

Eight Ideas for Using the Computer in Elementary Mathematics

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Computer use has been categorized in a variety of ways. For example, Taylor (1980) has compiled a set of readings that describe the computer as a tutor, tool and tutee. A more extensive taxonomy might include at the least the following uses.

Computer-Assisted Instruction

This category includes all practice courseware such as Math Blaster (Davidson & Associates) and Addition Logician (MECC). Tutorial software as well as simulations and educational games could also be classified as computer-assisted instruction, together with some problem-solving courseware. Using the computer for demonstration or to generate materials for children may also be considered computer-assisted instruction.

Computer-Managed Instruction

In computer-managed instruction, the computer helps organize and manage instruction, for example, by keeping records of students' progress (including whether specified objectives have been achieved), and generating reports for teachers, parents and other interested parties. Testing could also be classified in this category.

Productivity Applications

Wordprocessing, spreadsheets, data base management, drawing, painting and desktop publishing are often referred to as productivity uses of the computer. More teachers are using these tools for personal and in-class productivity.

Eight Quick and Easy (Spontaneous) Uses

Many commercial courseware packages are pedagogically sound and have some "bells and whistles"

that appeal to children. These packages should be used when they mesh with the mathematics program in the classroom, but often the match of courseware to a program is not as close as one would like. A use developed spontaneously by the teacher then becomes the better way to go.

The purpose of this article is to describe a few, simple ideas for using the computer in the mathematics program—the kind of things a teacher could incorporate into a lesson plan for the next day. These ideas would be classed as computer-assisted instruction. The sample procedures have been written in Apple (LCSI) Logo but could be done in other Logo dialects or in BASIC. First, here are a few utility procedures.

Utility Procedures

The following procedures are used in the examples. They need to be loaded into the workspace before the other procedures will run. More experienced Logo users may want to bury these procedures in a **STARTUP** file.

```
TO SETTEXT          TO PRESSKEY
TEXTSCREEN CLEARTEXT SETCURSOR [5 23]
SETCURSOR [0 0]     TYPE [PRESS ANY KEY TO
END                 CONTINUE.]
                    MAKE "INPUT READCHAR
                    END
TO BLANKLINE :HOWMANY
REPEAT :HOWMANY
[PRINT[]]
END
TO TAB :NUMBER
REPEAT :NUMBER [TYPE
CHAR 32]
END
```

Scenario 1: Counting

Teachers of young children are creative in developing activities with counters of various kinds (chips,

buttons, beads, popsicle sticks). Calculators with a built-in constant can provide additional variety in the kind of counting experiences children have, and the computer can also be used for this purpose.

Groups of students could be engaged in counting activities with counters, calculators, and using computers as follows. COUNTUP begins a counting sequence with the first four numbers. After that, when a key other than "S" is pressed, the next counting number appears. Pressing "S" clears the screen and stops execution.

```

TO COUNTUP
INSTRUCTIONS
SETTEXT
BLANKLINE 5
COUNTFOUR 1 0 1
END

TO INSTRUCTIONS
SETTEXT
BLANKLINE 3
PRINT [TOUCH ANY KEY TO COUNT.]
BLANKLINE 1
PRINT [WHEN YOU ARE READY TO STOP COUNTING.]
BLANKLINE 1
PRINT [TOUCH THE "S" KEY.]
PRESSKEY
END

TO COUNTFOUR :S :CT :INC
IF :CT > 3 [COUNTREST :S :INC] [TYPE :S SPACE 1]
COUNTFOUR :S +INC :CT + 1 :INC
END

TO COUNTREST :S :INC
MAKE "K READCHAR
IF :K = "S [SETTEXT THROW "TOPLEVEL] [TYPE :S
SPACE 1]
COUNTREST :S + :INC :INC
END

```

INSTRUCTIONS may be omitted because of the reading level. Some children may be capable of counting on from some number other than 1. COUNTUP2 enables children to specify the starting number as input to the procedure. Otherwise, it works the same as COUNTUP. The subprocedure COUNTFOUR was written for the general case so it can be used for both these settings as well as for the next one, skip counting.

```

TO COUNTUP2 :START
INSTRUCTIONS
SETTEXT
BLANKLINE 5
COUNTFOUR :S 0 1
END

