little boxes. Since one of my objectives was to see if students could independently utilize previously learned skills and concepts, I was pleased that several of them decided to make one BOX procedure and then use the BOX as a subprocedure to create a ROW procedure with the REPEAT command. Finally, they joined the ROWs together to create the four sides of the board in a procedure called GAMEBOARD.

Text written with the LABEL option (Open-Apple-8) proved too large for labeling spaces like GO-TO-JAIL or PARKING, so students turned to the SHAPES table to create shapes like prison bars or cars or dollar signs tailored to size. These were then stamped into the appropriate boxes.

As the boards took shape, attention turned to assigning colors or patterns to each group of real estate properties. A brainstorming session resulted in each team making a set of cards with an assigned color or pattern that could then be shared by every other team. The cards included such information as price, mortgage value, and rental value, all within price ranges agreed upon by the entire class.

Once the basic format had been established, the logistics of actually playing the game became the next concern. Turtles 1 and 2 were assigned the job of dice. The students had to use the RANDOM command to call up six dice shapes they had created in the SHAPES table for a previous assignment. Several improvements on the theme evolved. One team made the dice spin randomly several times before actually stopping, and another added a routine to make the dice jump around before landing on the final count.

Sample Procedures

A Standard Roll

```
TO ROLL
TELL [0 3] <—Activates two turtles
ST
EACH [SETSH 1+RANDOM 6] <—Picks a
    random number (0-5) and adds
    1 to select each die shape
END
```

Several Spins to Each Roll

```
TO ROLL
TELL [0 3]
ST
REPEAT 5 [EACH [SETSH 1+RANDOM 6]]
END
```

Dice Shake and Spin

```
TO ROLL
TELL [0 3]
ST
REPEAT 3 [PU FORWARD 10 LEFT 90
    FORWARD 10 BACK 10 RIGHT 90
    BACK 10]
EACH [SETSH 1+RANDOM 6]
END
```

Turtles 0 and 3 became game tokens that could be set to special shapes created in the SHAPES table. The tokens were moved around the board by addressing them with the TELL command and using the Open-Apple-9 key and the Arrow keys to move the turtle.

The Arrow keys were so convenient for moving the turtle that someone asked if there was a way to make the turtle do other things by just pushing individual keys. It was time to introduce the WHEN command, which allows students to program control keys that call up procedures to perform specific tasks. The class agreed on a common set of control keys that would be programmed to spin the dice, call up chance cards, go back and forth between property cards, and return to the game board. These were put in a STARTUP procedure on the flip side of their game board.

When all the property and chance cards were completed, I compiled them onto a scrapbook disk and added a page that included a routine I had written for selecting and randomly calling up the chance card pages.

The final phase of the project was for students to make up a name for their game and use the word processor to write a set of rules and directions for playing the game. This reinforced the need for students to be able to give specific and logical directions, which is an important programming skill. The students used either *LogoWriter* or *Print Shop* to create a cover for the

printed instructions. Students traded their completed games with each other to gain peer evaluation. Written feedback was given to the original designers so they could make revisions or improvements. Writing the rules and providing written evaluations gave students practice in analyzing a process, breaking it down into parts, and explaining it in their own words.

The project took about five weeks of daily work. The students persisted, I believe, because of a climate of cooperation, a sense of personal investment in their group and the project, and the perception that a worthwhile product would result from their efforts. They demonstrated their abilities to apply a top-down programming strategy by breaking a problem into parts, working on the individual parts, then bringing their individual solutions and contributions together in a final product. They learned to brainstorm and then analyze and evaluate ideas. They were able to generalize previously learned skills and concepts, applying them to a new problem-solving context. They demonstrated the ability to elaborate on an idea when they improved the ROLL procedure to make the dice work more realistically than before. They showed a willingness to revise their strategies if those strategies proved to be ineffective, or to adopt a better idea when needed. This was apparent when they abandoned the LABEL function and turned to the SHAPES table to identify special spaces on the game board. Students' involvement, performance, and skill development exceeded my original expectations. The learning itself was fun, and many other students will enjoy the games.

For a more detailed description of the project, including guide sheets, sample screens, and examples of Logo procedures, write to the address at the end of the article. Please enclose \$1.00 to cover postage.

