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COMPUTER ACTIVITIES FOR TEACHING MATHEMATICS

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In the last issue of *Teaching & Learning* (see Reference No. 3) suggestions were made about computer activities in the classroom. It was suggested that the available software for conducting activities in the classroom were tutorial programs, simulation programs, instructional games, drill and practice programs and the computer management instruction programs. All these software can be readily obtained. This article describes some modes of presenting mathematics lessons using a microcomputer which are rarely developed commercially. An attempt is made to include presentations covering mathematics from the primary level to the pre-university level.

Angles, Lengths and Estimation (Primary Maths)

The program described below illustrates the use of LOGO language advocated by Papert to use microcomputer as a tutee. Pupils are expected to write a simple program using some simple statements of LOGO language. The objectives of this program are:

(1) to enable pupils to write LOGO language using the following statements: FD, RT (Forward, Right Turn)

(2) to train pupils to acquire a sense of direction (left, right, forward or backward)

(3) to enable pupils to estimate the lengths of 50, 100, 120, 150 units on the monitor and

(4) to enable pupils to measure or estimate angles (or to acquire a sense of measuring angles).

To begin with, the teacher will have to prepare a few transparencies as shown on next page:

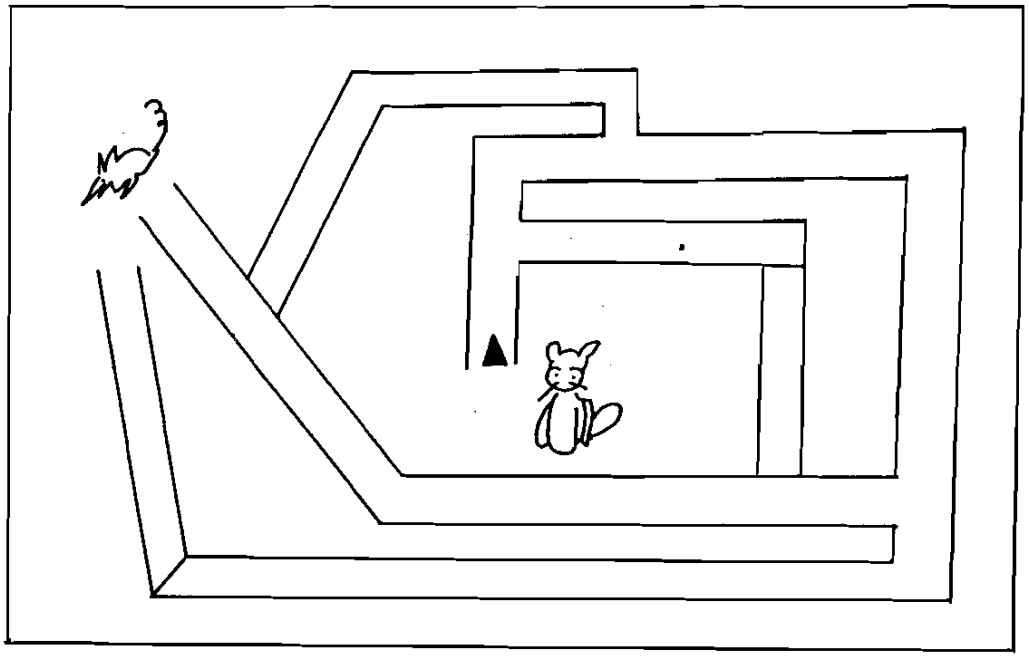

Figure 1: Transparency Master

This transparency shows an ordinary maze which requires the learner to trace the route the cat has to take to catch the mouse.

The teacher may have to start the program using the LOGO software. The turtle (▲) appears at the centre of the screen. Next, the transparency (with diagram drawn) is placed on the screen so that the 'start' position rests on the turtle (▲) of the screen. The pupil (learner) is required to write a simple program (using some simple statements) so that the cat can travel along the correct route in order to reach the mouse. In this program the pupil will need to reenter the statements if he finds that his route has proven to be a wrong choice. The following is the list of statements required to trace the correct route:

```
FD50
RT90
FD100
RT90
FD100
RT90
```

```
FD150
RT45
FD120
```

As stated in the objectives, the learner is required to have a correct sense of direction (left or right) and be able to estimate the angle of turning in the process of programming. He also needs to estimate the length of each segment of the route with respect to the dimensions of the screen. Hence this simple activity provides the learner with an opportunity to learn and master the concepts of angles, directions, and estimation of angles and lengths. Besides teaching these concepts, the LOGO language can also be used to teach other mathematical concepts such as shapes and pattern recognition.

Graphical and Numerical Solutions to Quadratic Equation (Secondary Maths)

A few methods which can be used to teach pupils how to solve quadratic equations are:

(a) using factorisation

(b) completing the square method

(c) using quadratic formula and

(d) estimating the roots by trial and error.

However, with the introduction of the microcomputer, a teacher is able to show the concept of quadratic equation and to obtain a more accurate estimation of the roots (where the roots are not integers).

