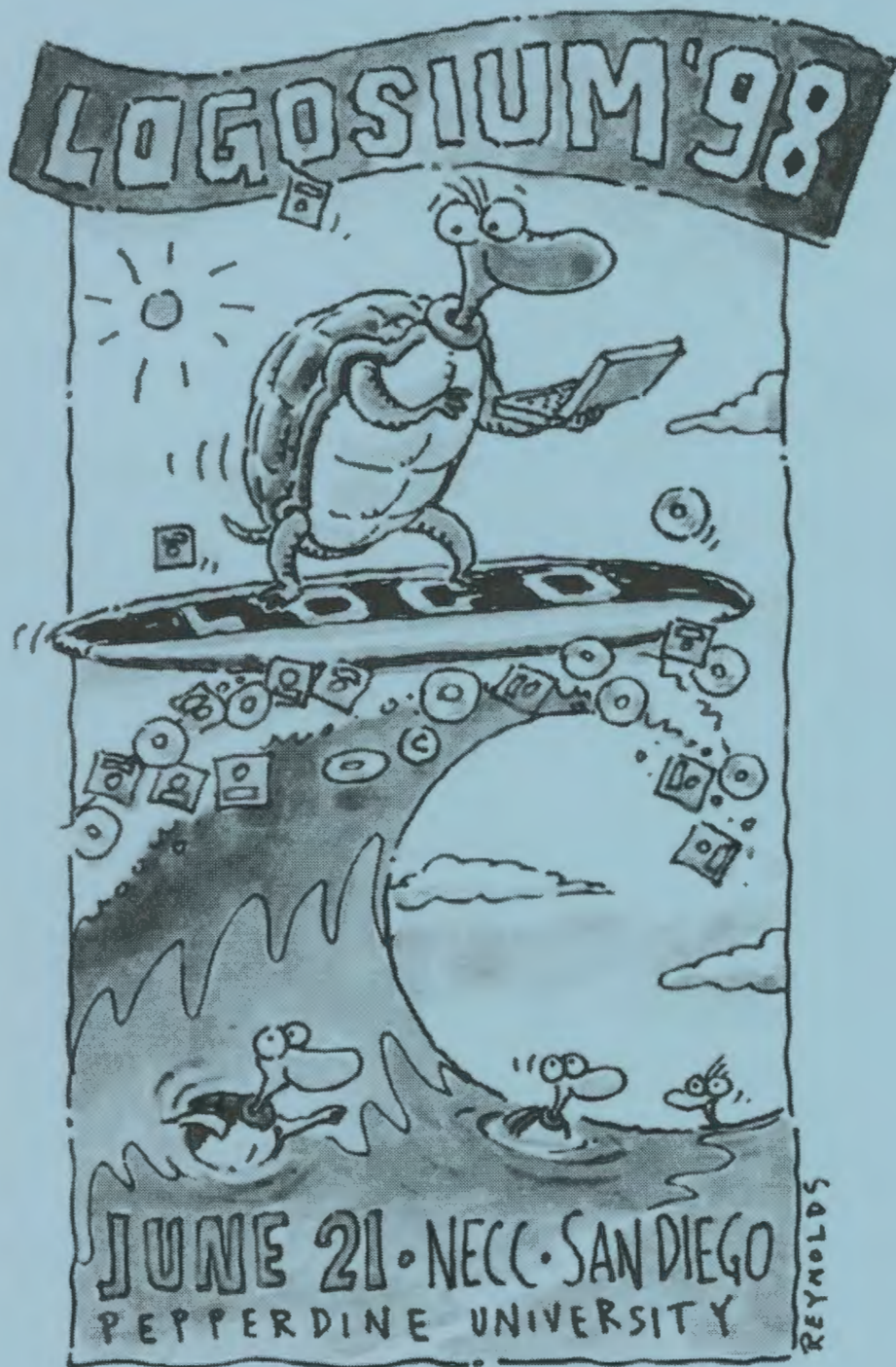


Logo Exchange

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



CATCHING THE WAVE!

INSIDE

- Elementary MicroWorlds
- Random Explorations
- Growing Up with Logo
- Creating Learning Moments with Logo
- Drawing with Arcs Part II
- Starlogo: The Chase
- The Prospector Game
- Book Review, Logo News, Teacher Feature



Logo Exchange

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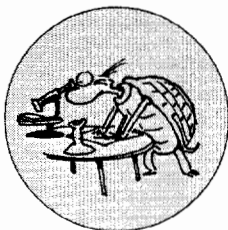
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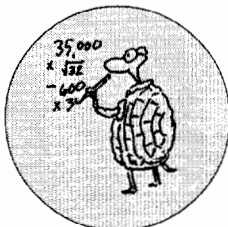
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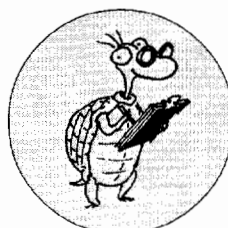
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Looking for Logo in All the Wrong Places

The Logo community has been unable or unwilling to confront the larger social issues that are tearing at public education. In 1981, I wrote: "Logo is one part of a larger change effort designed to serve as an intervention in learning and learning environments."

For the most part, this has not happened. The problem is not the technology, certainly not Logo. The problem is one of equity. Logo is for all kids, but the kids who need Logo the most have no access to it. They are relegated to educational games and instruction in the basic skills.

Logo remains the province of a small, somewhat special group of schools, teachers, and students:

- Teachers who are sophisticated learners themselves
- Students identified as gifted and talented
- Middle class and upper middle class populations
- Private and suburban schools

— Geraldine Kozberg

Logosium '96 Keynote Address

Dr. Kozberg's powerful statement has disturbed me for two years. While savage inequalities are still the unfortunate reality for far too many students, we are reminded that too few disadvantaged students profit from rich Logo learning experiences.

This issue is dedicated to sharing the Logo learning stories of remarkable teachers in under-represented communities. One of my all-time favorite

school districts is Newark, NJ. The proud citizens of Newark endure the worst of urban neglect and decay. Against the odds 60 to 70 Newark computer teachers never avoid the opportunity to learn something new. Sweltering workshops in the middle of the summer are well attended and a pleasure to lead. Newark's computer teachers frequently assume a leadership role in professional organizations and attend workshops on their own time. Teachers like those profiles in this month's co-Teacher Feature, Chuck DiComo and Mike Caputo, routinely sell thousands of dollars' worth of candy bars just to purchase LEGO logo or new computers.

Despite the obstacles facing the educators of Newark and the basic skills pressures they endure, Logo has been an important part of their repertoire for 15 years. District Technology Director Angela Caruso is an unsung hero in the development of educational computing. Her commitment to children, endurance, and skillful leadership has ensured that the kids who need Logo most are likely to benefit from the experience. Any number of Newark teachers deserve to be profiled in Logo Exchange. I've chosen Chuck and Mike to represent them. Teacher Feature author Pamela Morgan does a terrific job supporting the teachers of Newark in their use of computers.

Paula Don is a dynamic Philadelphia elementary school teacher I had the good fortune to meet in a recent Logo workshop. Paula immediately saw the potential for her young chil-

dren to use MicroWorlds in a public science fair. Her enthusiasm is infectious and was evidenced by her adherence to writing deadlines.

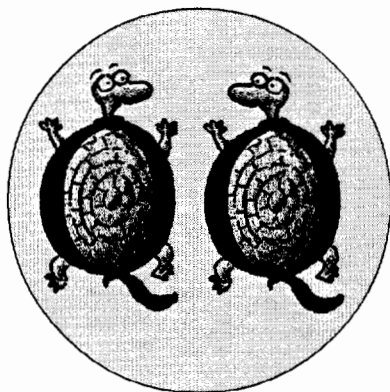
Orlando Mihich is a phenomenal teacher in the New York City Public Schools. He and his kids have long been known for the amazing things they've done with Logo over the years. I count Orlando as an e-mail friend and am fortified by his work.

Too many discussions of education reform, conferences and journals take children for granted. I thought that asking a successful young adult who grew up with Logo to share their learning story would provide an important perspective.

I never thought of Michael Gelman as my student, even when he was eight, because the word "student" implies subordinate. Michael was an exceptionally brilliant and creative child, eager to learn, explore, and express himself. Michael ran an electronic bulletin board while in the second or third grade; presented sessions on artificial life, robotics and Logo at national conferences; wrote five-act farces in Elizabethan English for fun; and spent his 12th summer conducting medical research. His basement was a shrine to LEGO, and he is now an opera aficionado.

The Logo community welcomed Michael as a co-learner when he was a precocious youngster of 10 or 11. I will never forget how when I introduced him to Seymour Papert, Michael's first words were, "Are you familiar with

See RIGHT PLACES (Page 27)



Just a Little Bit

Little things sometimes mean a lot. Call them coincidences if you want. It's often the little things that make the biggest differences.

Try this. Think back over your own years, regardless of how many there are. Can't you find one or more events that changed your life? If you look closely at those events, you might notice that their causes can often be traced to little things, such as —

A certain person said something in a certain way that affected you.

You happened to have the right change in coins and were able to make a certain phone call in time.

While browsing at a used book sale, a friend said, "Here's something that might interest you."

If these little things had not happened, you have no idea how different your life would be today.

Several years ago while I was a physics graduate student at the University of Virginia, my life was changed through a series of little things. Steve Tipps and Glen Bull, two education professors, decided to offer a course on a new computer language called Logo. The classroom happened to be in the building next door. The course happened to be offered over the lunch hour (the only time in the day when I was free). I happened to hear about the course through an offhand comment of another graduate student. All little things. But I went to the class and was never the same afterwards.

Can you remember how you first got involved with Logo? Wasn't it through

a series of one or two little things? How has it changed your life?

Recently, I was doing a little programming and had some difficulty with the IF statement. While thinking about it, I began to see another perspective of IF.

In its simplest form, I suppose, a conditional such as IF checks a single bit at a certain memory address in the computer to determine if it is 0 or 1, low or high, false or true. Everything that happens afterward depends on the status of just this little bit.

```
if :size > 50 [stop]
if touch1 = "true [rd]
if colorunder = "blue
[announce [You win!]]
```

Just a little bit. Just a little bit. And it makes all the difference. I had never thought about it in that way before. Everything else hinges on that little bit.

Then I got it. It is almost as if our lives are made up of a great series of IF statements, each checking on the status of its own little bit each moment of the day. Those little bits translate into the little things that affect and alter our lives, that provoke and stimulate us, that enrich us beyond imagination.

What if we apply this same idea to the lives of our students? How can we influence one of the little bits that is checked by their IF statements? For example,

```
if :learning > 0 [grow]
```

Bringing a little bit of Logo into their lives is one way to make a significant difference. Each of us knows this personally. And some are doing something about it.

Logo is showing up in surprising and unexpected places. It is important to learn about these occurrences, to recognize them and to celebrate them. Even though it may be just a little bit of Logo, it is enough to make a difference in students' lives.

And even if this little bit affects only one child, that's enough to change the world.

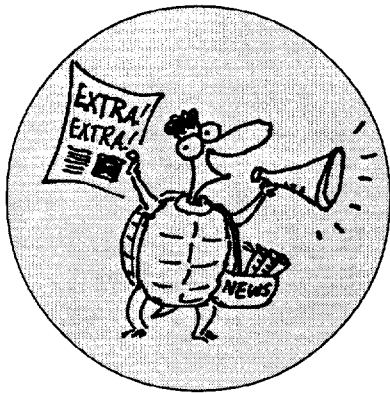
```
if logo? = "true [fd 100]
```

As always,

```
FD 100!
```

LX

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Logo News

News from LCSi

New Mac Version of MicroWorlds

There is a new CD-ROM-based version of MicroWorlds for the Macintosh. The new MicroWorlds version 2.03 CD contains all sorts of clip media files, new sample projects and starter projects for the recent plants and weather classroom projects. The student and teacher documentation is also on the CD in PDF format.

Version 2.03 also adds a number of nice features to MicroWorlds, including:

- The ability to import Windows '95 MicroWorlds projects on a Mac
- The ability to export Macintosh MicroWorlds projects as Windows projects
- Built-in HTML tools
- Additional shapes space in the shapes center
- Now you can option-click on a turtle to make it come to the front
- Primitives for saving sounds at different compression levels
- A handful of new primitives (see the read me file)

MicroWorlds version 2.03 is available for purchase or upgrade from LCSi at (800) 321-Logo or <http://www.microworlds.com>.

Web Plug-in for the Mac

The MicroWorlds Plug-in for the Macintosh is now available for free download from <http://www.microworlds.com>. All MicroWorlds projects playable on

the Web are in Windows '95 format. Therefore, Mac users will need to export their projects before uploading them to a server. Mac users may now open Windows '95 projects by using the Import command.



Logo Exchange needs you to contribute ideas and articles for next year's issues.

Upgrade Sale for Logo-users

North American owners of previous versions of Logo or HyperStudio may upgrade to a MicroWorlds site license, through July 31st, for \$499. That's \$100 off the regular price and half off the retail price of a site license. Call (800) 321-Logo for more information.

Low-Risk Site License Offer

LCSi is so confident that MicroWorlds will be a hit with your students that they are offering a one-of-a-kind opportunity to recoup your investment on a

MicroWorlds site license. Here's how it works. Your school purchases a site license for the low-price of \$599 and makes home-use CDs of the software available for you students to purchase for only \$25 each. After 25 students purchase a home-use CD, LCSi will send your school a rebate for half the purchase price of the MicroWorlds site license. Sell another 25 CDs and receive a rebate for the remainder of your purchase price. A 5 % shipping and handling charge is not included and a minimum purchase of two CDs is required. Call (800) 321-Logo for more information.

New Web Site

LCSi has a new Web site complete with an interactive project library and collection of turtle costumes available for download. Point your browser to <http://www.microworlds.com>.

Back to School Issue

The theme of the September 1998 issue is "Back to School." Please send your favorite ideas for introducing Logo in the classroom, descriptions of creative curriculum projects and successful teacher stories to be included in our next issue. The deadline for submissions is July 25, 1998. We will work with you to get your article ready for print.

Perspectives on Papert Issue

The theme for the September, 1998 issue will be "Perspectives on Papert."

See LOGO NEWS (page 27)



FEATURE ARTICLE

Elementary MicroWorlds Energy Simulations

by PAULA DON

This is so cool," fourth grader Kaleya exclaimed clicking on the button to start the wind blowing in our MicroWorlds Energy project. As the students explored the project, changing the speed of the wind, discussing what they observed, I became aware of just how powerful a learning environment MicroWorlds can be.