David Rockwell is a computer lab instructor at Lady's Island Middle School in Beaufort, South Carolina, where he has taught for the past seven years. He chaired the task force that developed the Beaufort School District's K-12 computer curriculum and served on the first board of directors of the South Carolina Council for Computers in Education. He has made presentations on problem solving with Logo at a number of statewide conferences, teaches graduate courses on computers in education for the College of Charleston and the University of South Carolina, and was recently honored by the SCCE as South Carolina's Computer Using Teacher of the Year for 1991.

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Probability Using Logo

by Paul B. Clark

I have always found the concept of probability and chance fascinating, so I was highly motivated to prepare a lesson for my fifth- and sixth-grade computer students using the RANDOM primitive. To prepare for this lesson, the classes brainstorm to generate a list of examples of random chance. They recognize that board games, lotteries, dice games, card games, the weather, birth dates, sweepstakes, and so forth all have at their foundation the vagaries of chance. We also did some work with simulating the roll of a single die. In addition, these students study area and perimeter while in these grades; thus, they have the prerequisite skills needed to complete this lesson.

The basic premise for our lesson revolves around hypothesizing what the outcome will be if we asked the question, What will happen if we place dots on the computer screen randomly? We had discussed the RANDOM primitive and the concept of randomness, and I felt the students were comfortable with these ideas. The students' guesses were varied, but a majority said that the dots would be distributed in a consistent manner since there really was no reason why one location on the screen should be lighted up more than another.

The students had seen examples of randomness previously when rolling a die: there really isn't a reason why any one side should turn up more frequently than any other side, and given enough rolls, each side of the die should roll face-up an equal number of times. The children proved this hypothesis to their satisfaction by having the computer simulate the roll a die for up to 600,000 times! They found that as the size of the sample (number of throws) increased, the chances of our hypothesis being correct also increased. When we worked with one die, we discovered that the more times we rolled, the closer we got to an even distribution.

We transferred the results of this observation to the random dots question by hypothesizing that just like sides of a die, the dots should react in a predictable manner. We then went to work to prove our hypothesis.

Our first step was to write a procedure that would make a box of variable size:

```
TO BOX :SIZE
HT
FULLSCREEN
SETPC 1
```

```
REPEAT 4 [FORWARD:SIZE RIGHT 90]
END
```

After being given approximate screen sizes in Apple Logo, the students could compute the area of the screen, depending on which size box they made. Because the screen is approximately 240 x 280 turtle steps, the area of the screen could hold 168 squares if a box 20 x 20 turtle-steps in size were used—in other words 14 squares across and 12 squares down. If a box 40 x 40 turtle steps in size were used, the area would be 42 squares.

The second step involved preparing a program that placed dots randomly on the screen:

```
TO DOTS :NUMBER
HT
FULLSCREEN
SETPC 3
REPEAT :NUMBER [PENUP RIGHT
RANDOM 361 FORWARD RANDOM 140 PD
FORWARD 0]
END
```

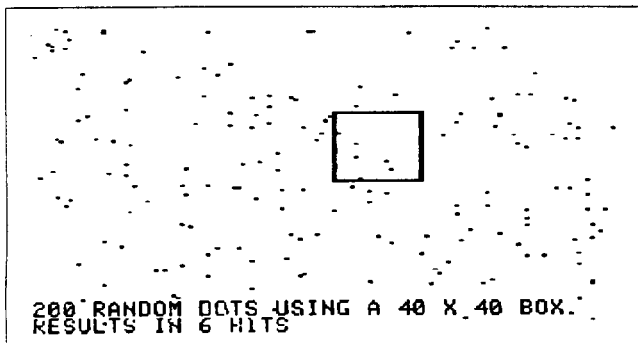
FORWARD 0 places a dot directly under the turtle. We used different colors for the box and the dots so that it would be easier to discriminate which ones landed in the box. We also drew the boxes one size bigger than the area we wished to enclose so that any dots inside the box were really inside the box and not on the border. That is, to make a box of 40, we typed BOX 41.

When the programs were prepared, we put a box of a specific size on the screen and then used our "random dot generator" to place dots on the screen. The box can be placed anywhere on the screen, and the students can experiment with different locations. Students soon discover that the placement of the box doesn't affect the outcome.