```

Scenario 2: Skip Counting

```

TO SKIPCOUNT
INSTRUCTIONS
SETTEXT
PRINT [BEGIN AT?]
BLANKLINE 1
MAKE "BEGIN FIRST READLIST
BLANKLINE 1
PRINT [COUNT BY?]
BLANKLINE 1
MAKE "INC FIRST READLIST
BLANKLINE 1
COUNTFOUR :BEGIN 0 :INC
END

```

Skip counting is often used as a lead-in activity to multiplication. For instance, when children count by 3s (3, 6, 9, 12 . . .), they are *teased* into thinking about the three times table. Children can gain experience in many ways with skip counting, including using the calculator and the computer. One group of children might use the Logo procedure SKIP-COUNT. An interactive procedure, this asks for the starting number and the increment. It then counts as before using the same counting subprocedure COUNTFOUR. For example, if 7 and 3 are entered as the beginning number and the increment respectively, then the starting screen display will be 7 10 13 16.

Scenario 3: Addition Table

After children have had substantial experience with the basic facts (using concrete materials in real-world settings), they are expected to master the facts to the point of instant recall. Games, puzzles, riddles and many other techniques can help children master the basic facts. Much of the available commercial courseware is designed to provide practice with the four basic operations. An alternative is to use the computer to generate an addition table as the students need it to check work or as a reference while they do a problem. The following procedures allow children to produce only the portion of the addition table they need at the moment.

```

TO ADD :N
SETTEXT
BLANKLINE 3
(PRINT [ADDITION TABLE FOR] :N)
BLANKLINE 1
ADDTABLE :N 0
END

TO ADDTABLE :N :C
IF (OR :N < 1 :N > 9 :C > 9) [STOP]
(PRINT :N "+" :C "=" :C + :N)
ADDTABLE :N :C + 1
END

```

Scenario 4: Multiplication Table

The same comments apply as for the addition table. The following analogous procedures could be used to generate the multiplication table for a designated multiplier.

```

TO MULTIPLY :N
SETTEXT
BLANKLINE 3
(PRINT [MULTIPLICATION
TABLE FOR] :N)
BLANKLINE 1
MULTABLE :N 0
END

TO MULTABLE :N :C
IF (OR :N < 1 :N > 9
:C > 9) [STOP]
(PRINT :N "X" :C "= :C*:"N)
MULTABLE :N :C + 1
END
    
```

Scenario 5: Numeric Exploration

Elementary school students need a variety of experiences to help them build a concept of the magnitude of one million. Most do not have a good feel for this. Estimating how big a container would be needed to store a million bottle caps, or how many pages of "Xs" would give a million "Xs" are examples of activities that might be done in the classroom. The last idea could be performed on the computer.

Another computer experience that might contribute to a child's appreciation of the magnitude of a

million could make use of these Logo procedures. Ask the children to guess how long it will take the computer to count to 1,000,000. Execute **MILLION**. Press a key after about 5 seconds and note the number displayed. This is how far the computer counted in the time allowed. Execute **MILLION** again for about 20 seconds before pressing a key. Observe how far the computer counted and ask the children if they want to adjust their original guess. Check a few of these guesses by timing the computer as you do other class work.

```

TO MILLION
MILLIONC 1
END







TO MILLIONC :ST
IF KEYP [PRINT :ST STOP]
MILLIONC :ST + 1
END
    
```

Scenario 6: 2-D Pattern Exploration

Logo is an excellent medium for exploring the properties of geometric figures. For example, children could complete the activity shown in Figure 1, working in pairs.

TURTLE SHAPES

Find numbers for the blanks in each Logo statement that will produce the figure. The square has been completed for you.

	REPEAT _____ [FD 55 RT _____]	Describe as many patterns as you can in the numbers you used.
	REPEAT <u>4</u> [FD 55 RT <u>90</u>]	
	REPEAT _____ [FD 55 RT _____]	
	REPEAT _____ [FD 55 RT _____]	
	REPEAT _____ [FD 55 RT _____]	
	REPEAT _____ [FD 55 RT _____]	

If you wanted to make a figure with 18 sides, what Logo statement could you use?