When my school was selected to participate in the *Scientist in the City* project, a regional science project being coordinated by the Franklin Institute with funding support from Unisys, I jumped at the chance to explore the curricular connections between science and technology. As the technology coordinator at an urban lower elementary school, I am constantly looking for ways to challenge my students to see computers as powerful tools for learning and communicating, rather than just extensions of their 'Playstations.'

Scientist in the City units were developed to focus on the city as a laboratory for study, exploration and analysis. We chose the theme of Energy in Our World, with the objectives of our students gaining an understanding of how energy resources provide electricity, and how these resources are delivered to us. My goal was to have the students use technology as a vehicle for presenting their knowledge about energy resources. MicroWorlds (Mac)

became the presentation tool. MicroWorlds is an exciting environment that allows for creative thought, critical thinking, problem solving and a lot of cool fun!

I began to meet with a group of fourth graders twice a week for four

ergy, and basic electrical circuits.

I have to admit that, even though I have been an avid LogoWriter teacher for years, tackling such an ambitious project in MicroWorlds for the first time was a bit frightening, but we continued on. Working in groups of two or three, I had the teams first select their energy resource, then design their background or "environment." Using either the paint/draw tools in MicroWorlds, or importing from Kid Pix, the students created their environments. After the background was created, they were to select their "characters" or turtles for animation. Most of the teams used stamps from Kid Pix as their turtles. They modified stamps to fit their needs and created a picture with their stamps. I showed them how to copy and paste from Kid Pix into

MicroWorlds, using the Finder to navigate. With the AT EASE interface running, they had a secure environment in which to practice navigating between two applications. Once their stamps were pasted into the shape center, they then needed to describe to me how the characters interacted with the energy resource within the environment. Then the fun began.

As the students became more acquainted with the workings of MicroWorlds, they began to feel more confident about taking control of their

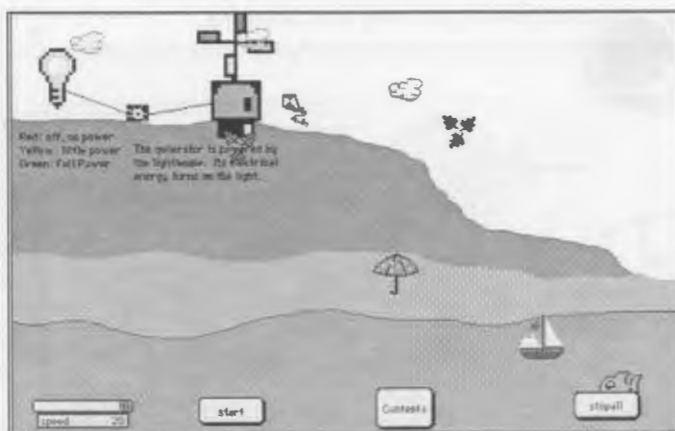


Figure 1 Wind Energy, Watch Everything Blow! designed by Fourth Grade computer club as a group effort.

weeks. I created a wind energy microworld for the students to explore, work with, experiment with, change, mess up and fix. Having a finished microworld to work with gave my students, who were seeing MicroWorlds for the first time, a visual model that would enable them to begin thinking about their own designs. We then began brainstorming about the energy sources we were aware of in the world around us. Our choices, after brainstorming, were narrowed down to include solar energy, hydroelectric en-

projects. The students began to modify stamps and turtles to create their mini-animations for their worlds (lights blinking, people waving), moving back and forth between Kid Pix and MicroWorlds. My students began to see themselves as computer programmers. The only real frustrations came when their ideas became so complicated that we really couldn't make them happen, so modifying and redesigning an idea became a new process for them to experience. As they became more comfortable with the tools, their imagination and humor blossomed into fun and play with the project. One undersea group wanted a fish floating "belly-up" to the surface!

One solar energy group decided on a roller coaster. The challenge was how to keep the turtle on the wavy red line of the coaster track. Although these students did not have much experience with Logo or MicroWorlds, we were able to discuss and brainstorm many different options to get the coaster working. They finally decided to keep track of the turtle as they moved it along the track, writing down turns and steps. I introduced them to the concept of TOWARDS and that allowed them to rework their list of instructions into a smoother procedure. They selected a nice large turtle to plot along the track to help with their calculations, then hid the turtles when they were finished.



Figure 2 Submarine World, Created to Run on Hydropower (redefined by the students!), designed by Jeremy and Jemaine.

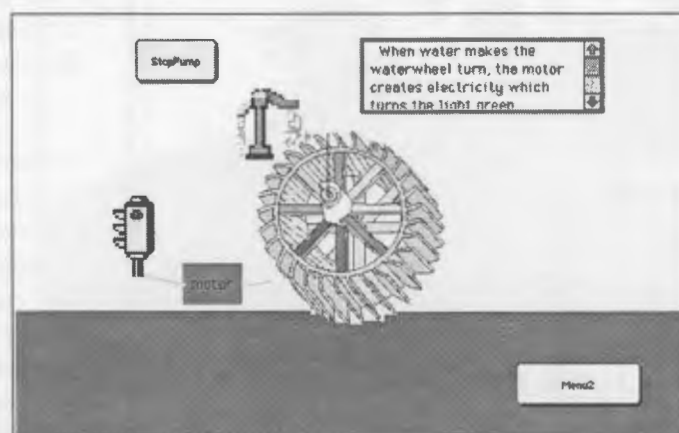


Figure 3 WaterWheel, The Water Turns the Wheel, Which Powers the Light, designed by Isharae, Y, and Rathary.

Another group used a race track and two race cars as their energy demonstration. Each car had a battery attached that powered the car. As the cars ran around the track, users need to "recharge" the battery before sending the cars on another race. The issue of who would win the race each time turned into an interesting discussion of a random variable in controlling the speed of the cars, a concept with which

these students had not been previously acquainted.

In addition to using the computer as a problem solving tool, the students were motivated to experiment with variables in a context that made the effects easy to analyze and manipulate. Giving children authentic experiences for learning about variables is difficult. Many times we provide students with simulations using variables, but the effects are not as evident as when you let children "play" with numbers, space, and objects all interacting in the same environment. This project gave the children a context within which to manipulate their own data, watch the results, analyze the effect and change the variables until the outcomes were satisfactory.

The students' responsibilities were to create the world, environment, turtles, and "script" the animations that were needed. I assisted with the programming and procedures, including the students in decision making,

refining of procedures, checking for errors and managing other surprises that didn't make sense. In this way, I was a part of the collaborative process-not the leader, as the students took this role, but the facilitator who (in the words of my students) helped make things "go!"

As a learning experience, this was one of the most valuable and exciting projects we have done. I watched the

children apply their computer knowledge and expand their confidence and skills, while working in an atmosphere of true cooperation and collaboration. There were some difficult moments though. Teams disagreeing on the environment when beginning to work on their own projects prompted us to discuss the value of collaborative problem solving as a way to work through difficult tasks. Two teams fell very far behind when the design of the background took more time than the actual elements in the project.

From a science perspective, the students were focused more on the "technology" of their project rather than the genuine simulation of their energy resources. Being fourth graders, they had an introductory understanding of circuits, batteries, and solar power, but when questioned directly about the energy resources actually functioning in their worlds, their knowledge was a bit lacking. The students had difficulty applying concepts they had learned in the science lab.

This lack of transfer prompted an added last step. Once the worlds were working, the students were asked to write a description detailing what was happening in their worlds and how the energy was being transferred. The students were so excited watching their worlds come alive, that coming back to the science, letting the children use their own worlds as the focus, gave them a

chance to "rethink" and "reapply" the energy concepts in a meaningful context, a context of their own creation.

MicroWorlds is a powerful learning tool. I learned so much watching my students play and struggle with math, programming, and science concepts, in an atmosphere of collaboration and cooperation. It challenged my role as a teacher to step back and let the students create, and use their creations as

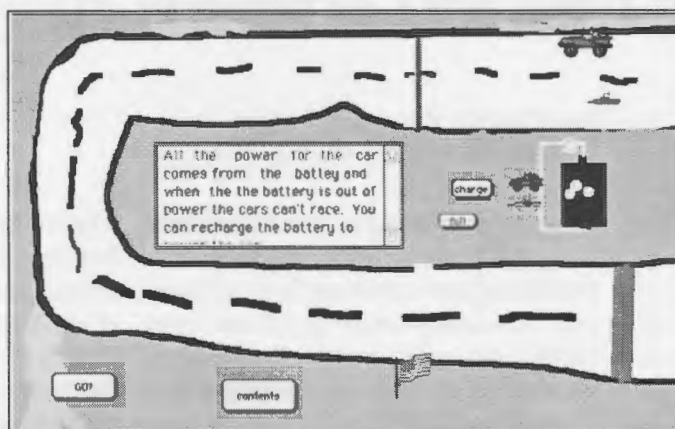


Figure 4 Racers and Batteries, Recharging the Car after the Race, designed by Corey and Shawn.

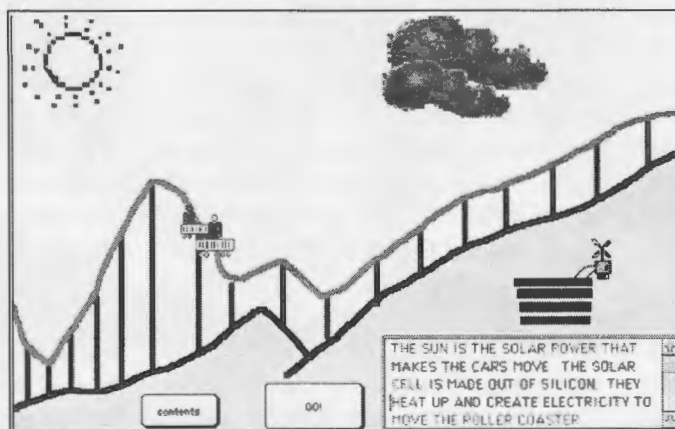


Figure 5 Roller Coaster World, Created to Run on Solar Power, designed by Sylvester, Ruth and Jim.

the foci for learning. I plan now to have these children work with other students in creating more MicroWorlds projects on the solar system. Given more time, and my increased familiarity with the way students interact with the software, I plan on teaching the students more about procedures and programming turtles. This project, given all of the variables with which we were dealing, was a challenge for beginning students. But it did help me see how easily the students can work with many variables and computing concepts, defining their own structures and sequences for completing the task. MicroWorlds allows the students an open-ended environment, in which each student's learning style and thinking can flourish alongside the styles of others. Nonetheless, all reach a successful conclusion. This was both an exhilarating and exhausting experience. I can't wait to get started on the next one.

I would be happy to share ideas, comments, or our project with you. Please visit our Web site at www.phila.k12.pa.us/schools/childs/energy to see the rest of our projects. **LX**

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BOOK REVIEW

Spamming the Generation Gap

by **CAROLYN DOWLING**

***Growing Up Digital: The Rise of the Net Generation* by Don Tapscott
1998, McGraw-Hill, New York
ISBN: 0-07-063361-4**

People are anxious about computing technology for all sorts of reasons, and these anxieties can be expressed in quite curious ways. For my own part, I confess to having avoided for some years engaging with computer controlled Lego models on the pretext of disliking the colours of the plastic blocks. A commonly expressed anxiety concerns the harm that new developments in technology might inflict on young people. Stated from this point of view the rhetoric is that of competent, authoritative adults making reasoned and informed judgments. The speakers are concerned not for themselves but for others. Behind such a stance, however, we can reasonably posit the existence of a panic stricken disempowered individual contemplating a future from which he or she feels potentially disenfranchised—not simply in terms of job opportunities, but in relation to much of the minutiae of everyday life.

Considered from this point of view, the book *Growing up Digital: The Rise of the Net Generation* is clever. While purporting to address the anxieties of adults with regard to the various forms of damage to which young people might be, it extends the argument on several fronts to address much broader levels of concern in relation to a number of key areas of activities in our culture, ranging from interpersonal relationships through commercial activity, entertain-

ment and learning, to politics. In this sense the book is not so much 'about' young people as it is about their parents, and the adaptations they will need to make if they are to function as effective members of a rapidly changing society.

As a just-pre-baby boomer of advancing decrepitude and, as this book and others of its ilk seem to suggest, decreasing social relevance, my initial reactions to the book were mixed. It is difficult for a reader such as myself to avoid a sense of being steam-rolled by a juggernaut of change that, while arguably it should not be feared, is nevertheless inexorable. It is not uncommon for scenarios of futures dominated by technological change to be presented in this style, involving the simultaneous application of the carrot and the stick, the promise and the threat. The future holds wondrous things—and you'd better sign on, or you'll be written off! The technique is persuasive. The difficulty is that it removes any sense of choice or control on the part of the reader. To this extent, in relation to technology, such a mode of argument is profoundly and disturbingly technocentric.

The sense of inevitability is reinforced by a strongly polemical style of writing. The text is long on assertion and short on words like 'perhaps', 'might', 'could' or 'maybe'. For me it was the sense of inexorability that was unpalatable, rather than the specifics of most of the changing directions of practice described in the book. Few readers of this journal would want to argue, for instance, against the benefits of interactive media over traditional television, or against the desirabil-

ity of an educational philosophy strongly flavoured by constructionism. Many of us happily conduct significant portions of our lives in cyberspace, including visiting the websites associated with hard copy publications. We manage to ride the waves of change with reasonable comfort—but with a sense that we can, to a certain extent, steer our surfboards in our chosen directions. We are not mere passengers on a ride over which we have no control.

Perhaps this belief is unrealistic. If so, then I suspect that for many of the pre-Net generation this is where the real threat of technology lies.

So while at one level this book offers some comfort and reassurance to the anxious, that the directions of change as described will be in many ways advantageous both to young people and to society as a whole, it may simultaneously serve to encourage anxiety at another level concerning the lack of control and choice which can be exercised by individuals within these scenarios.

There are important, probably inescapable issues at stake here, and despite my discomfort with some aspects of the book's argument I'd recommend it strongly to readers of all generations as a focus for thought and discussion.

LX

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TEACHER FEATURE

Mike Caputo and Chuck DiComo

by PAMELA E. MORGAN

An interview with two Newark computer resource teachers, Michael "Mike" Caputo, McKinley School, and Charles "Chuck" DiComo, Elliot Street School.