It was an easy task mathematically to divide the number of dots by the area of the box to get the hypothetical number of dots that should show up inside the box. That is, a box of 40 drawn anywhere on the screen with 1,000 dots placed randomly on the screen should contain about 24 dots. A box of size 20 is one-fourth of that area and should hold about 6 dots.

Since the screen could contain approximately 42 boxes 40 x 40 in size, dividing 1,000 random dots by 42 possible boxes should result in 24 hits. Using boxes 20

x 20 in size would decrease the area enclosed to one-fourth, therefore decreasing the potential hits.



I made a chart so that the children could use it to gather their own data and find averages. It was sometimes easier to keep track if the children did the counting as the dots appeared on the screen. It would be fairly simple to add a pause (WAIT) to the current DOTS program to slow down the generation of the dots.

Chart for Random Dots Activity

This experiment serves to demonstrate the concepts of probability, chance, randomness, and area in a

motivating and fun manner. It also requires certain mathematical and programming skills.

There are numerous follow-up activities that can be used. We write procedures to generate lottery numbers (six numbers from 1 - 36), make a database of birthdays in the school and analyze them, and use RANDOM liberally in many of our Logo sessions. Your students' imagination and proficiency level will provide you with many opportunities to explore probability and chance.

Paul B. Clark is the elementary computer coordinator at the Manchester Memorial School in Manchester, Massachusetts. He teaches both students and adults the joys of working in Logo environments. He is also a member of the adjunct faculty for Lesley College's Computers in Education Masters Degree Program, Cambridge, Massachusetts.

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Global Logo Comments

by Dennis Harper

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This issue's international column describes different Logo Projects being developed with special needs children throughout Latin America. These projects are based upon the work that started at Edinburgh, MIT and the Núcleo de Informática Aplicada à Educação in Brazil. Dissemination of the Brazilian project is being sponsored in part by the Organization of American States (OAS). Today, more than 50 Latin American educational centers and special education institutions are using Logo with their special needs children. Following is José Valente's report.

Logo and Special Education in Latin America

by José Valente

A Brief Historical View

The use of Logo in special education is based upon several research projects that have been developed with children with different types of deficiencies. In 1975, Sylvia Weir, a research fellow, and Ricky Emanuel, a graduate student, from the Department of Artificial Intelligence at the University of Edinburgh, used Logo in their work with Donald, a seven-year-old autistic boy (Weir and Emanuel, 1976). Donald used the button-box (a keyboard with only 16 large iconic keys) and the floor turtle.

Autistic children are known to have great difficulty in relating their own actions with the change these actions produce in the world around them. However, through the use of the Logo environment, Donald was able to establish the one-to-one correspondence between pushing a button and the turtle's action. Second, he was able to convey his intentions by acting them out with his body (as a choreographic conversation). Third, he established a strong identification with the turtle in several ways: an identification of his belly button with the PENDOWN and PENUP buttons, his own body

with the turtle, and his hand as an agent that produces the action in both cases. Thus, the turtle assumed the function of a mediator in Donald's interactions with the world and served as an object to help with actions with his own body. Once this connection was established, the turtle became the object with which it was possible for Donald to exercise his spatial and body concepts involved in his actions, to reflect upon these actions, and to debug them, thus creating new mental schemes.

Weir and Emanuel's work was presented to the Logo community in April, 1976, and was received with great hope and enthusiasm. It would open the possibility of using Logo with a population of children who really need a special educational tool. Paul Goldenberg, then a graduate student working at the MIT Logo Laboratory, showed a great interest in using Logo with special needs children. In July, 1976, he started a pilot study that used Logo with cerebral palsied children, then with deaf children, and later with autistic children (Goldenberg, 1979). This was an exploratory work, but it was of great importance in showing that the computer and Logo could be a possible educational solution for these children. The computer activity became the means for these children to be able to do something, to express their ideas that were inaccessible before, and to be able to assume a more active and productive role in their educational process. Thus, Logo became the means by which these children could interact with objects and people, and, at the same time, develop intellectually.

Based upon the experiences of Weir and Emanuel, and of Goldenberg, the researchers from the Logo Laboratory at MIT became very interested in developing a project with special needs children. The objective of this work was to create a learning environment for children with cerebral palsy (children with motor deficiencies due to brain lesion that occurs during the first year of life), and to use this environment to study the nature of these children's intellectual deficiency and to



explore whether these deficiencies could be minimized by developing computer activities.