Figure 1. A Logo Activity to Observe Patterns in 2-D Figures

Scenario 7: Geometric Constructions



Children can also learn about the typical line constructions using Logo. In pairs, children can explore parallel lines, perpendicular lines, perpendicular bisectors, angle bisectors, obtuse angles, oblique parallel lines with a perpendicular

bisector, and many other possibilities. Children can work in immediate mode using only **PENUP**, **PENDOWN**, **FORWARD**, **BACK**, **RIGHT** and **LEFT** to position the turtle, and then use this **LINE** procedure to draw a line where :N is the length of line desired. Children with more Logo experience might try writing procedures for some of their constructions.

```
TO LINE :N
FD :N BK :N
END
```

Scenario 8: Flips

Logo is also an excellent medium for helping children understand the concept of a flip (reflection or mirror image). A study of flips should begin with the use of concrete devices such as the geoboard or mira. Once children understand what a flip does, Logo could be used to highlight one property of a flip.

Demonstrate for children **VFLINE** and **HFLINE**. These procedures simply draw a line, either vertically (**VFLINE**) or horizontally (**HFLINE**), through the centre of the screen. This line will be the *flip line*. Children should work in pairs and agree on either a horizontal or vertical flip line and execute the appropriate procedure. The first student will then create any kind of a design on one side of the line, recording on paper each Logo command in sequence, with the last two commands being **PENUP** and **HOME** to return the turtle to its starting position. The second student then uses the listing of commands on paper to create a flip image of the design. He or she may want to change the color to make the image more distinct from the object¹.

```
TO VFLINE
CS
FD 80 BK 160 FD 80
END

TO HFLINE
CS
RT 90 FD 120 BK 240 FD 120
LT 90
END
```

After each student has had at least one turn in each role, ask them to write a statement about how they created flip images. They should be able to observe that to create a flip image, all **RTs** become **LTs**, all **LTs** become **RTs**, and all inputs to **RT**, **LT**, **FD** and **BK** remain unchanged. Figures 2 and 3 provide a sample of possible inputs by students.

¹Students may need to be told, particularly when using **HFLINE**, that part of their design may not show. When the design is complete, they should hold down the **CONTROL** key and touch "L" and the full screen will be visible. **CONTROL-S** returns them to split screen.

Student 1

```
VFLINE
PU RT 90 FD 20 LT 90 PD
FD 55 RT 45
FD 50 RT 115
FD 77 RT 66
BK 22 LT 22
FD 66 RT 95
FD 60
PU HOME
```

Student 2

```
SETPC4
PU LT 90 FD 20 RT 90 PD
FD 55 LT 45
FD 50 LT 115
FD 77 LT 66
BK 22 RT 22
FD 66 LT 95
FD 60
PU HOME
```

Figure 2. Sets of Logo Commands to Produce an Object and its Flip Image

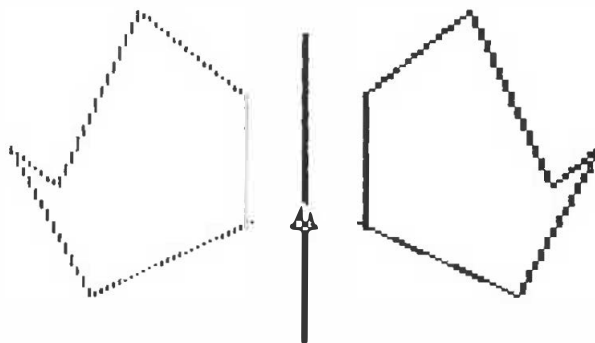


Figure 3. Object and Flip Image Produced by Commands in Figure 2

Conclusion

My purpose in writing this article is to point out that there are many classroom settings where computer activities could be created quickly and simply to enhance the mathematics lesson. I describe eight such settings, only a few of the many that are possible.

To make the most of these opportunities, teachers should be able to design simple procedures in Logo or some other language. With the exception of those used to generate the addition and multiplication tables, the procedures in this article require minimal programming expertise. Many settings do not require writing procedures at all, as children can explore many ideas and patterns in immediate mode. The computer is a tool that can enhance many mathematics lessons. Let's use it!

Bibliography

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