Q: What is your educational background?

Chuck: I am K-8 certified and have 25 years of teaching experience in Newark, 12 of which have been as a computer teacher.

Mike: I am a product of the Newark Public School system, and I'm teaching in the same district for over 25 years. I have a B.A. in education, and my computer skills are completely self-taught.

Chuck: Since the age of 18, I have always had my hand in the computer business.

Q: Please describe your school community.

Mike: McKinley serves primarily Hispanic and African-American students, most of whom are classified as Title I. I don't want to say that it's a poor community, but . . .

Chuck: It's economically poor but rich in so many other ways.

Mike: I don't like to label. I grew up on Stone Street and sometimes my parents had hard times, so I know that

that sometimes is not a factor. But when you talk about the technology, it does have an effect. When you ask children how many have computers at home, you may get four or five (who respond). It does make a difference. We have lots of good before and after school programs, parent workshops and training classes. We have open communications with our parents. At

the third and fourth grades have fewer bilingual classes. Our parents are really the center of our school. They help with programs in art, gym, computers, and other school areas. We have a great PTA president who helps maintain the momentum for technology. We have computers in every classroom, K-4, predominately using the CCC program. Grades K-2 are able to really tie the

technology into the curriculum. The teachers themselves have chosen what they wanted to do with computers.

Q: When did you begin using Logo?

Mike: I began using Logo in the summer of 1988.

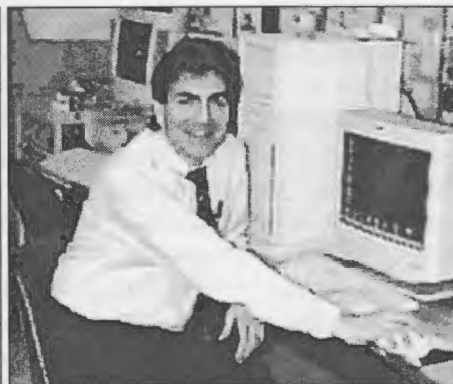
My job was changed from classroom teacher to computer teacher. A requirement was that I know Logo. So, I had an Apple computer, and I spent \$89 to buy the Logo program.

Chuck: It's funny, I did the same thing.

Mike: I taught myself to do all the basic commands, and thought it was pretty neat. I looked at Logo and I took each individual object and learned it. At my first computer teacher meeting, I took a list of 150 Logo objectives to share with the other teachers. Angela Caruso was so happy to see those objectives, and we began to design the curriculum around those objectives. I did this out of neces-



Chuck DiComo



Mike Caputo

one time we had a wonderful corporate relationship, sort of an "angel" over our shoulder. They gave us a good deal of computer equipment. We have an award-winning Web site that reaches people all over the world. I get email from former students from California and other places. Our school is one of the newly networked schools, so I have a networked lab and computers in each middle school classroom and the media center.

Chuck: Elliot is a K-4 school with a student population that is 90 to 95 % Hispanic. Our students are from traditionally large families. Up to the second grade, our classes are bilingual, and

sity, I was told this is what we had to do, and I did it.

Chuck: I began in 1985-86. I became a computer teacher, went out and bought a PCjr and taught myself the PCjr and Logo. It was fun, it was a beginning.

Mike: I was using Windows 1.0. Those were the days.

Q: Did you participate in any classes as you were beginning your exploration into Logo?

Chuck: Yes, there were some classes. I think it was at New Jersey Institute of Technology.

Mike: I ended up teaching a few workshops at Essex County College. One class was in how to create interactive programs using Logo. I showed people how to make interactive games. That's how I learned how to type, using games such as Wishbringer and Zork. I brought those ideas back to the kids and asked them how do they feel about them. So we sat for about a month and programmed those games. We looked and saw that they were only text, and we realized that since the turtles had pens, we would be able to use the verbose descriptions we had developed, and add graphics. That added another element of challenge. We were able to successfully merge the two together into a playable game. My response to students who wanted to come to the lab to play games was that they had to create a game in order to play one.

We did another project on the solar system that had graphics and text. It would run by itself. We would turn off the lights in the classroom, press SS (the program name), and this huge program that would draw the planets appeared.

Chuck: I hadn't been using Logo for very long when LogoWriter was published. I really liked to get into the lan-

guage aspect. Everybody was using LogoWriter for graphics, but I wanted to get into the text processing. I did a lot of that because I saw a direct link to the classroom. I was completely smitten after my introduction to LogoWriter. We bought a site license and linked a lot of our projects directly to the classroom. We made storybooks where we linked on chapter to another. You could call up individual pages . . .

Once, I did a game approach with a special group, something like a computer club. We created almost the full working version of PacMan. With LogoWriter, we also got involved in LEGO Logo. I was asked to field test the program for LEGO Dacta. At this time I had the computer club, 10-12 students. We found that LEGO Logo was a very powerful mathematics tool. One of the projects we created was the car and traffic light. You'd start the car, and when it would get up to full speed you would stop it at the traffic light. We set the town where you would drive the car up on a table in the lab, and we'd explore for hours.

Q: What was your initial reaction to Logo?

Mike: I thought, "This is great!" It's not going to do anything unless you tell it to. I don't like things that work automatically. I like to make kids think. I liked the question mark. It was almost like a mystery, it almost lures you. Kids would type their name and were then told that the computer doesn't know how to . . . The Almighty question mark. You knew there was something beckoning you to do something right!

Chuck: What attracted me was the structure of how to do the program because I had a COBOL programming background.

Mike: There was a pro and a con.

Chuck: I would also start my class with the blinking cursor, I likened it

to the robot in the movie "Short Circuit." I taught forward, then the input, linking the command and the input. I really fell in love with LogoWriter. It really made it a lot easier to link things to the classroom. We were able to do book writing and story writing.

Q: What were the grade levels of your students who used Logo?

Mike: I started with grades 5 and 6. Those were the only grades I serviced.

Chuck: When I started it was actually Grades 4, 5 and 6.

Mike: Part of the expertise of teaching is knowing what grade levels are appropriate for different activities. I wanted to go beyond polygons to higher level assignments. I wasn't sure that I could have done that with second and third graders.

Q: How did you use Logo in the classroom?

Chuck: Once I field tested it, I bought a lot more LEGO Logo equipment. I did a lesson with levers, and the children had to bring in levers. Kids brought in shovels, spoons, etc. Then they had to build levers using LEGO.

Q: Were your children able to use Logo to explore any social constructions?

Chuck: With LEGO Logo a lot of those lessons were related to real life. We were able to apply real life situations to what we were doing. We tried to relate what we did to the real world.

Mike: When I came to McKinley, I saw (housing) projects, poverty, violence. With Logo I saw a place kids could grow mentally to get away from that. With all the forwards and backs kids didn't worry about who was lurking. It was a place they could go to escape from their other problems. When immersed in Logo, you are definitely in your own world.

Chuck: Rosa Rinaldi and I had a

special LogoWriter program that was reader based. It was strictly story and reader based.

Mike: Kids who had labels became “geniuses” during my Logo experience. I would have to go to them to ask, “How did you do that?”

Q: *What did you find were the benefits of using Logo for the students?*

Chuck: If I was to pick one highlight, I remember we were testing LEGO Logo and something went wrong. I tried to correct a student, and fix something for him. He told me, “Don’t fix it, I’ll do it myself.” I had helped him to become in charge of his own learning.

Mike: Kids would write four pages of code and I couldn’t correct them. Kids would have to go through a period of debugging. Constant cooperative learning. The rule was, “Ask three before you ask me.”

Q: *Were you able to nurture and parental/community involvement through your use of Logo?*

Mike: Computer in general helps with self esteem. When there is high self esteem, it ultimately helps the community. If you multiply that, it can have a positive effect on a greater part of the community. Parents then want to see what has caused this change in their child.

Chuck: That’s what I would present on parent night.

Mike: My lab was always open. For students whose behavior is being modified here the parent would come to find how they could get a computer to help that child.

Chuck: Yes, giving them an interest where they didn’t have an interest before. I meet kids who still have the projects they did a number of years ago. They take pride and ownership in those projects.

Q: *Have any of your former students pursued careers in technology based on their experiences with Logo?*

Chuck: I can tell you the owners of A + Computers (a local computer repair company) are all former students of mine, especially Raul, the fix-it man.

Mike: One former student of mine is now in medical school.

Chuck: The effect I had as a technology teacher is that a lot of the students that have gone on to careers or college come back to talk to me. I’m amazed at the number of students I’ve influenced.

Mike: There have been students that have come back to tell me that what we’ve done has influenced them. They tell me that they take computer courses not as a luxury, but as a necessity to employment.

Q: *How would you compare early versions of Logo to MicroWorlds?*

Chuck: I admit that I’ve been taken in by LogoWriter. But for the basic logic and programming, I like the basic Logo.

Mike: It forced the children to go through the process of thinking thought the creation of animation or other activity.

Q: *What would be your vision for your students exploration with MicroWorlds?*

Chuck: I would like to see our science lab link our MicroWorlds with LEGO. I want to see a linking with that. I think that it would be totally cool.

Mike: I see the perfect vision for MicroWorlds is to use it with a classroom teacher, in conjunction with the other technological tools and the Internet. I’d like to see more classroom teachers really be able to utilize MicroWorlds to teach their subject, to enhance a particular lesson.

Chuck: The right tool for the right

teacher. I want to tell them, “This is what’s available, and this is how it can help you.” We will be able to encourage group collaboration with the proper planning and the proper projects.

Mike: I value my Logo experiences. They have helped to make me the teacher I am today.

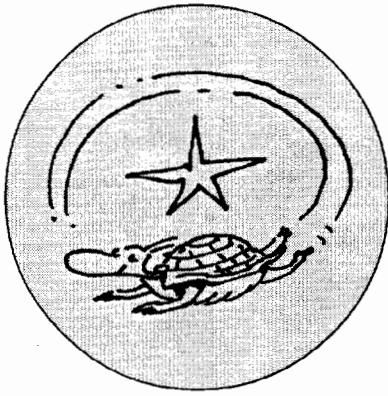
Chuck: I agree.



About the author

Pamela Morgan began teaching in Newark as an elementary teacher in 1972. Constantly searching for tools to empower her students, she discovered the power of technology in the early 80’s, and subsequently became a computer teacher, specializing in LOGO, in 1985. Since that time she has worked in the field of educational technology as an instructor in both public and higher education, and as an administrator for the Newark Public Schools’ Office of Instructional Technology. In 1994 and 1995 she received funding from the U.S. Department of Commerce’s TIAP program to implement a community based telecommunications networking program that serves families in the inner city of Newark. In acknowledgment of her contributions in the educational technology field, the New Jersey Association of Educational Technology recognized her as Technologist of the Year in 1996.

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The Chase: Part 1

StarLogo is ideally suited for modeling dynamic systems. Predator-prey systems are an example, in which one species depends on another species for food. The predator species might have no self-regulating behavior, and therefore ends up feeding on the prey species as needed to satisfy its hunger. Sometimes the prey species becomes decimated or extinct, inadvertently causing the predator species, whose diet depends solely on the prey, to die out itself. Perhaps some stray animals then wander in from another area, and re-populate the domain. The possibilities for complexity are wide, and using a modeling tool such as StarLogo, is an excellent way to explore these ideas.

In many scientific modeling systems, the behaviors of the system are precisely expressed by parameters and attributes as described in mathematical equations. The skill needed to "program" these simulations often requires a dedicated and well trained individual, leaving them out of reach of younger students and lay researchers.

StarLogo represents an alternative way of writing system dynamics simulations. Instead of mathematically describing the behavior of the entire system, with StarLogo one simply describes the rules for behavior of the individual players and classes of players. Breeds of species can be defined with a variety of survival characteristics, and then let loose in the random environment of the simulation.

In this column, I will describe the setup of one such predator-prey simulation, introducing breeds and the hatch and output commands. The next column (September) will add a method of representing the data resulting from this simulation in a graph, and suggest some changes and explorations one can do with this model.

The setup for this model involves creating two sets of turtles called lynx and hare. Sliders named 'lynx-initial' and 'hare-initial' will be used for the initial population, and these can be created first with a range of, say, 1-200 for the lynx and 1-500 for the hare.

In this model I will be including descriptive comments within the code. Adding comments can be a big help to others when reading your code, and to yourself when revisiting the program

later. Of course it helps to be accurate in your comments.

In order to make this program simple to read and understand, I have broken it up into small procedures, often with fewer than 10 lines.

The setup procedure is simple enough, clearing all, creating the two sets of turtles, and setting up the breeds. A setup button will come in handy here. (see Code 1)

The setup-all procedure is simple also, calling another procedure named genetics to differentiate the breeds: (Code 2)

The 'who < hare-initial' is a way of distinguishing the turtles that will be designated lynx from those to be designated hare. This assumes that as the turtles are created, they are assigned sequential ID numbers (the

```
breeds [hare lynx]                                ;; setup breeds for lynx and hare

to setup
ca
crt lynx-initial + hare-initial                    ;; create all turtles
setpc white                                         ;; set bkgrnd patches to white
setup-all                                          ;; setup lynx and hare
end
```

Code 1

```
to setup-all
ifelse who < hare-initial                          ;; if ID < # of hare, then
[genetics 0]                                       ;; it's a hare, otherwise
[genetics 1]                                       ;; it's a lynx
end
```

Code 2

```
turtles-own [caught age dead]
```

```
to genetics :type
ifelse :type = 0                ;; type 0 = hare, 1 = lynx
  [setbreed hare                ;; set its breed
   setc pink                    ;; set its color
   setdead false                ;; not dead yet
  ]
  [setbreed lynx                ;; set its breed
   setc brown                   ;; set its color
   setcaught 0                  ;; hasn't caught anything yet
  ]
setage 1 + random 10             ;; its initial age is 1-10
setxy random screen-size        ;; random position
  random screen-size
end
```

Code 3

```
to move
step                             ;; each animal takes a step
ask-lynx [lynx-chase-hare        ;; lynx chase hare
          lynx-death]           ;; check if lynx dies of old age
ask-hare [hare-reproduce          ;; hare reproduce
          hare-death]           ;; check if hare dies of old age
remove-dead                      ;; remove eaten hare
end
```

Code 4

```
to step
rt random 50                     ;; turn right (0-49 degs)
lt random 50                     ;; turn left (0-49 degs)
fd 1                             ;; go forward one unit
setage age + 1                   ;; get older by 1
end
```

Code 5

```
turtles-own [closest dist-to-closest]
```

```
to lynx-chase-hare
setclosest find-closest-animal
setdist-to-closest distance xcor-of closest
                                ycor-of closest
if (breed-of closest) = hare    ;; ignore other lynx,
  [chase-hare]                  ;; only chase hare
end
```

Code 6

value returned by 'who'). If, for example, the value of hare-initial is 30, when the setup-all procedure is run for each turtle, if 'who' returns an ID less than 30, those turtles will be designated hare. The procedure 'genetics' will be called in these cases with 0. Otherwise it will be called with a 1 for the lynx.