To implement this project, Dr. Weir joined the Logo Laboratory. The project, "Information Prosthetic for the Handicapped" (Papert & Weir, 1978), was developed and submitted to the Bureau of Education of the Handicapped. The research started in 1978 and was developed at Boston's Cotting School for the Handicapped Children, a vocational school that offered a 12-year academic program for physically handicapped children. The target population was limited to the cerebral palsied children because one of the project's objectives was to understand some Piagetian issues, such as the role of world experience in these children's intellectual development. Since their lack of motor coordination prevent these children from having a full interaction with the world, the research questions from a Piagetian perspective were: How does their intellect develop? What do they know? How have they learned it?

A microcomputer was installed at the school, and the work started with Mike, a 17-year-old cerebral palsied boy, who was enrolled as a 10th-grade student. He had severe quadriplegia and had sufficient motor control in his left upper limbs to control his electric wheelchair, feed himself, type, and handle objects. He was dysarthric, but his speech could be understood by those used to it. However, he had never used a pencil, and there were very few things he could do with his hands.

Mike participated in the project from October, 1978, to June, 1982, for approximately 10 hours per week. He explored the use of Logo in several areas: drawing, animation, turtle geometry, list processing, business programming, and writing. This work made it possible to identify several aspects of Mike's intellectual development. On the one hand, if we consider his degree of motor handicap it was surprising to discover how much knowledge he had acquired and how creative and meticulous he was. On the other hand, this high degree of competence made it all the more surprising to find situations in which he performed much below age level. However, his computer activities helped him to overcome some of his deficiencies; to acquire skills in domains other than programming, such as writing and mathematics; to improve his motor abilities; and to augment his social interactions with his school colleagues and others around him. Also, the comparison of Mike's Logo activities with the Logo activities of a younger nonhandicapped child demonstrated that the solutions they adopted for their problems and programs were quite similar. This suggests that the difference is one of delay rather than of deviation of Mike's problem-solving and programming skills, and that this delay may be at least partially caused by Mike's lack of

experience in solving problems in the physical world (Valente, 1983).

The notable change in Mike's life made a remarkable impression on the other students. Even younger students in the fourth grade participated in the project. This created an experimental research environment where everyone had something to contribute and gain from the project. By developing computer activities, the students were acquiring a better understanding of their deficiencies and learning to cope with them by developing a more positive attitude—they were becoming active achievers rather than complacent losers. The project researchers were able to show that the computer can be an effective instrument to be used with physically handicapped children. It provided them with a way of understanding these children's intellectual disorders so that we could be truly helpful to them, giving them a way out of what seemed to be a hopeless situation.

The researchers from the Logo Laboratory at MIT extended the experience acquired with the physically handicapped population to other types of special need children, such as those with learning disabilities and dyslexia (Weir, 1981, 1987; Weir & Watt, 1981; Weir, Russell, & Valente, 1982). Also, this experience was disseminated to other research centers and schools in the U.S. and abroad.

Use of Logo With Special Needs Children in Latin America

Based upon the results from the MIT projects, several research groups and institutions in Latin America started to develop computer-based activities with their students. Today, several countries have such projects, and this type of work is spreading very rapidly. The computer has become a very helpful tool for special needs children. In the remainder of this article, I will give a very brief report on the work going on in countries such as Brazil, Costa Rica, Panama, Venezuela, Colombia, Chile, Paraguay, and Argentina.

Brazil

The use of Logo with special needs children in Brazil started in 1984 when my wife (Ann Berger) and I moved there from the U.S.. At that time, we were determined to start a project here that would continue the work we did at MIT. In the process of looking for financial support, we participated in several conferences, showed our work to several people and institutions, and made contacts with several agencies that could support this type of work. The idea of using computers in regular education was just starting here and was a very controversial. However, the idea of using computers with special needs children was welcome because it was seen as a noble use of technology.

One of these funding institutions declared that it would support our project provided that we invest much of our effort in training other professionals to do what we did at MIT. As they put it to us: "we know that you can do beautiful work with the handicapped. Show to us that you can train other people to do what you do." This challenge was accepted and has become the motivating factor of our work with special needs children. Thus, in 1985 we started the project "Uso da Informática na Educação Especial."