The following computer program written in 'BASIC' language is used to compute the solutions of the quadratic equation $x(x-5)+3=0$

```
10 INPUT L,U,S
20 FOR X = L TO U STEP S
30 PRINT X, (X – 5) * X + 3
40 NEXT X
```

This program requires the teacher/learner to indicate the lower and upper bounds of the value of x and the interval between two values of x for finding the roots of the equation. (L = Lower bound, U = Upper bound and S = Interval). The following output is the result of the inputs of L = –5, U = 5 and S = 1:

```
? –5, 5, 1
  –5          53
  –4          39
  –3          27
  –2          17
  –1           9
   0           3
   1          –1
   2          –3
   3          –3
   4          –1
   5           3
```

An inspection of the two columns shows that the function changes from 3 to –1 and from –1 to 3 when the value of x varies from 0 to 1 and 4 to 5 respectively. The student can estimate the roots, i.e. between 0 and 1, and 4 and 5. However, a more accurate estimation of the roots is possible using a smaller interval and the lower and upper bounds closer to the estimated root. Using L = 0, U = 1 and S = 0.2, the printout yields the following result:

```
? 0, 1, 0.2
  0           3
  0.2         2.04
  0.4         1.16
  0.6         0.36
  0.8        –3.6
  1          –1
```

The figures above show that the function value changes from 0.36 to –3.6 indicating that one of the roots of the equation lies between 0.6 and 0.8. Hence this root is estimated to be 0.7.

This approach of finding the estimated root can be accompanied by showing the graph using a computer. Graphical software to show the graph intersecting 2 points on the x axis are available.

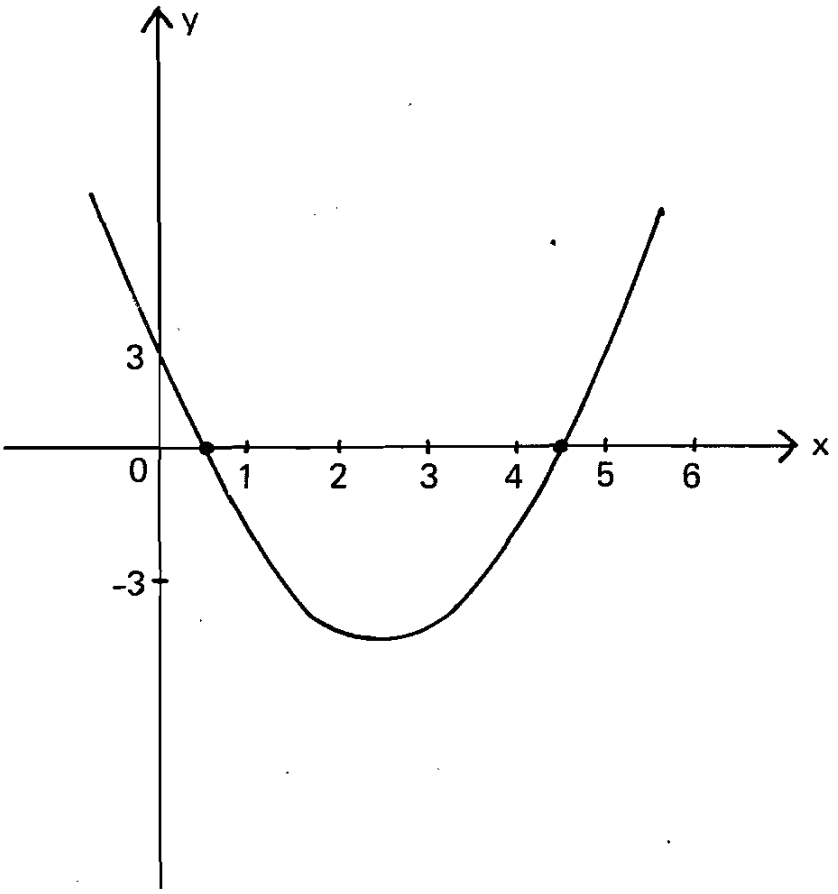

Figure 2: Graph of y = x(x – 5) + 3

Group Exploration on Exponential Function (Pre-U Maths)

A lesson on exponential function in the pre-university level can be taught more effectively if a few microcomputers and the relevant software are available in the class. This particular software (e.g. The Graphical Experiment available in CDIS) should be able to plot the exponential function when the specific values are required. Using this approach the students will be able to see how the graph behaves as the different parameters vary. The lesson should follow the sequence given below:

(1) Boot the system using the diskette supplied by the teacher.

(2) Select the item on exponential function.

(3) State the ranges of x and y axes (if necessary).

(4) Enter the graph of $y = 2^x$ (for the computer keyboard you enter $y = 2 \uparrow x$).

(5) Read from the graph, the answers to the following questions:

(a) What is the value of y for $x = 0$?

(b) Is there any value of x for $y = 0$?

(6) Enter the graph of $y = 3^x$ (i.e. $y = 3 \uparrow x$).

(7) Investigate the x and y intercepts.