The 'genetics' procedure sets the attributes of each type of turtle. (Code 3)

'Setbreed' is a StarLogo command that sets the breed attribute (like a variable), in this case to 'hare' or 'lynx'. This will allow me to use a shortcut later to direct only the hare or only the lynx to do something.

There are three variables in use: dead, caught and age. 'dead' will be used to tag a hare after a lynx catches and eats it, for later disposal. 'caught' will be used by the lynx only, as a way to determine whether it has eaten any hare (and thus whether it should reproduce). 'age' will be used as a counter to determine when an animal will die of old age.

Next comes the 'move' procedure, for which a 'forever' button should be created. In it, each turtle takes a step forward, and the lynx and hare are each asked to do their individual behaviors, using the breed short cut commands: ask-lynx and ask-hare. Afterwards, any caught hare are removed (using 'die'). (Code 4)

In 'step' each lynx and hare moves and ages by 1. (Code 5)

The procedure lynx-chase-hare finds the closest other turtle, and if it is a hare, calls the chase-hare procedure to run after it. (Code 6)

In lynx-chase-hare, I chose to create the procedure find-closest-animal in order to keep this one simple. The output command is a convenient way to have a procedure behave like a reporter, so that you can substitute a procedure name where you need a value.

The procedure uses 'output' to make this happen. (Code 7)

In chase-hare I set a tolerance of 2 as the distance at which a lynx can catch and eat a hare. If the hare is further away, the lynx will turn in the hare's direction and advance. (Code 8)

After catching a hare, the lynx might be able to reproduce. The rule embedded in the lynx-reproduce procedure is, "if you have caught more than 2 hare, and you are of breeding age (19-49), then hatch an offspring". Hatch creates a turtle that inherits the variable values of the parent (including its breed), and allows you to add commands and procedures for just the offspring to run (e.g., 'setage 1' and 'fd 2'). (Code 9)

The 'move' procedure also called the lynx-death procedure, which merely checks if a lynx is older than 60. (Code 10)

The 'ask-hare' procedure in 'move' tells each hare to try to reproduce, but only if they are in a narrow age range (21-22). The hare-reproduce procedure describes this rule. (Code 11)

Hare die of old age as well, although their old age occurs much earlier. (Code 12)

Finally, the remove-dead procedure disposes hare that have been eaten by lynx. This is needed since the lynx is the actor when it catches a hare, making it difficult for the hare to die at that time. Think of this as a cleanup service for old bones. (Code 13)

This StarLogo program makes up the skeleton of a predator-prey simulation model. It will run until either of the species overwhelms the other, or until they both die out. Next time, I will introduce the graphing facility and suggest ways to explore these concepts further. **LX**

About the Author

Alan Epstein has been developing software since 1975 and most recently has been studying ways that computer technology can be effectively used in schools. He is most interested in robots, especially for children.

Alan Epstein

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```
to find-closest-animal
output who-min-of-turtles
[distance xcor-of myself ycor-of myself]
end
```

Code 7

```
to chase-hare
ifelse dist-to-closest < 2
[setcaught caught + 1          ;; lynx caught another
 setdead-of closest true       ;; tell closest hare to die
 lynx-reproduce                  ;; see if conditions warrant
]                                ;; lynx reproduction
[seth towards xcor-of closest  ;; turn and step toward prey
 ycor-of closest
 fd 1
]
```

end

Code 8

```
to lynx-reproduce
if caught > 2                      ;; has it caught 3 hare?
[if age > 18 and age < 50          ;; is it between 19-49?
 [setcaught 0                    ;; reset its caught counter
 hatch [setage 1 fd 2]           ;; hatch an offspring
]
]
```

end

Code 9

```
to lynx-death
if age > 60 [die]
end
```

Code 10

```
to hare-reproduce
if age > 20 and age < 23          ;; is it 21 or 22?
[hatch [setage 1 fd 2]           ;; hatch an offspring
]
end
```

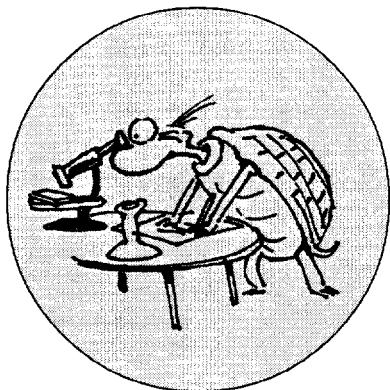
Code 11

```
to hare-death
if age > 30 [die]
end
```

Code 12

```
to remove-dead
if dead [die]                      ;; tell StarLogo to get rid of it
end
```

Code 13



From Science Center Through Lego to Logo to Sheldrake?


by ORLANDO MIHICH

My students came back from a visit to Liberty Science Center in Jersey City, and, among other things like molds and bacteria, they were mostly impressed by the Museum's laser light show. Next, Patrick Mahaney, Sam Lazarus, and Moris Behar dug into all those Lego pieces, got two mirrors, positioned the mirrors at an angle, rescued a laser from the science department, and the result was this great laser show. They programmed the motors to rotate the mirrors at different rpms and the results were all kind of circles projected on the lab's ceiling. The laser was changing regular circles into complex movement of constantly changing spiraling circles, reminders of complex equations. They created a show that entertained and amazed students and visiting parents. At home, Patrick programmed the turtle to recreate in Logo all those everchanging circles and e-mailed it to the lab.

Later, we were surprised to read in

WIRED that at the same time in a Boston Lab Mitchel Resnick's students were doing similar work with Lego and mirrors. Multi-resonance?

Two years ago, the above students created a Lego roamer with a QuickCam on top to tape my sixth-grade students. Their work was described in the Spring 1997 issue of *Logo Exchange*. Later in the spring of 1997, David Seiter from Lego visited our Lab and brought in some brochures featuring a Mars explorer called Red Rover. We were all really surprised because we realized that at the same time and totally unaware of the Lego work, we created a similar, and in the opinion of my students, even better Explorer. Better, because the QuickCam eyeball could be moved up and down.

We discussed Rupert Sheldrake's controversial ideas on multi-resonance through space and time, and concluded that maybe, just maybe, multi-resonance was at work in these two cases. 

References

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Also featured in PBS's *A Glorious Accident*.

About the Author

Orlando Mihich, a graduate chemical engineer, has been teaching Logo and Science to middle school students for the past 14 years. He is currently a computer teacher at Booker T. Washington MS 54 in New York City, and an instructor at the New York Institute of Technology.

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Random Explorations

by **BILL KERR**

I have been exploring a different approach to teaching the chance topic in Mathematics whereby the random concept is moved to center stage, so that its unpredictability can be celebrated as a fascinating, interest generating phenomenon. This approach requires extensive use of computers and a programming language such as Logo that has a random primitive.

For comparison purposes, this innovative approach may be contrasted with traditional math's textbook approaches to chance or probability that are focused around understanding probability to get the "correct" answer. Here are a couple of questions selected from such a math's text:

- 1) When rolling a dice once what is the probability of getting a 6?
- 2) If you rolled a dice 600 times how many 3's would you expect to get?

These questions are meant to have just one correct answer. Although strictly speaking question 2 has a "correct" answer (100) I could also argue that I would NOT expect that answer since the combined probabilities of getting another answer is greater than getting exactly one hundred 3's. When the students come to actually do the experiment it is more likely that they will NOT get exactly one hundred 3's. In practice these sort of considerations confuse students since what is regarded as correct in probability has a different feel to it than what is regarded as correct when we multiply 3 times 4. In most textbooks and classrooms,

question 2 is interpreted through the culture of correctness and in this culture there is only one correct answer and other possibilities are sometimes not even discussed. This reinforces a cultural stereotype of mathematics as a cut-and-dried discipline rather than a discipline where messing around, exploring, and making mistakes is a natural part of learning.

Critique of traditional textbook method

Even though the concept of random is indirectly present in these questions (through the dice), it is sidelined and not explored. All the emphasis is on the power of the probability concept to solve the problems posed by the unpredictability of the dice. In the contradiction between the chaotic, unpredictable concept of random and ordering, predictive concept of probability the traditional mathematics textbook culture leans heavily towards the side of order. The popularity of chaos theory in recent years has broken down the public perception of mathematics culture to a degree but most (all?) mathematics textbooks lag behind seriously in this regard.

Papert's influence on my thinking

My acid test for a successful mathematics activity is when students decide for themselves to work on it in their own time. For the first time in years of teaching probability I have achieved this using the random approach described in this article. My goal is to help

students get to the point where they want to explore their own or suggested probability projects. One of Papert's aphorisms is project before problem. By this he means that if students are working on an interesting project, then they will be discovering and solving problems all the time. This is a different, more self-directed activity than teacher directed problem solving.

I had done some reading around this topic and a recent article by Seymour Papert (1996) proved to be quite influential. One thing that stuck in my mind (from Papert's article) was what he calls the power principle, using it before getting it. By using random on the computer, interesting—sometimes spectacular—screens can be generated. Hopefully, students will want to explore further and in the process develop their own random variations. I recalled the words of Hofstadter (1985, p.232), "Variations on a Theme as the Crux of Creativity".

My other key thought, which arose from reflection on past efforts in teaching this topic, was that I wanted to explore probability from a broader perspective than just the casino mentality. In the past when I have taught Probability, my first action was to go to the mathematics office and book out the dice and the cards (the kids supplied their own coins). Nearly all exercises and problems were based on situations with dice, cards and coins. It's easy enough for a mathematics teacher to rationalize this—it's part of the real world!

Although there are still dice and coins in my current approach (see con

tract below) I have also introduced more real-life phenomenon such as a drunken turtle who, in one scenario, is trying to find his way home. This proved to be very popular with the students. Another favorite was the program where two turtles raced each other, with the challenge of using random to make the winner unpredictable. Random is everywhere because life itself is unpredictable. Random is very much part of youth culture. Random behavior is unpredictable behavior, which is an important element of fun and games. If we can tap into this aspect of kids culture with a powerful mathematical idea, then the potential for a mega-leap in motivational mathematics learning is certainly there!

The medium is the message

In the past we have lacked the technology to explore random in the way I am suggesting here. With random on the computer you can do much more than with dice, cards and coins. Yet another Papert slogan is media before content. What this means is that the new media suggests to us that we should teach different content (emphasis on random) because the new media supports that content more powerfully. Those who want to use computers just to rework the old content are missing out on presenting new powerful learning challenges to their students!

ABOUT LOGO

These exercises were initially carried out by my students using LogoWriter, but I have rewritten this version of the article for MicroWorlds 2.0.

RANDOM EXPLORATIONS: PROJECT IDEAS (with annotations)

Explanation: In a classroom situation, the teacher would pose the problem and talk students through it over an extended time frame along the lines suggested in Comments and Explanations below. What is presented below is not intended for distribution to stu-

dents as is but would have to be modified, so the students are presented with the challenge but not the answers.

INTRODUCTORY AND WARM-UP ACTIVITIES

- 1) Say what happens when these instructions are typed in the command center. **IMPORTANT:** take your time, do them more than once, since the results will vary each time. Try to work out what is happening.

Focus questions: What does random do, exactly? How could you use random to simulate a dice? What is the difference between a logo command and reporter? (Note: You must create a textbox on the page in order for the following examples to work.)

- a) random 6 {a} is not meant to work but help us understand the nature of logo's random}
- (b) pr random 6
- (c) repeat 10 [pr random 6]
- (d) pr 1 + random 6
- (e) repeat 10 [pr 1 + random 6]
- (f) show random 6
- (g) repeat 10 [pr random 2]
- (h) repeat 50 [insert random 10]
- (i) fd random 60
- (j) repeat 20 [fd random 60 wait 10 bk random 60 wait 10]
- (k) rt random 361
- (l) lt random 361

Comment: The purpose of No. 1 is to help you understand the nature of random by using it in a lot of different ways. Before you go on write down what you think random does.

- 2) Which of these logo primitives are commands and which are reporters — > > random, pr, show, fd, rt, lt. Explain what the difference between a command and reporter is.

Explanation: A command does something right away (e.g., fd 60). A reporter is more like a messenger. The random reporter produces a value but doesn't know what to do with that value. You have to tell random what to do with its values (e.g., to print them, to show them, to go forward or to right or left turn with them). The point is that random being a reporter produces a lot more flexibility about what we can do with it. (Some teachers may prefer to defer this explanation to later.)

- 3) Write down at least 6 other English words that have a similar meaning to random.
- 4) Which of the instructions in Question 1 simulates a dice. Say which one and explain why!

Comment: If you rushed through question 1 then you might need to go back and do it again—it's an important point of detail about exactly what range of numbers random produces!

Explanation: pr random 6 produces the range 0-5. So to simulate a dice you need pr 1 + random 6. Very few students can work this out on their own, in my experience.



PROJECT: RANDOM COLORS

- 1) Write a procedure that draws lots of random lines all over the screen. The turtle should turn left some of the time and right some of the time (not the same way all of the time).

Comment: Yes, it's possible to do this just with these commands, pd, rt,

It, fd, repeat. I didn't realize this at first and thought I would have to teach a new command (seth) but it's not necessary—the students showed me how.

Explanation:

```
-to randomlines
pd repeat 1000 [fd random 100
rt random 361]
end
```

Make a button, randomlines, once only.

- 2) Write a procedure that fills in the spaces created in part one, randomly, with random colors.

Explanation:

```
to randomfill
pu setc random 140 fill
rt random 361 fd random 100
end
```

Make a button, randomfill, many times. The random 140 comes about because there are 140 colors in MicroWorlds.

Comment: This one has a surprise as the procedure unwinds. The challenge is to discover the surprise and then explain it.

PROJECT: DRUNK TURTLE

Use random to write a procedure that makes a drunk turtle walk. Make a howdrunk slider that can alter how drunk the turtle is, from sober (walks a straight line) to very drunk (staggers all over the place).

Explanation:

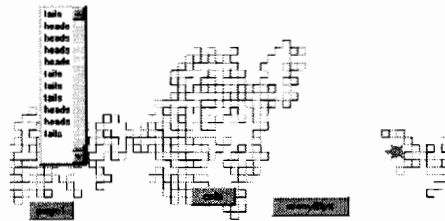
```
to drunk
fd 1 lt random howdrunk
rt random howdrunk
end
```

Make a slider, minimum = 1, maximum = 45 (enough for very drunk) Make a button, called drunk. Adjust the slider value to simulate degree of drunkenness.

PROJECT: COIN FLIP

Type in and run this coin procedure and then try to explain how it works:-

```
to coin
ifelse 1 = random 2 [pr
"heads][pr "tails]
end
```



Explanation: If the condition is true then the first square bracket is run. If it is false then the second bracket is run. The output from random 2 can be either 0 or 1.

Challenge:- Rewrite the coin procedure so that when there is a head the turtle changes color to red, then turns right 90 degrees and moves forward 10 with the pen down. When there is a tail changes color to green, then turns left 90 degrees and moves forward 10 with the pen down. Repeat this process many times.

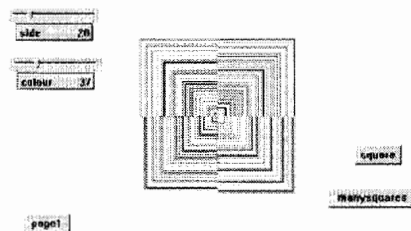
Explanation:

```
to manyflips
pd
ifelse 1 = random 2[pr "heads
setc "red rt 90 fd 10][pr
"tails setc "green lt 90 fd
10]
end
```

Make buttons called coin (once only) and manyflips (manytimes)

PROJECT: RANDOM SQUARES

- 1) Write a procedure that draws squares of random size.
- 2) Write a procedure that draws square of random size and random color.



Explanation: With MicroWorlds you can create sliders to represent the variables side and color. Then use the setside and setcolour commands in conjunction with random to vary the sides

and color. This way you can see the rapid changes in side and color in the changing slider values as well as the actual changes in side size and color.

Create two slider, one called side and the other color. (Note: Use the color spelling since the word color is reserved as a MicroWorlds primitive.)

```
to rsquare
pd setside 1 + random 100
setcolour random 140
repeat 4[fd side rt 90]
end
```

Make a button called rsquare, click once only.

Challenge: Write a procedure that rotates the squares around the origin, creating a window with 4 panes.

Explanation:

```
to mansquares
rsquare
rt 90 * random 4
end
```

Make a button called mansquare, click manytimes.

Challenge: Write a procedure that produces different shades of the same color in each of the 4 window panes.

PROJECT: RACE

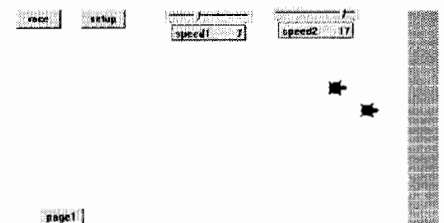
- 1) Here are getready and race procedures:

```
to getready
everyone [setx -250 seth 90]
end
```

Make a getready button, once only.

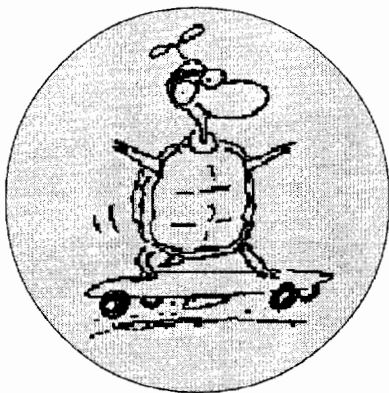
Make two sliders called speed1 and speed2, maximum value = 20