One objective of this work was to investigate the use of Logo with hearing-impaired and physically handicapped children. Two separate institutions were involved in the project, which started by training six professionals—three from one institution that works with physically handicapped children and three from another institution that works with deaf children. The first year of the project was totally dedicated to training processes. The actual work with the children started in 1986.

The work with the physically handicapped started with a small group of children and gradually incorporated other children. In 1990 we had approximately 30 children, ranging in age from 5 to 12 years old, participating in the project. The computer was fully integrated in their school curriculum and in their other therapeutic activities. It was almost a dream come true when the institution decided to change their approach and discontinue the project. Today, the work with the physically handicapped is part of a research project we are developing with the neurology department from UNICAMP. The current approach is more of a neuropsychological investigation than an educational one.

The work with deaf children still continues today, and the approach is to use Logo as a way of providing young deaf children with a means to acquire the first concepts about writing, reading, and simple mathematical concepts. This can be seen as their preparation for entering normal school with some important background that would help them to enter into normal classroom activities.

More recently, we started to work with visually impaired (subnormal vision) children and mentally impaired children. This work is still very exploratory, and methodological approaches are being developed.

With all these different populations, the working approach is similar. First, we train the professionals from the institutions. Then we gather a group of professionals who are interested in working with Logo. With our help, this group builds a working project the institution will implement. In general, this is a working plan; the objective is to provide some service to the target population. Once the project is in progress, our function is to help the professionals from the institution

to reflect upon their work and identify research questions that can give theoretical support to their activities. These research questions may be pursued by these professionals or by university students interested in doing graduate work in this area.

The educational methodology and the results from the research have been disseminated and used to train professionals in Brazil and other Latin American countries. Thus, we have conducted several courses and workshops as part of a training project sponsored by the Organization of American States. As a result of this project, we have approximately 30 institutions, in practically every one of the 26 states in Brazil, using Logo with different types of special needs populations.

A complete report of the work done in Brazil is presented in a recent book by Valente (1991), *Liberando a Mente (Untrapping the Mind)*. This book was sponsored by OAS and has been distributed to the institutions interested in this work. The book has three parts. The first part has 6 chapters that give an overview of the different uses of computers in education, Logo, special education, and computers in special education. The second part has 7 chapters that report results of research studies and provide case studies of practical implementations of computers in classrooms for special needs students. The third part of the book has 29 chapters that report on projects from different institutions in Brazil, Panamá, Colombia, and Chile.

Costa Rica

The use of Logo with special needs children is a natural extension of the work conducted with the general student population in Costa Rica and reported in the Winter, 1991, issue of *Logo Exchange* (Volume 10, No. 2). In August, 1991, the Ministry of Education, in collaboration with the OAS, provided a workshop for 30 professionals working with special needs children. This workshop was conducted in collaboration with the Omar Dengo Foundation, which is also involved in disseminating information on the use of Logo in special education.

As a result of this workshop, a project was set up in the Centro Nacional de Educación Especial Fernando Centro Guell in San José. This project incorporated Logo activities into these children's academic work. The initial work has started with deaf children; later it will include mentally impaired children who attend the same institution.

Panamá

The work in Panamá started in 1989. Cristina Echevers, a teacher from the Instituto Panameño de Habilitación Especial, visited UNICAMP and participated in a one-month training program for special education teachers. This program culminated with a



proposal written for a project to be implemented in Panamá. This proposal involved the training of other teachers from the Instituto Panameño de Habilidad Especial and pilot work with cerebral palsied children. One goal of the proposal is to identify ways in which Logo can be used to introduce writing and reading concepts to cerebral palsied children.

Since 1989 Logo has been used as part of the process of introducing writing and reading concepts to these children. This work is being done at the Instituto Panameño de Habilidad Especial in collaboration with the Universidad Tecnológica de Panamá.

Venezuela

The use of Logo with special needs children is at the beginning stage in Venezuela. Two professionals from the Venezuela Ministry of Education also participated in the one-week Costa Rican workshop last August. One of these professionals has worked intensively with deaf children and the other with physically handicapped children. During the past few months, they have developed two proposals that will guide the implementation of computers in their respective special education areas. However, the government's intention is to be able to implement several projects using computers with special needs children.