(8) Sketch the 2 graphs on a graph paper.

(9) Now, without using the computer, sketch the graph of $y = 4^x$ (i.e. $y = 4 \uparrow x$)

(10) Discuss how the graph $y = k^x$ behaves. (Use the computer to investigate further.)

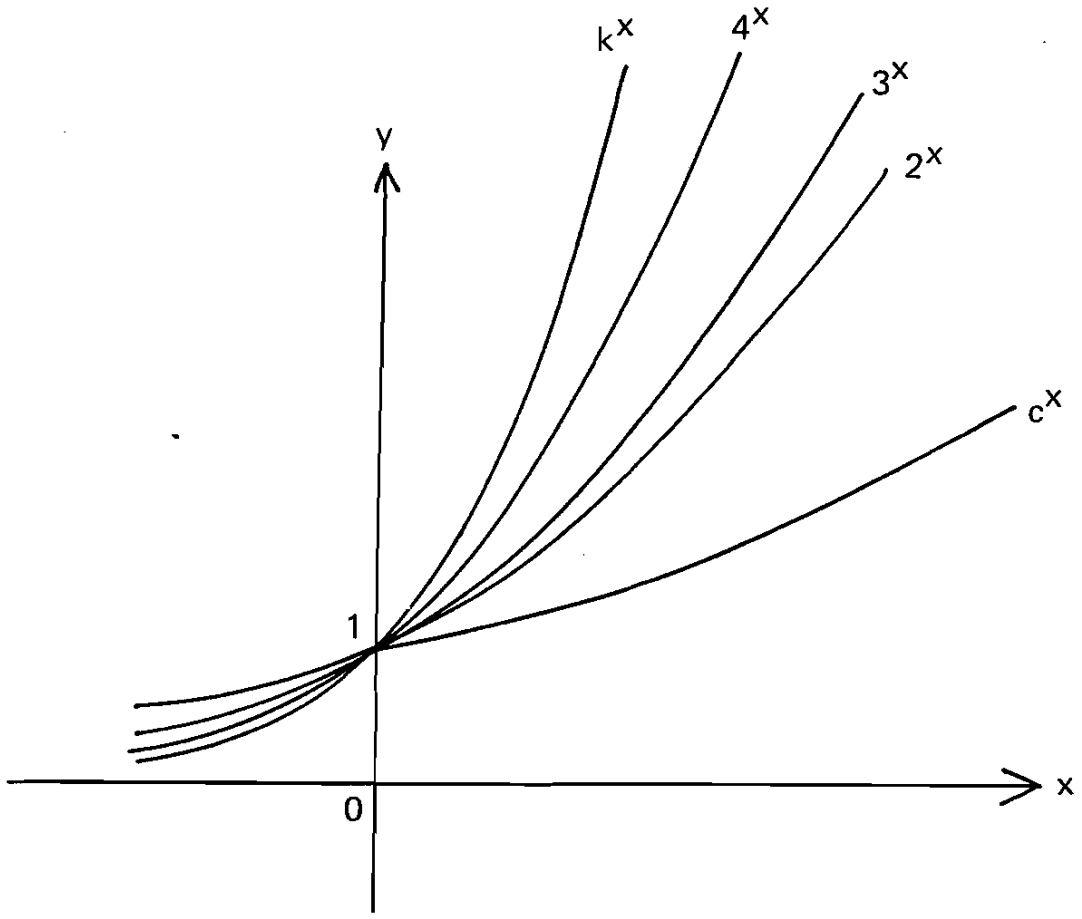

Figure 3: Graph of $y = k^x$

Usually, teachers will instruct their pupils on this topic using Ausubel's approach of receptive learning. However, this topic could be taught using the computer to show the behavioural concept of the exponential function. In this respect, the computer will have helped the teacher to perform certain tasks in a shorter period and more effectively.

The three examples selected above indicate the capability of using the microcomputer to present mathematics at three different levels (primary, secondary and pre-university). The styles of presentation are also not identical. The first example using LOGO is based on Papert's philosophy of using the computer as tutee. The learner became the tutor, and according to Papert, learners could enhance their concepts or skills through tutoring the computer by writing their own programs. Besides, an activity is incorporated in the teaching-learning process. During the activity, the learner must have the basic skills in order to achieve the full task.

In the second example, the microcomputer is used as an electronic blackboard showing the estimated roots of a quadratic equation. The main feature illustrated in this example is the capability of the computer in getting a more accurate estimated value. Another factor is that the computer also speeds up the computation and hence more examples can be illustrated in the class. This helps the pupils to conceptualise more efficiently through a variety of examples.

The third example shows that a microcomputer can be used in group activity for exploration of graphical concepts such as the exponential functions. This activity, if carried out without the use of computer, will be laborious and time consuming. However, concept learning can be speeded up by using the computer.

The above paragraphs show that a computer can be used to teach mathematics when it is used as a teaching aid. In these examples, the teacher is still the master of the classroom. He can still perform his task as a teacher and organise various activities in the classroom. However, with the help of the computer he can perform even better.

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