```
to race
setspeed1 10 setspeed2 10
t1, fd speed1
t2, fd speed2
end
```



This is a boring race because the two

See EXPLORATIONS (page 24)



IN THEIR OWN WORDS

Growing Up with Logo

by **MICHAEL A. GELMAN**

Unfortunately, the story of my introduction to Logo must begin with BASIC. As best I can now recall, in the spring of 1984. My parents had just purchased our first computer, a ridiculously expensive (by today's standards) IBM PC, and the programming bug had bitten me severely. As fashion dictated then (and still does, to some extent), my introduction to programming was through BASIC. The folks had arranged for me to be tutored at home, once a week, in BASIC programming, and although I acquired a rapid grasp of the commands, I frequently found myself watching my instructor write a program, step by step, talking me at ground level through an exercise which he had clearly planned out from the top down. It was probably then that my parents and my school system decided to kill two birds with one stone.

The more diplomatic side of me would say that I and my second-grade teacher were having "learning-style differences." The more direct side would characterize her as an authoritarian, and me as a disruptive little hellion. (I can only thank goodness that I grew up before the Ritalin craze.) In any case, since I had heard Logo described as a "graphics language," and I was interested in learning graphics, I was taken out of class twice a week to receive one-on-one instruction in the fundamentals of Logo from a fifth grader. Her name is sadly lost to me now, but my thanks do go out to her, wherever she may be.

My actual Logo education was probably no different from that of many others. After mastering the basic turtle-navigation commands, I spent some time happily doodling around before being

introduced to the concept of the procedure. Once I realized that I could make my own seamless additions to the language, things rapidly took off. Soon enough, I came to the attention of one of the computer teachers at my school, Jim Jaeckel, who introduced me to Logo's list-processing capabilities. As I became more and more proficient, and once I was admitted to my school district's magnet program for gifted and talented children, I had the good fortune to make the acquaintance of Gary Stager.

Gary's limitless enthusiasm and skill at teaching programming in the Logo style, added to his access to the newest and flashiest of Logo toys, formed an unbeatable combination. I became a protégé of his, and when I developed an enthusiasm for building small robots from hobby kits, he was quick to harness that energy in suggesting that I write a computer simulation of one of the robots' behavior. The result was a random-walk-like program called PEPPY, which I presented at the 1987 East Coast Logo Conference. ECLC '87 was a definite high point of my Logo experience. Gary introduced me to all of his heroes, from Seymour Papert to Brian Silverman to Peter Rawitsch, whose delightful Logo songs I can still sing today.

When I returned from the conference, I devoured *Mindstorms*. Its philosophy of "teaching by discovery and construction" has completely spoiled me for the remainder of my education. Gary also introduced me to the LEGO TC Logo system, a forerunner of today's "intelligent Lego" toys with a strong Logo programming front end. During junior high school, my brother and I would spend afternoons in

the basement, Lego blocks strewn everywhere; working on this project or that. I managed to attach a simple motor system to a robotic arm, a feat more of engineering than of artificial intelligence, and I presented my work at the New Jersey Educational Computing Conference, as well as at ECLC '88.

As college loomed, my involvement with Logo began to wane. Gary would come by with the newest, latest version of LogoWriter or LogoExpress, and I would have less and less time to play with it. My high school's computer curriculum was focused on training students in Pascal, for the AP exams, but I found it too BASIC-like, and the concept of batch compiling lent a finality to projects which was at odds with my philosophy of "playing around." Still, my love of exploration has found a new outlet in my current career as an MD/PhD student at the University of Wisconsin-Madison, and I hope to apply Dr. Papert's wisdom as a university professor in the future. Logo has given me things that I will keep forever. **LX**

About the author

Michael Gelman, age 22, graduated co-valedictorian from Wayne Hills High School (in three years), 1992 A.B., Harvard University, Chemistry and Physics, magna cum laude, 1996 MD/PhD Program, U. Wisconsin-Madison, 1996-present. Current PhD project in the lab of Prof. Samuel H. Gellman, Chemistry Department, on solubilization and crystallization of membrane proteins using designed amphiphiles.

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Creating Learning Moments with Logo

by **NICOLA YELLAND AND JENNIFER MASTERS**

Abstract

The use of computers in classrooms needs to be justified in terms of their relevance for teaching and learning within existing curriculum frameworks. It is no longer appropriate to “teach” about and with computers out of context. Technology needs to be integrated with teaching and learning goals set by the teacher and the school, and add value to learning opportunities in the context of the school.

Geo-Logo and Turtle Math are examples of how technology can be used to facilitate learning in a engaging and meaningful context. These packages are integrated into a complete curriculum unit that promotes geometry discovery, problem solving and mathematical application. This paper describes strategies for teachers implementing the Logo-based mathematics curriculum with young children and understandings on how a technology environment can facilitate children in their own mathematical investigations.

Computers in Curriculum

The notion that computers could be used by children was considered truly revolutionary in the 1970s. However, we now accept the notion of computers “belonging” to children (Miller 1994) and forming an integral part of their learning both in schools and the home context. Computers play an integral role in our society and children are exposed to computer applications in their daily lives, so they adopt the technology as a tool for their own pur-

poses. The implementation of technology into education, however, has been less evolutionary. As technology has revolutionized other disciplines such as communication, medicine, engineering, and even entertainment, the adoption of technology in the educational context has been less than inspiring and remained static over the last decade (Papert 1994). While computers are beginning to appear as standard items in the classroom scenario, the use of this equipment is often mundane; the computers are merely used to reinforce existing educational practices rather than as catalysts for educational innovation.

Research has illustrated that the most frequent consequence of the introduction of computers in schools is the “drill and practice” game (Hickey, 1993; Clements 1994; Becker 1992; Collis 1988). These software applications reinforce basic skills in content areas such as mathematics operations or phonetic blends and are most frequently used by teachers as a reward or to add “variety” to diet of skill practice. While there is some evidence that these programs can promote basic skills (Kelman in Clements, Nastasi and Swaminathan 1993), the educational value of such applications is limited. There may also be detrimental results from this type of technology utilization. Research suggests that a structured computer environment such as those embodied in drill and practice games can encourage competition and discourage cooperation between chil-

dren (Clements et al.1993) and stifle creativity (Haugland 1992). Additionally, the computer tasks provided in this software are usually out of context with the child’s environment and divorced from the classroom curriculum. Finally, this utilization of technology does not reflect the importance technology demands in our society. The majority of our schools are not meeting the challenge of the technology revolution.

Clements et al (1993) suggest that computers in education stands at a cross-roads. The first path is well worn and leads along the concept of the computer isolated in the classroom, often a reward for early finishers. The second uses the same “drill and practice” and structured games, however integrated, as part of the curriculum. The third path is the more challenging and the “road less traveled.” This option means that the teacher uses the computer to liberate the curriculum. This may include using problem-solving environments to extend children’s thinking, production tools as a further medium for expression, and publishing (both electronic and paper) to reach extended and “real” audiences. This path alone offers the potential of true educational innovation.

The Geo-Logo environment is grounded in the philosophy of this third option. It aims to facilitate children’s mathematical investigations and problem solving through a supportive, engaging, and meaningful context. Turtle Math⁽¹⁾ is a stand-alone version

of the Geo-Logo environment software and Geo-Logo - Turtle Paths⁽²⁾ is the software integrated into a complete curriculum unit that promotes geometry discovery, problem-solving, and mathematical application.

The Geo-Logo Environment

Over the last three years we have used the Geo-Logo / Turtle Math environment as a vehicle for research. The initial project was a curriculum implementation with a Year 3 class related to young children's skills in mathematics, problem-solving, and computer programming. The second investigation involved further implementation of the curriculum activities with the same children when they were in Year 4. These projects acted as a pilot studies for a much larger project, with 85 Year 3 students, designed to generate a model of performance of young children working with novel problems.

The first study was characterized by collaborative problem-solving with the teacher mediation via scaffolding. The second study examined the spontaneous problem-solving of young children while they worked on the same tasks. Thus, the children were technically supported but had little teacher intervention.

While the results of the second project are still to be analyzed, some interesting observations were made in terms of the children's involvement with curriculum project and their perceptions of the software environment. The children who worked with the Geo-Logo project in their classroom as part of the general curriculum appeared to be more motivated, were able to concentrate for longer periods, cooperated better in pairs, and were less inclined to be stressed or upset when working on the computer. They also demonstrated a far more positive attitude to the Geo-Logo environment at the end of the project than the children who worked in an environment removed from the classroom.

These observations support the philosophy that technology implementa-

tion is most powerful when it can enhance learning children's learning experiences within the context of the classroom curriculum.

Sample

In both studies, the sample group was organized into pairs. The children were paired on the basis of their performance on the Colored Progressive Matrices (CPM) test, as it was considered to be important that children of similar intelligence be paired to prevent one member from dominating the interaction. Additionally, the children were paired in gender groups—boys, girls and boy/girl.

The sample from the first project consisted of 14 children, nine boys and five girls, from a Year 3 class in suburban primary school. The allocation of pairs according to CPM scores resulted in four boy pairs, two girl pairs and a mixed gender pair. The project was conducted in the first semester of the year and at the commencement of the project, the mean age of the children was 7 years, 9 months, with a range from 7 years, 4 months to 8 years, 5 months. The research site was located in the back of the children's regular classroom.

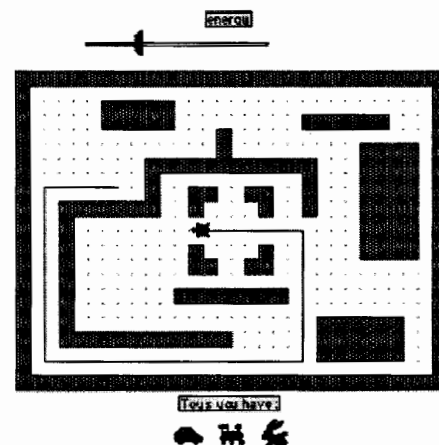
The second study involved 84 students from another suburban primary school. This sample was taken from three Year 3 classes and a Year 2/3 composite class. The children were organized to provide 12 boy pairs, 12 girl pairs and 12 boy/girl pairs. At the commencement of the project (Semester 2), the mean age of the students was 8 years, 6 months with a range from 7 years, 10 months to 9 years, 2 months. For this project, the children were collected from their classroom and taken to a maths centre classroom for the on-computer tasks.

The task

The task that was used was a Geo-Logo on-computer activity called "Get the Toys." It consisted of a three maze-type levels in which the children have to use Logo commands to guide a turtle icon

through corridors of a floor in a building to find a toy symbol. When they reach the toy exactly, the toy is transported to a storage area at the bottom of the screen and the children are instructed to return to the elevator in the centre of the screen (Figure 1)

Figure 1
Get the Toys (level 3)

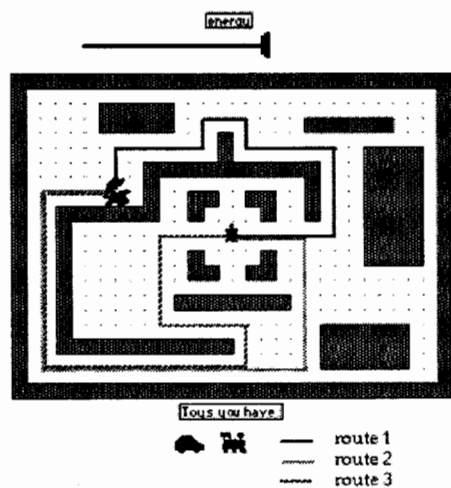


They then are able to move to the next floor in the building to attempt a harder maze. In this mode, the Geo-Logo environment introduces the child to Logo commands in a highly supported mathematical fashion. The Get the Toys activity will permit only 90-degree turns, so consequently the turtle moves only in orthogonal orientation around the screen. This meant that the choice of turn, rather than being a matter of calculating degrees, was reduced to left (Lt 90) or right (Rt 90) while still reinforcing that a right-angle turn is 90 degrees. Additionally, the children were supported in their choice of distance. Although the program permitted moves other than multiples of 10, the floor plan displayed a grid of dots that represented 10 steps. Once the child recognized the correlation, calculating the distance of the forward move was simply a matter of counting in 10s along the grid. Finally, the Get the Toys activity was based on an aspect of "energy." A meter at the top of the screen indicated to the child how much energy was being consumed with each move (energy consumption was based on the number of moves rather

than the size of each move.) The purpose of this feature was to promote efficiency in use of moves and estimation of distance. For example, a child who moved the turtle fd 2, fd 5, fd 6, fd 2, would consume energy at a higher rate than one who entered fd 15. Fortunately, the Geo-Logo environment promotes reflection on this process and would allow the first child to combine his or her moves to fd 15 and regain the lost energy.

Choosing the most efficient route to the toy was not always obvious. In order to get the toy in the most efficient way, the children should discuss which is the most effective route for the turtle to follow. In the case of Floor 3, there are three possible routes that the turtle can be directed to follow in order to get the toy rabbit. (Figure 2)

Figure 2
Possible solutions to Get the toys (level 3)



Route 1 is "over the top" and although this "looks" the closest and is indeed the shortest route in terms of distance traveled, it uses more energy as a lot of turns are required. The second route (2) covers more distance than the first but is less complex and consequently fewer moves are required to complete it. This means that this path is in fact the optimum. Route 3 is a variation on route 2, has more turns, and is less efficient. Naturally, the children could also use a combination of the routes.

Results

In the first study, the following general characteristics were noted:

- the children were encouraged to work collaboratively in their pairs and we often reinforced this idea if it was apparent that they were not doing so
- they were encouraged to think and discuss their plans to choose the most efficient route for the turtle to get the toy
- the tasks were completed quickly and efficiently
- time on task was high
- as the children worked, we asked them to explain their strategies that they were able to do with ease
- the pairs had the opportunity to make errors and we were able to support them so that they could extricate the turtle from the problem situation

In contrast in the second study, the children:

- rarely spent time planning the route and launched into the task immediately
- spent more time off task
- frequently lost energy before the turtle reached its finishing position
- gave up before task completion because they thought they would not have enough energy to finish
- displayed a sense of frustration, loss of confidence and motivation for the task as a result of not meeting the task requirements

To illustrate these features, we will discuss the attempt of two boy pairs, one from each study. The two pairs are very similar in CPM scores and also in temperament.

Study 1: Shaun and Cody

Shaun and Cody were keen to get started on the third floor. Although they were both very much aware of the need to conserve energy, they found they had conflicting views as they dis-

cussed the concept and planned the route before they embarked upon directing the turtle to get the rabbit.

Researcher: Can you tell me what you first thought of when you saw this floor?

Cody: Which way to go.

Researcher: Which way could you go?

Cody: There's three ways (pointing). That way, that way, that way.

Researcher: Which way will you go?

Shaun: That way.

Cody: forward fd. . .

Researcher: Which way do you think will use up the most power?

Shaun: That way.

Researcher: Which is the shortest way?

Cody: That way.

Researcher: Is the shortest way the one that will use the least amount of energy? Is it the fewest amount of moves or the shortest distance?

Cody: Shortest?

Researcher: No, the fewest amount of moves. So, which path do you think the fewest amount of moves?

Shaun: This way.

Cody: (Counting various paths) The way we were going before.

Cody: Or we can go 1, 2, 3 . . .

Shaun: No, we can go bk . . . we can go that way.

Cody: What we can do is go that way, that way, that way.

Researcher: How many moves was that?

Cody: 1, 2, 3, 4, 5, 6.

Researcher: OK, well you think of the way that will use the least energy (leaves Cody and Shaun to work alone)

Shaun: That way.

Cody: OK where is the pencil, I'll write it.

Cody: Rt 90.

Shaun: Rt 90.

Cody: space 90.

Shaun: That will be that way but.

Cody: Yeah, we're going that way cause the shortest amount is that way, that way.

Shaun: Then it will be Lt. That's R, that's L.

Cody: I know, so you go . . . (Shaun types in his move in contradiction to Cody's request)

Cody: Put Rt, put rt, no Shaun pl-ease . . . (They struggle over the keyboard.) Shaun completes his move.

Shaun: See that way. We have to go that way.

Cody: But that's not shorter . . .

Shaun: Mmm . . . The shortest amount of moves is the . . .

Cody: I want to do something.

Shaun: No, I'm the typer!

(Cody leaves to appeal to the researcher for intervention.)

Cody: I asked him to do that way because it had the shortest amount.

Researcher: OK, and what do you think Shaun?

Shaun: Go that way.

Cody: But it doesn't . . . 1, 2, 3, 4, 5, 6, 7

Shaun: And this is . . .

Cody and Shaun: 1, 2, 3, 4, 5 . . .

Shaun: 6, 7

Researcher: So how many different ways have you got?

Cody: Three and I decided that would be it because it has only got five.

Researcher: So what do you think Shaun?

Shaun: Um . . .

Researcher: Do you see what Cody is trying to say?

Cody: This is shorter.

Researcher: There are three different ways . . .

Cody: There's the shorter one, there's the second shorter one, and the third shorter one.

Shaun reconsiders the situation. The crisis seems to be over and so the researcher leaves them to it. The boys proceed to program the path using Cody's system.

Study 2: Alex and Steven

Alex and Steven were also confident and keen to begin the level. They ran from the classroom and sat down in front of the computer. Alex is positioned directly in front of the computer and typing, while Steven is behind and to the right of Alex.

Alex: Rt 90. (He types without input from Steven.)

Alex: 20.

Steven: No, 60, 40, 50.

Alex: Yeah 50 (He types fd 50. The turtle does not move far enough.)

Alex: 20, 20.

Steven: I told you it was 70.

Alex: Lt 90.

Steven: Yep. (Alex types Lt 90.)

Alex: 50, fd 50.

Steven: 60. (Alex ignores Steven and types fd 50.)

Steven rocks back on his chair and watches another group.

Alex continues to type several moves without input from Steven. Steven occasionally comments on the moves, but they soon receive an "Ouch" message indicating they have hit the wall. Neither knows what to do and sits there until the researcher comes and gets them back on track. Alex continues to input moves with occasional comments from Steven, but he turns his shoulder to block Steven's access to the keyboard and pulls Steven's fingers away from the keys if he tries to type. After a while Steven sits back and loses interest. Even so, they have remained pretty much on track to get the toy, although the energy is getting low from multiple forward commands. As Alex approaches the toy, Steven comes back into the picture. Alex has input fd 90 and moved past the toy. He has turned down (rather than correcting the forward command) and is trying to get back to the toy.

Steven: This dumb thing! It needs to go to the shell shop.

Researcher: Well you asked it to go fd 10 and that's exactly what it did. (Alex types fd 10, Lt 90 without comment and the turtle turns to line up with the toy.)

Alex: Yesss!

Steven: 50.

Alex: fd 20. (He types in fd 10.)

Steven: It's running out of energy! (The maze redraws and Alex groans when he sees that he is only marginally closer.)

Steven: 20.

Alex: Whatever you say, Master. (He types fd 20.)

Steven: Hey, we've got the rabbit!

Researcher: Well, you are touching the rabbit, but you have to land right

on it to take it. (Alex types two more commands and lands on the rabbit.)

Both: Yes!! We got the rabbit.

Researcher: Great! Now you are supposed to get back to the elevator, but I think you might have a problem with energy.

Alex: Oh boy, we are never going to get back there!

Steven: We should just get a black texta (magic marker) and draw it in.

Alex: (to the researcher) We have run out of energy.

Researcher: I think you still have a little bit. Get as far as you can.

Alex: No, we give in.

Conclusions

These studies revealed that when young children are supported in their problem-solving by a teacher who encourages them to use higher order thinking skills, the way in which they collaborate and complete the task would seem to be more effective than children who attempt the same task without such help. In other words, the children in the study did not spontaneously use executive skills unless encouraged and supported to do so. It is thus apparent that when young children are presented with problem-solving tasks the teacher needs to:

- encourage the children to actively work together and support each other in order to meet the task requirements.
- monitor the children's progress and request that they explain and justify strategies deployed.
- assist them to unravel problems that may occur.
- model appropriate problem-solving behavior such as responding to feedback, monitoring performance, planning, predicting, and discussing possible outcomes.
- support the children with the use of the technology, avoiding the possibility that the task of physical manipulation of the environment will overshadow the problem-solving task.

- maintain moral and the children's enthusiasm for the task. In this way, children can work together to make sense of the problem, with a mutually constructed understanding. The teacher participates in this process, and as appropriate, provides scaffolding to support children's thinking until they can function independently. As such, the activity becomes an active learning experience that will facilitate mathematical exploration in an engaging and meaningful context. **LX**

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Jenny Masters is a doctoral student in the Centre for Mathematics and Science Education and an associate lecturer in the School of Maths, Science and Technology at Queensland University of Technology in Brisbane, Australia. Her research interests center on the use of computer technology to support teaching and learning in elementary schools.

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turtles go exactly the same, uniform speed!

a) Which turtle will win this race? b) Rewrite so that t1 always wins by lots c) Rewrite so that t2 always wins but only just! d) Using random, rewrite so that no one can predict who will win. e) Rewrite so that the turtles do not go straight ahead but wander about just a little bit off the straight path during the race.

Here is how to announce the winner. Draw a block of color on the right hand side and then program that color (double click on the color) with the word winner. Then write a winner procedure:-
to winner
announce se [And the winner
is] who
end

Acknowledgement

Many of the programming ideas have been obtained over the years from ideas and programs posted to the logo newsgroup, comp.lang.logo. They belong collectively to the sharing and constructionist logo community. **LX**

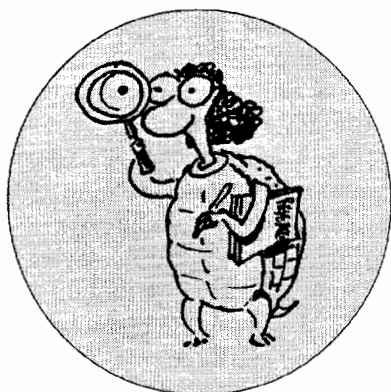
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About the Author

Bill Kerr is a teacher at Paralowie R-12 (Reception to Year 12) School in Adelaide, South Australia. He has been using Logo to teach maths in the classroom intensively over the past five years. He was initially turned onto Logo by the educational philosophy expounded by Seymour Papert in *Mind-Storms* and his other writings. He participates regularly in interesting discussions held on comp.lang.logo. You can find his Web site at <http://www.senet.com.au/~kerrb/>

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Computers in and for Our Diverse Society

by **DOUGLAS H. CLEMENTS AND JULIE SARAMA**

How are computers used within our diverse multicultural society? A recent report by the President's Committee of Advisors on Science and Technology—Panel on Educational Technology (1997) provides an overview. The Panel states that:

On the one hand, it has been frequently noted that new computing and networking technologies have the potential to empower historically disadvantaged groups of Americans with greater access to the sorts of knowledge-building and communication tools that might help them to overcome at least some of their respective disadvantages. While the Panel believes this potential can scarcely be overstated, it also believes that the ways in which educational technologies are actually deployed and used will determine whether they serve to narrow these historical disparities or widen them even further. (p. 67).

What are the dimensions of such access? A main measure is the density of computers in various schools. Another is the way the schools grant access to various groups. An important additional issue is equitable home access to technology. Computers are in about half of all American households with children, and a large fraction of all children whose families do have computers at home use them regularly for school work.

The Panel considered several factors. We will describe their conclusions and also insert additional research information from a comprehensive review of the research (Sutton, 1991).

SES: Socioeconomic status

Specially targeted federal programs have helped to move toward equitable access. Income-related differences in computer density have decreased. They still exist, however. The poorest schools have one computer for every 11 students, while the richest have one for every 9.5 students. That is better than a decade ago, when four times as many rich schools had computers, compared with poor schools. We can not let our guard down, though. First, the federal programs (Title I) are under pressure. Second, the computers are often used differently within schools of different SES. Students from low SES families report 14 % lower usage of computers in schools. They are more likely to be taught about computers than to use computers for learning.

Finally, when high SES students use computers, they are more likely to engage in computer programming. Low SES students are more likely to engage in low-level computer tasks. At seventh and eighth grade, for example, high SES students were 25 % more likely to use computers for "high-order activities," while low SES students were doing drill-and-practice or other skill-building or knowledge acquisition activities.

The greatest disparities are found in the homes. Computers are in 14 % of

low SES students' homes. In high SES student's home, the percentage was more than five times as great, 73 %.

The Panel recommends that minimum standards should be formulated and maintained for the use of technology in schools, regardless of the SES of the student population. Title I funding should be maintained. The Federal Communications Commission should ensure that affordable telecommunications services be available to all schools. Digitized intellectual material, including that controlled by the federal government, should be affordable or free. Everything should be done so that libraries, community centers, and other public institutions help provide access to those students without technology at home. Schools should consider lending laptops.

Race and ethnicity

Title I funding has improved the density of computers in minority schools. Still, schools with more than 90 % minority enrollment have 16 % fewer computers per capita than other schools. Many differences are accountable by SES variables, but certain disparities seem related to race or ethnicity. Hispanic students seem particularly disadvantaged, especially in elementary schools.

Again, the home situation is more threatening. African-American students are 57 % less likely, and Hispanics 59 % less likely, to have computers at home. Even after adjusting for SES, education, age, and so forth, the figures

remain significant: 36 % and 39 %. Even telephone service is inequitably distributed. So, while addressing SES concerns will help, special attention should be given to racial and ethnic fairness.

Geography

Differences in density of computers within regions—West, Midwest, Northeast, and South—are relatively small. But there are differences in use. Students in southern states are 32 % less likely to be heavy users of school computers and 25 % less likely to use computers for higher-order activities.

Finer-grained classifications may reveal other problems. Inner city students are likely to suffer special disadvantages.

Educational achievement

Though the research is only suggestive, it appears that lower-achieving students may benefit more from using computers than higher-achieving students, at least in some situations. However, they have less access to technology. They are also more likely to be assigned drill-and-practice software (Sutton, 1991). In one survey, nearly 3/4 of the teachers believed that drill and practice was effective in teaching students of low ability. The same teachers' responses were mixed on whether bright students were suited to drill and practice.

Students with special needs

Given the special role technology can play, the Panel states that equal access may not be equitable access. (Sutton, 1991, provides a similar research-based view.) Special measures must ensure that special needs students get maximum benefits from technology, from aiding physical disabilities to learning.

Summary

Research shows that the use of computers has maintained and exaggerated inequities (Sutton, 1991). Our society needs to address this at every level,

from the federal government to the individual adult. Equity may require inequality! For example, we may have to provide more in-school and out-of-school access for poor children (Sutton, 1991).

What about Logo specifically?

We already saw that minority and poor students spent more time on drill and practice and less time on programming than did high-SES and majority students (Sutton, 1991). This appears to be based on two long-standing beliefs. The first is that children must master "the basics" before moving to higher-order thinking. The second is that poor and minority children lack the basics. Certainly, this does not represent the use of computers or Logo to "re-think" education.

Several studies have addressed ethnic differences in Logo use. Emihovich and Miller (1988) found a significant interaction between ethnicity and mathematics achievement. White children in the CAI and control group outperformed the African-American children. However, this trend was reversed for the Logo group with African-American children outperforming white children. What is more interesting is that ethnicity was confounded by SES: The African-American children came from low-SES homes, whereas the white children came from middle-SES homes. The authors believe that Logo builds on strengths of African-American students, such as their high responsiveness to visual and auditory stimuli and their desire to collaborate. By encouraging minority children to talk and share their ideas and to use the "turtle" as a concrete representation of their thinking, a learning environment can be constructed that may make these students more aware of their thought processes. The African-American children actually found it easier to "break the rules of school," assuming control and initiating new topics or ideas for experimentation. The authors recommend that minor-

ity students be given more access to computer programming.

Another study of black and white Zimbabwean children also showed different effects (Wilson, Mundy-Castle, & Cutts, 1989). Black girls who used Logo showed particularly large gains on spatial reasoning. With such interesting but tentative results, more research racial differences when learning Logo seems warranted.

Gender

One critical issue we did not address is gender equity. So much research exists on this issue alone, in general and in using Logo, we will dedicate our next column to that issue exclusively.

Acknowledgement

Time to prepare this material was partially provided by a National Science Foundation Research Grant, "An Investigation of the Development of Elementary Children's Geometric Thinking in Computer and Non-computer Environments," NSF MDR-8954664. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.



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- Wilson, D., Mundy-Castle, A., & Cutts, J. (1989). Academic locus of control and Logo performance among black and white Zimbabwean girls and boys. *Journal of Social Psychology*, 129, 565-567.

About the Authors

Douglas H. Clements, Professor at the State University of New York at Buffalo, has studied the use of Logo environments in developing children's creative, mathematics, metacognitive, problem-solving, and social abilities. Through a National Science Foundation (NSF) grant, he developed a K-6 elementary geometry curriculum, *Logo Geometry* (published by Silver Burdett, & Ginn, 1991). With colleagues, he is working on the previously mentioned NSF research grant and is finishing a second NSF-funded project, *Investigations in Number, Data, and Space*, to develop a full K-5 mathematics curriculum featuring Logo. With Sarama, he is co-authoring new versions Logo for learning elementary mathematics. One, *Turtle Math*, is presently available from LCSi.

Julie Sarama, Ph.D., is an assistant professor at Wayne State University where she teaches mathematics content courses for pre-service teachers and research courses for graduate mathematics education students. She has studied teachers' use of computer innovations and students development of mathematical constructs while working in computer microworlds. She is co-author of several *Investigations* units and of *Turtle Math* and is currently designing and programming new versions of Logo and other computer microworlds.

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RIGHT PLACES / Continued from Page 2

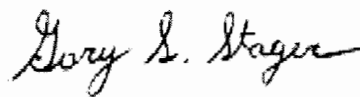
Braitenberg's work?" After sneaking off for several hours of discussion with Dr. Papert, Michael shipped a large box full of his programs, designs, and other top-secret materials to MIT. Months later, Michael was disappointed that he had not received a response to his correspondence. While I explained how busy Papert must be, Michael mentioned that the letter he sent was written in secret code. When I asked him if he thought that the secret code might delay a reply, Michael replied, "But it was an easy code!"

Michael Gelman is now studying for a dual PhD/MD at the University of Wisconsin. I am grateful for his contribution to *Logo Exchange* and for all I have learned about teaching and learning from him.

Bill Kerr teaches in South Australia and is an amazing repository of the constructionist research and mathematical ideas. Bill is an active member of the Logo-1 listserv on the Internet and often knows more about U.S. research and new books than educators who don't live on the other side of the world.

Bill Spezeski contributes another terrific article on math and Logo. Nicola Yelland and Jenny Masters share some of their early childhood research with us. Adam Smith shares an activity from his new Schoolkit software. Dan Kinnaman, Carolyn Dowling, Alan Epstein, Doug Clements, Julie Sarama and *Logo Exchange* founder Tom Lough continue to contribute their big ideas to *Logo Exchange*. I am grateful to my colleagues from around the world who have worked tirelessly on behalf of this important publication. The Table of Contents demonstrates that we have been looking for Logo in all the right places!

Please continue the good work that you do and share your ideas with *Logo Exchange*! LX



Gary

Gary Stager
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LOGO NEWS / Continued from Page 4

This issue will include personal anecdotes as well as scholarly analyses regarding Seymour Papert's impact on you, your teaching, your thinking and the world of ideas. *Logo Exchange* hopes that this issue will be a landmark publication in the world of educational computing. The deadline for submissions is October 15, 1998.

Logosium News

Our crack staff of reporters have covered the Logosium at NECC and their tales of Logosium will appear in subsequent issues of *Logo Exchange*.

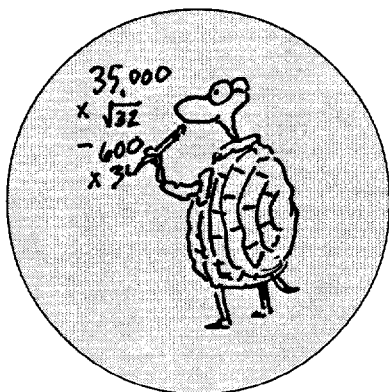
A Baby Turtle Is Hatched

Logo Exchange Contributing Editors Julie Sarama and Doug Clements gave birth to Abbey Rose Clements at 4:21 a.m. on June 18, 1998! 7 pounds, 7 oz., 21 inches. Congratulations to Julie and Doug!

Oops!

Thank you to all of our loyal readers who have found all of the embarrassing typos in the past few issues. We will work to improve our accuracy in future editions.

Seymour Papert is editing his speech that appeared in *Logo Exchange* Issue 16/2, and we will make the edited version available via the Web and other means in the near future. Dr. Papert gave *Logo Exchange* permission to transcribe his speech and publish that transcription. It literally took weeks to perform this task and then editing decisions were debated laboriously. It was my decision as Editor-in-Chief of *Logo Exchange* NOT to heavily edit the speech because it was in fact a speech by another person whom we respect. Most readers agree that what Dr. Papert had to say in that speech deserved to be heard. Out of respect to our readers and Dr. Papert, a revised edition of the article will be made available shortly. LX



Drawing with Arcs

Part II: Exploring Variations

by WILLIAM J. SPEZESKI

In Part I, we explored what happens when we replace straight lines with arcs when drawing objects with Logo. The diagram below illustrates the basic effect. The concentric polygons on the left take on a new look when their straight sides are replaced with concave and convex arcs, respectively. The sector lines shown are simply used to enhance the effect.

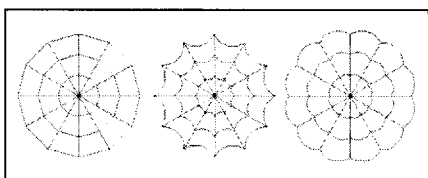


Figure 1

Drawing with Alternating Arcs

One variation when drawing with arcs is to draw polygons by drawing the first side with a convex arc, and then drawing the second side with a concave arc, etc., alternating back and forth between procedures ARCR and ARCL.

A. Polygons/Stars with Alternating Arcs

If the polygon/star being drawn has an even number of sides, then an equal number of concave and convex arcs will be used. If, on the other hand, there are an odd number of sides, then there will be an "extra" concave or convex arc. The procedure below will handle both the even and odd cases. In the event that the number of sides is odd, the extra arc will be concave.

