



The Logo Newsletter for Teachers

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FORWARD 100!

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## Twenty Powerful Ideas

by  
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When teachers know of the powerful ideas embedded in Logo, they can teach more effectively. Powerful ideas influence how they introduce Logo, how they decide which examples to show, and how they establish the context and culture for their students. When teachers know and demonstrate more than just a knowledge of the Logo language and its syntax, students are able to use Logo more powerfully and intentionally.

I hope that this set of twenty ideas will give you some things to consider as you begin a new school year.

**1. The Turtle.** Everyone knows how to move their own bodies. By using that knowledge and identifying with the turtle, everyone can tell the turtle how to move across the graphics screen. By teaching the turtle, we learn how to program in Logo.

**2. Playing Turtle and Playing Computer.** Pretend to be the turtle and walk the design you want the turtle to draw on the screen. Observe carefully your steps, your directions, your turns. Translate your steps and turns into Logo commands. This is a good programming tool and an excellent debugging tool.

**3. The Total Turtle Trip Theorem.** Whenever the turtle has drawn a figure and returned to its starting location and heading, it has turned a total of 360 degrees (or some multiple) during the Total Turtle Trip. This idea contains information needed to draw any regular shape, such as a square (4 times 90) or a triangle (3 times 120).

**4. Drawing.** Almost everyone uses drawing as a natural way to express ideas. With Logo, you are using the turtle to draw and to express your ideas.

**5. Exploration and Discovery.** Every Logo user is an explorer and can make genuine discoveries of how to draw a shape or solve a problem in its rich mathematical environment. A successful explorer must be willing to try ideas and see what happens.

**6. Theory Building and Problem Solving.** Logo learners make up theories about everything, especially about turtle moves. Taking note of their specific expectations and of the differences between them and what actually happened invites students to develop workable problem solving strategies.

**7. Describing and Defining.** All Logo procedures are descriptions of something you want Logo to do. You can save these descriptions as procedures and use them over and over. Also, describing and defining a problem is useful in debugging or solving that problem.

**8. Debugging.** Trapping and eliminating bugs is a great deal of what Logo programming is about. (Ed. note: See NLXual Challenges elsewhere in this issue.) Hardly anyone gets a Logo program to work the way they want the first time through. This is the problem solving "curriculum" built into Logo. Logo error messages are helpful in finding bugs.

**9. Procedures.** When doing routine jobs, most of us follow a series of small procedures. A procedure does one small task in life, as well as in Logo. Procedures are Logo's helpers. They can be combined to work together with a superprocedure as a boss. Procedure trees show how procedures work together and in what order they are called.

## Powerful Ideas continued

**10. Naming.** Everyone loves to name things. In Logo, you name anything you want to save or use again. Naming helps you remember what you did and allows you to use something again by calling its name. Also, naming is an important part of problem solving.

**11. Extensibility.** You can teach Logo how to do something by defining a procedure. This extends the language.

**12. Variables.** A variable is a piece of information. It could be thought of as a place to put a number (or other object) as input to a command or operation. Numerical variables allow you to create the same shapes in many different sizes on the screen, thus giving you a great deal of power in using small building blocks.

**13. Repeating.** Logo's REPEAT command allows you to repeat a procedure or any list of instructions a number of times. With REPEAT, you can explore patterns, create tessellations, and discover mathematical relationships between numbers or variables.

**14. Recursion.** A Logo procedure can call another procedure by the same name (a copy of itself) as a way to get a job done simply. The idea of recursion is one of the most powerful ideas embedded in Logo, and it is not easy to grasp. Using recursive procedures to describe actions in real life is helpful to students. For example, let's ask Dan to clear the dinner table and wash the dishes. Using recursive thinking, Dan would check to see if there were any dirty dishes on the table. If not, his job is done. If there were, he would clear his own place and wash his own dishes, then call a helper with the same set of instructions. With such examples, students can grow into the more complex versions of recursion and come to use Logo's full power as an artificial intelligence language.

**15. Conditionals:** Logo can stop procedures when certain conditions are met. For example, IF HEADING = 0 [STOP] might be used to stop a recursive procedure. Of course, conditionals have many other uses as well.

**16. Interaction.** Logo as a process is interactive, and invites students to learn at the computer by trying things out. More advanced programming allows users to input information into programs with commands such as READCHAR, REQUEST, and READLIST.

**17. Information Processing.** Logo stores information as words and lists. Naming files and procedures and using REPEAT and PRINT are simple examples of processing words and lists. Logo can also take information input as words and lists, operate on it, and give the result as output.

**18. Thinking About Learning and Learning About Thinking.** Part of learning Logo is observing your own thought processes made visible on the screen, often in the form of turtle tracks. By watching the turtle's heading, you can see your own thought process in

estimating angles. By describing it in words, you can refine your thinking about angles.

**19. Microworlds.** Logo makes it possible to establish a safe, defined learning environment where students can do some real learning through open ended exploration. Teachers become guides and challengers, rather than lecturers

**20. Modes of the Computer.** Logo has two main modes: direct (or command) mode, and edit mode. When you are working in the direct mode and you type an instruction and press the "do it" key (sometimes called <return> or <enter>), something happens. In the edit mode, however, instructions are stored to be used later. Nothing happens when "do it" is pressed. Understanding the effect of each mode and being able to shift from one mode to the other is essential to learning to use Logo effectively.

(Ed. note: This set of ideas is the product of Molly and Dan Watt's thinking and current work in Logo. More detailed versions of this article appear in Molly's Welcome to Logo! series from D. C. Heath, and Molly and Dan's Teaching with Logo from Addison-Wesley.)

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