Colombia

The work in Colombia has been conducted with deaf and visually impaired children from the Instituto para Niños Ciegos y Sordos de Cali. This work was reported in the May, 1989, issue of the *Logo Exchange* (Volume 7, No. 8). Today, approximately 19 visually impaired children and 63 deaf children are using Logo as part of their academic activities. Also, Logo has been used as a way of complementing the psychological diagnosis of these children.

Paraguay

In Paraguay the use of Logo with special needs children is also just starting. In September, 1991, there was a one-week workshop for teachers working with special needs children. The majority were working with deaf children and were from the Instituto Antonio Provolo. This workshop was sponsored by OAS and by Paraguay's Ministry of Education. The objective of the special education sector of the Ministry is to work with the Provolo Institute to start a project that will train other teachers and act as a laboratory to disseminate information on the use of Logo in special education.

Following the one-week workshop, the teachers who participated started a project to learn more about the use of computers in education, including Logo and word processing. They started pilot work with some deaf children from the Institute so that they could

identify ways of implementing Logo as part of the academic activities of their students.

Chile

The work in Chile has been developed with children attending hospitals or rehabilitation centers. One program is for children who stay for a long period of time in a hospital. In this case, children often lose an academic year because they cannot attend schools. To combat this problem, an alternative educational program was established to provide Logo experiences as a way of continuing these students' education. A second program was set up for children who attend rehabilitation centers one or two days a week. In this case, the child, as well as the accompanying parent, have a chance to use an alternative educational methodology that better suits the child's needs.

This project has been conducted at the Children's Hospital "Luis Calvo Mackenna" in Santiago, where approximately 1,000 children have participated in these programs. Also, a great effort has been made to train professionals to participate in this project and to inform parents about their role in the child's educational process.

Argentina

The use of Logo with special needs children in Argentina started in 1979 after Professor Antonio Battro visited the MIT Logo Laboratory. During the summer of 1979, he had the opportunity to learn about the work that was developed with Mike and to learn about the use of Logo with physically handicapped children. After his return to Argentina, he started several research projects using Logo with deaf, mentally impaired, and physically handicapped children. This initial work is reported in Battro (1986).

As a result of Battro's work, several schools and institutions in Argentina are using Logo as an educational tool. The more well-known one is Instituto Oral Modelo in Buenos Aires. This institution has been using Logo since 1979 as part of the school curriculum. Today, the computer facility has been upgraded with several communication facilities, such as telecommunication and satellite-communications, which have been investigated as alternative ways for deaf children to communicate and to learn. This work is reported in Battro and Denham (1989).

Discussion

There is no question that the computer has become a very important tool for special needs children and that they should have access to this type of technology. The computer can be used in many different ways: as an educational tool, as a communication tool, and as a tool to control objects in their environment and to control

devices, such as artificial limbs, that make the lives of those with special needs more comfortable.

In Brazil, special education was an entry way that made the use of computers in education possible. Even though the economic resources were limited, it did not take too much to convince financiers that they should invest in projects in this area. The social and educational returns were immense compared to the small investment made. Also, the use of computers in special education skirted many of the criticisms we encountered about its use in regular classrooms in Brazil: that technology is very dehumanizing and that the schools did not have desks or chalk and we were proposing computers. This type of arguments, based on fears of the new rather than on concrete experience, was preventing the possibility of setting up computer-based learning environments that would show the real advantages and disadvantages of computers in the classroom. Thus, special education helped to solve a problem which formally had no solution.

Working with special needs children also provided us with a congenial learning environment. First, it is a situation that invites exploration of new ideas and of new ways of learning. In general, the education of these children is not restricted by the curriculum requirements, and there is almost no expectation academically. This creates a situation in which we can try new things and to develop alternative ways of helping these children. Second, it is a learning environment in which we all learn. If we take the attitude that when we do not know something we can be considered handicapped, in terms of learning, we can come to realize by working with the special needs population that we all belong to the same pool of individuals. By participating in their experience, we learn as much from them as they learn from us. Third, this environment is very appropriate to study intellectual development. Because everything in their environment happens slowly, it creates a good opportunity for us to see and to understand every step made in the child's intellectual development.

For these reasons, the work with special needs children is a very interesting and promising way of starting projects involving the use of computers in education. It is a process that can provide important services to these children, to the professionals working with them, and to the funding agencies. It creates a situation in which everyone gains!

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