```
to l.r :n :d :m
cs fs ht
```

```
rt :d/2
repeat int(:n/2) [ arcl 50
:d rt :m*360/:n arcr 50 :d
rt :m*360/:n ]
if (remainder :n 2) = 1 [
arcl 50 :d ]
end
```

Several things are worth noting about procedure L.R. It draws two sides of a polygon each time a *repeat* instruction is executed. Thus the expression *int(:n/2)* appears in order to compensate for this "doubling" effect. Drawing an extra arc when *n* is odd is handled by the *if* statement. Finally note that the pre-draw and post-draw offsets for the alternating arcs cancel each other. This results in a simplified expression within the brackets. The procedure L.R produces the following figures:

Polygons: *n* is even, *m* = 1
(*n* = 4, 6, 6)

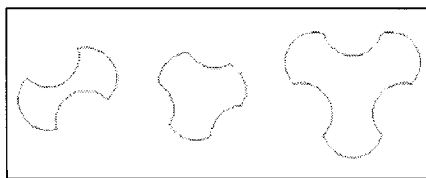


Figure 2

n is odd, *m* = 1 (*n* = 3, 5, 5)

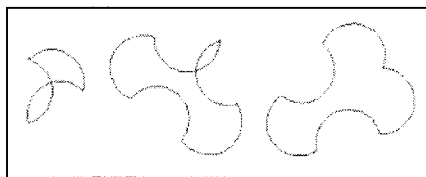


Figure 3

Stars: *n* is even, *m* > 1 (*n* = 8, 12, 12)

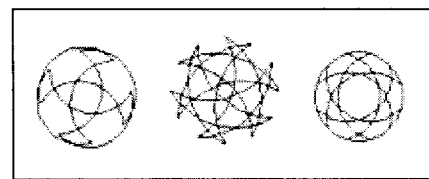


Figure 4

n is odd, *m* > 1 (*n* = 5, 7, 5)

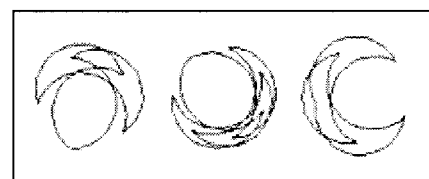


Figure 5

B. Spirals with Alternating Arcs
Polygonal spirals can also be drawn with alternating concave and convex arcs using

```
to r.l.spiral :ang
cs fs ht
make "radius 10
repeat 40 [ arcr :radius
150 rt :ang arcl :radius 150
rt :ang make
"radius :radius+1]
end
```

Procedure R.L.SPIRAL can produce the following (*ang* = 90, 72, 60):

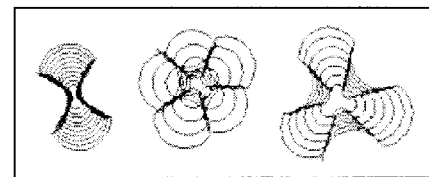


Figure 6

Drawing with Pairs of Arcs

As another variation of drawing with arcs, we can draw with pairs of arcs, that is, a convex (right) arc immediately followed by a concave (left) arc producing a tilda-like swiggle (~). Using this drawing technique, each side of a "polygon" will be a swiggle consisting of two arcs. The swiggle can be drawn using instructions like

```
LT n/2 ARCR m n ARCL m n
RT n/2
```

In this case the post-draw offset for ARCR cancels out the pre-draw offset for ARCL to give the expression above.

A. Polygons/Stars with Paired Arcs

A procedure that produces polygons with straight lines replaced by arc pairs is

```
to swiggle :n :d :m
  fs cs ht
  seth 0 lt :d/2
  repeat :n [ arcr 50 :d
    arcl 50 :d rt :m*360/:n ]
end
```

It can produce the following:

Paired-arc Polygons: $m = 1$,
 $n = 4, 3, 4$

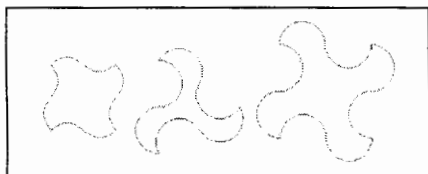


Figure 7

Paired-arc Stars: $m > 1$, $n =$
 $5, 7, 7$

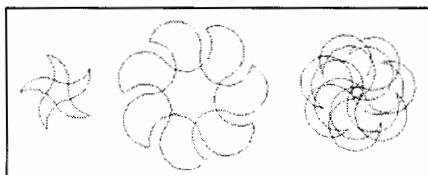


Figure 8

B. Spirals with Paired Arcs

The corresponding procedure that draws paired-arc spirals is

```
to swiggle.spiral :ang
  cs fs ht
  make "radius 10
  repeat 50 [ arcr :radius 90
    arcl :radius 90 rt :ang make
    "radius :radius+1 ]
end
```

It can produce the following ($\text{ang} = 120, 72, 150$):



Figure 9

Conclusion

Some very interesting and elegant figures can be drawn when you replace the straight lines of polygons and spirals with arcs. Connecting points with an arc offers more intriguing possibilities than simply connecting points with a straight line; each arc can be drawn using either procedure ARCR or procedure ARCL, and each arc can have a wide range of curvatures. Consequently, the diagrams above represent but a few of the multitude of figures that can be drawn. The table below attempts to summarize the considerations of this article. A polygon, a star and a spiral are shown along with four arc variations: replacing their straight lines with convex arcs, with concave arcs, with alternating arcs and finally with paired arcs.

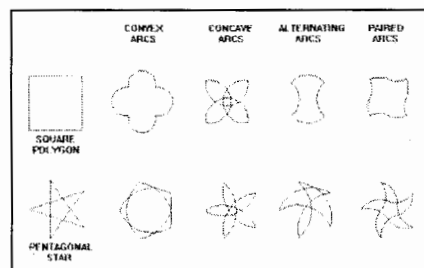


Figure 10

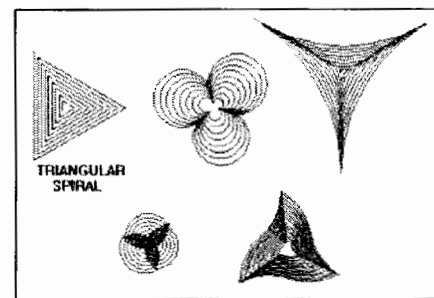


Figure 11

As we also noted, the application of these ideas is not restricted to just the world of polygons, stars and spirals. We can, for example, replace the straight lines in fractals by arcs or arc patterns as indicated below. Here the straight lines of the fractal on the left are replaced with paired arcs to produce the very impressive fractal on the right.

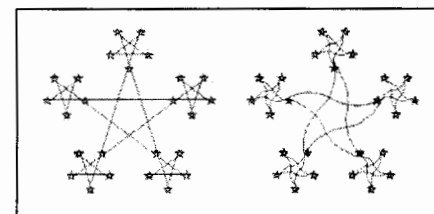


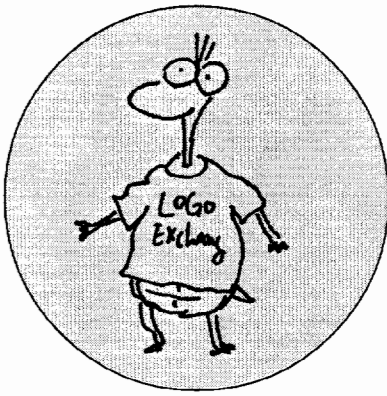
Figure 12

The possibilities are endless. Try some yourself. One last comment—there has been no attempt to fully parameterize any of the procedures in this article. That is a straightforward task that will be left to the reader. **LX**

About the author

Bill Spezeski teaches at Massachusetts College of Liberal Arts and is a long-time contributor to *Logo Exchange*. Look for other articles by him in future issues.

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FOR BEGINNERS

The Prospector Game: Playing with Coordinates

by **ADAM SMITH**

SchoolKit MicroWorlds Resources

SchoolKit is a product that helps teachers to find, use, and share computer-mediated learning activities across all curriculum areas. It consists of two fundamental parts: a Web-based library from which teachers can select "digital activities" that suit their particular needs and preferences, and a program that runs on student computers to provide for the easy addition, management and, starting of these activities.

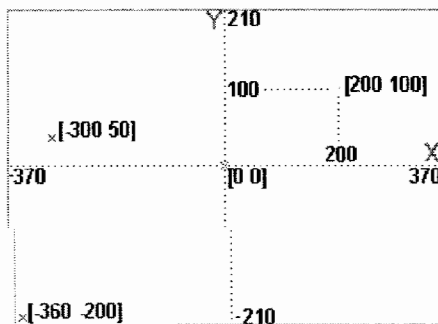
Each activity sets a challenge, launches students into an application such as Word or Excel, and then provides curriculum and technical guidance. Most of the activities are open-ended to encourage creative and analytical thought. Of particular interest to us is the developing range of MicroWorlds activities. A simple example has been reproduced below, and may be copied and given to students. The US SchoolKit site will be launched in September this year. Until then, readers are encouraged to visit the existing library at www.whatthehey.com. Here you can freely download demonstration activities and a demonstration copy of the Student Resource Manager.

Prospector Challenge

You will use MicroWorlds to create a game called Prospector. In the game, a prospector is searching for gold, which is hidden in the ground. You will tell the prospector where to dig by stating coordinate positions.

What are Coordinates?

Imagine a line running horizontally across the middle of the MicroWorlds screen (the X-axis) and another line running vertically from top to bottom (the Y-axis).



You can tell the turtle to go to any position on the screen by providing the coordinates.

- Look at the green cross. It is at 200 on the X-axis and 100 on the Y-axis. Therefore, its position is [200 100]
- In MicroWorlds we can tell the turtle to go to this position with the command **setpos [200 100]**
- Study the diagram and experiment in MicroWorlds to understand coordinate positions.

Make the Prospector

To make the Prospector, you need to name the turtle **Prospector** and given it the shape **Boy**.

If you are not sure how to do this, follow these instructions:

- Click on the Eye Tool:



- Click on the turtle to open its dialog box.
- Change its name to Prospector:

- Click the OK button.
- Click the Shapes icon:
- Choose the shape called Boy (use the arrows).
- Click on the turtle in the workspace to give it the new shape.



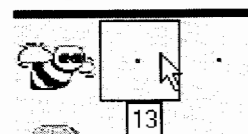
Make A Gold Nugget Shape

You need a new shape that looks like a gold nugget. If you are not sure how to do this, follow these instructions:

- Click the Shapes icon:



- Double click on one of the empty spots:



- Use the Shape Editor to draw the new shape.
- Click the OK button. You should have a new shape like this:



Make 3 Nuggets of Gold

You need 3 new turtles called Nugget1, Nugget2 and Nugget3. Each turtle needs to have the gold nugget shape, and must hide itself when you click on it. To make Nugget1:

- Click the Hatch icon:



- Click anywhere in the workspace and a new turtle will appear.
- Click the Shapes icon:



- < Choose the gold nugget shape.
- < Click on your new turtle to give it the gold nugget shape.
- < Click the Eye tool.



- < Click on the new turtle to open its dialog box.
- < Enter a name and instruction like this:

- < Using the same method, make Nugget2 and Nugget3.

Hide the Gold

Click on each gold nugget turtle (with the arrow tool). Each one should disappear. They are hidden somewhere on the screen.

How Does it Work?

You programmed like this:

HT means hide turtle. The turtle is still there, but it is invisible.

Setpos means set position. It needs a list of two inputs, the x coordinate and the y coordinate.

$-360 + \text{random } 721$ provides an x coordinate between -360 and 360.

$-200 + \text{random } 401$ provides a y coordinate between -200 and +200.

When you click on the turtle it carries out its instruction. You have told it to hide itself and to move to some random position on the screen.

Search for Gold

With the gold nuggets hidden, we need to use the prospector to look for them. The prospector needs to know how to Dig. Enter the following procedure:

```
to DIG :location
  prospector,
  setpos :location
  if 30 > distance "nugget1 [nugget1, st
  note 120 1]
  if 30 > distance "nugget2
  [nugget2, st note 120 1]
  if 30 > distance "nugget3
  [nugget3, st note 120 1]
end
```

How Does it Work?

prospector, means talk to the turtle called Prospector.

setpos :location moves the prospector to the position you have indicated.

if 30 > distance "nugget1 [nugget1, st note 120 1] checks whether the prospector less than 30 turtle steps from the gold. If the prospector is close to nugget1 the nugget is told to show itself and a note is sounded.

Playing the Game

To play the game:

- Make sure all of the gold nuggets are hidden by clicking on them.
- Tell the prospector where to look by typing instructions in the command center. Eg. **DIG [200 100]**
- If the prospector finds gold, it will appear, otherwise you need to keep searching.

- You could take turns to play the game with a partner. See who can find all three nuggets in the least number of moves.

Extension Ideas

There are many ways in which you could improve this game. Try some of the following:

- Increase the number of gold nuggets.
- Using the Drawing Center, create a "bird's eye" view of the gold field.
- Write a procedure to count the nuggets that the prospector finds in 10 digs.
- Provide tips to the prospector to say when he/she is getting close to a gold nugget.

For example:

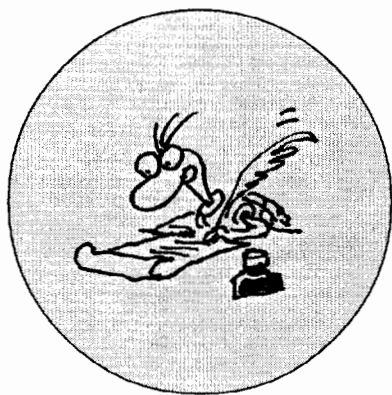
```
ifelse 30 > distance "nugget1
[nugget1, st note 120 1]
[if 50 > distance "nugget1 [announce
[You are close to a nugget.]]]
```

LX

About the author

Adam Smith is well known as a veteran classroom teacher, administrator and Logo user across Australia. He recently created the software package, *Schoolkit*, designed to help teachers and students share project ideas to explore with open-ended software tools.

Adam Smith
www.schoolkit.com



Using Logo in All the Right Ways

by DANIEL E. KINNAMAN

I used to think that there were distinct *right ways* and *wrong ways* to use Logo. But I was wrong. As people's exhibit number one, I offer the following example.

Several years ago, before hypermedia and all things Internet, I was introducing a school district to Logo and to LEGO TC Logo. One teacher enthusiastically invited me to watch him begin his first LEGO TC Logo lesson with his middle school students.

With pride he unveiled a LEGO model that he had obviously spent considerable time planning and building. He then *instructed* his students to build a replicate of his model. He also gave them a few Logo programs with instructions to *copy* them into one of the three LEGO interface-equipped computers in his classroom. The degree to which their models looked like, and worked like his determined their success and guided his assessment.

My initial reaction, which I fortunately voiced silently only to myself, was, "Oh no, that's all wrong! He doesn't get it!" His students, however, seemed thrilled with the assignment. They worked very hard and took great pride in making their look-alike, work-alike models.

When the teacher and I met later to discuss his lesson, I decided not to tell him he was *wrong* (Given the students enthusiasm and participation, how wrong could he be?). Instead, I asked him what he was trying to accomplish educationally with his students. His answers were very *product-oriented*, and weren't surprising given these two basic axioms of teaching:

1. Teachers tend to teach the way in which they were taught; and
2. Teachers tend to teach according

to their perceived expectations of what administrators and parents want.

His *instructions* for the lesson clearly represented the classroom-based norm-referenced approach under which he had learned. In this approach students *race* against one another to produce identical products or outcomes, and success is measured not so much against a set of criteria, but in terms of the how an individual's performance compares to that of his classmates. Interestingly, it was also clear that his students had been *conditioned* over the years toward this approach, and finishing the task within the allotted time gave them a sense of accomplishment and success (with the title of "class champion" going to the student who finished first). By these measures, his lesson—and his use of Logo—were successful.

Just as clearly to me, however, some important things were missing. None of his students asked him why they were doing the activity, nor did any of them question why his model (or their look-alike models) had certain features, while lacking others. Not a single student attempted (or was encouraged) to add to or modify the prescribed Logo procedures. In short, there was no focus on *process*, no focus on personal interpretation, and no focus on creative expression. There was no focus on problem formulation, just on problem solving (and at a very limited, highly structured level).

Our discussion of his lesson focused on these topics and their relative importance to the education of his students. Over time we had numerous such discussions regarding schooling in general and the use

of Logo in particular. One year later, I was again invited to his class to see the same lesson. This time the teacher had also built a model, but he had it covered by a cloth so no one could see it. The assignment was for the students to create their own models, with the requirement that they be able to perform several specific tasks. There were no prescribed Logo programs to copy, and no step-by-step-build-this-model instructions. He told the class that they would be judged on the degree to which their *creations* performed the required operations (i.e., criteria) and the efficiency with which they did so.

Quite a change (and quite an improvement, I thought). It emphasized for me that the how, when, where, and why of using Logo is dynamic. That is, it changes and evolves—as is true for any curriculum resource—according to what the teacher and his/her students believe about school learning and how it best takes place.

LX

About the Author

Daniel E. Kinnaman, a contributing editor to *Logo Exchange*, has more than 15 years' experience as a classroom teacher and district-wide director of education technology. He also has taught graduate teacher education courses in conjunction with colleges and universities nationwide. He is executive editor of *Curriculum Administrator* magazine and serves as a consultant to Compaq Computer Corp., Safari Technologies, and school districts and education service centers throughout the United States.

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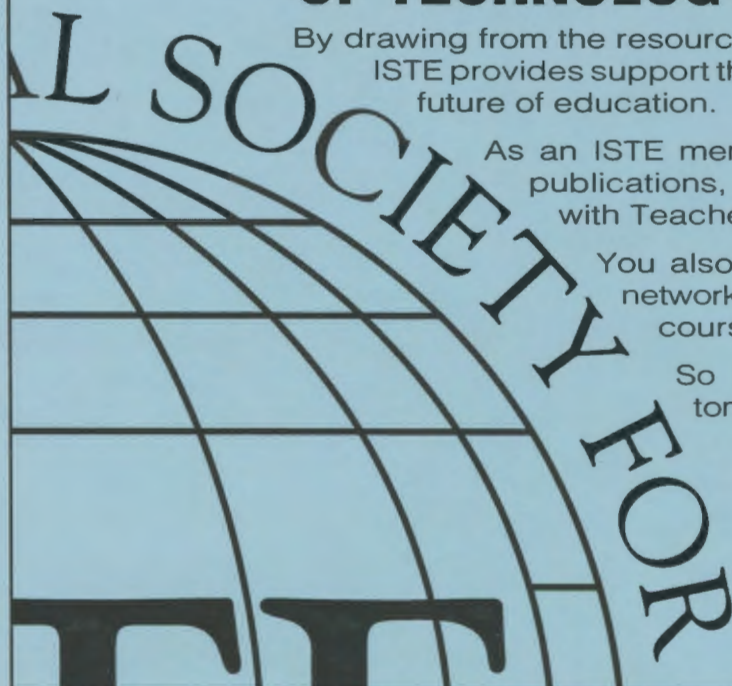
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