

WORKSHOP ON LOGO IN THE PROBLEM SOLVING TECHNIQUES

2nd to 13th July 1990

A REPORT



REGIONAL COLLEGE OF EDUCATION, MYSORE-570 006
(National Council of Educational Research & Training, New Delhi)

WORKSHOP ON LOGO IN THE PROBLEM SOLVING TECHNIQUES

Venue : Computer Resource Centre
Regional College of Education
Mysore 570 006

Date : 2nd July to 13th July 1990

Background to the Workshop:

The idea of conducting a workshop on Logo in the Regional College of Education, Mysore, was mainly due to the efforts of Dr.A.K.Sharma, Joint Director, NCERT. When Dr.Sharma was approached by Dr.S.N.Maheshwari, Head, Computer Science, I.I.T., Delhi with the idea of utilising the services of Dr.Purnima Banerji, who has a long experience of using Logo for teaching children in the USA and had agreed to come to India on her own for a short period in conducting a workshop on Logo, Dr.Sharma accepted the offer. He was keen that the workshop should be conducted at the Regional College of Education, Mysore, which has an active group in the area of computer education. Further, the Demonstration School attached to the RCE, Mysore would serve as a laboratory for testing some of the ideas that may be generated in the workshop, on young children. The RCE, Mysore agreed to conduct the workshop and the Computer Resource Centre then carefully planned a course based on the course outline sent by Dr.Purnima Banerji. The workshop was one of its first kind to be conducted in this country for practising teachers and teacher

educators who have been exposed to the use of microcomputers in school education. The workshop was planned to be conducted for eleven days and the BBC microcomputer systems, which are installed in CLASS schools (including the Demonstration School) and IBM compatible PCs were to be used for the practicals.

Introduction:

Before we proceed further, a brief discussion about Logo will be useful. Logo is a computer language and its name is derived from the Greek word for "word" or "thought" and was coined by Wallace Feurzeig. This language was developed by Wallace Feurzeig, Daniel Bobrow and Seymour Papert over a number of years and being specifically used for education. Logo is fundamentally a simplified form of LISP, the artificial intelligence language. It is very easy to use by children and it combines the basic concepts of geometry, language and numbers with musical sound and colourful displays to provide an exciting learning environment which children will find totally absorbing. The system will encourage the children to experiment, which simulates imaginative and logical thinking and in the process introduces young minds to the creative and practical process of writing computer programs. In addition to developing an awareness of geometrical shape and providing limitless scope for exciting designs, Logo will also introduce numerical concepts which help children to use numbers purposefully and with understanding. Another important educational feature of Logo is the facility to play with words, through which techniques for exploring language can be practised.

Because of the immense potential of Logo in the school curriculum, the participants of the workshop were selected mostly from schools. The selected teachers were all familiar with computers and have been using them in classroom teaching. A few teacher educators who have been using computers in education were also invited to participate in the workshop. Annexure I gives the list of the participants of this workshop.

Objectives of the Workshop:

The objectives of the workshop were : -

- i) To enable the participants to acquire knowledge about Logo.
- ii) To understand the philosophy of 'Turtle Graphics' in Logo.
- iii) To apply the knowledge of 'Turtle Graphics' in problem solving techniques.
- iv) To understand the philosophy of 'list processing', which is the basis of 'expert systems' in Artificial Intelligence.

With these objectives in mind a work schedule was prepared for the workshop (see Annexure II).

Philosophy of Logo and Turtle Graphics:

The workshop began with an introduction to Logo and the philosophy of Logo as enunciated by Seymour Papert in his book 'Mindstorms'. This book relies heavily on two fundamental ideas. The first is that it is possible to communicate with computers in a natural way, more like learning French by living in France than trying to learn it through unnatural process of foreign

language instructions in classrooms. Secondly, learning to communicate with a computer may change the way other learning takes place. The computer can be a mathematics-speaking and an alphabetic speaking entity. By making computers to communicate, children tend to learn mathematics as a living language. Mathematical communication and alphabetic communication are thereby both transformed from the alien and therefore, difficult things they are for most children into natural and easy ones.

The next topic to be introduced was the "turtle geometry". An important aspect of Logo is its "turtle graphics". The turtle is a triangular cursor which moves around the computer screen (VDU) to plot images. This is a friendly character at the heart of Logo's drawing facility. The turtle responds to four fundamental commands, viz., FD (forward), BK (back), LT (left turn) and RT (right turn). As it moves over the screen it leaves a trail behind it and these lines can be built up into patterns and pictures. It will take only a few minutes for young children to master these commands and soon they will be eager to experiment and start drawing ideas of their own. Here we wish to add that Indian school children who have been exposed to DART package (which is akin to Logo, but not its full implementation on the BBC micros) under the CLASS Project, have enjoyed using the turtle graphics of DART. In fact, even grown-ups like teachers who were trained under CLASS project interacted with the turtle graphics better than with other generic packages like Database management, Spread Sheet and Word Processor! The interesting aspect of turtle graphics is that the computer user learns by trial and error and sometimes

her/his mistakes are even more exciting than her/his original intentions. The great power of turtle graphics is that children can practise a routine either by drawing on paper using the same sets of commands or by walking around the room. In this way, they establish an immediate rapport between the behaviour of the screen turtle and events in the real world.

Problem Solving Skills with Logo:

The four fundamental rules for solving problems have been identified by George Polya. These are i) understanding the problem, ii) planning, iii) executing and iv) reviewing and modifying. Understanding the problem consists in reading what is given and what is to be solved, looking for key words and extra information. The next stage, namely, planning involves either drawing a table or graph, reducing the problem and a strategy to solve the problem. Executing is to solve the problem (which may include the running of a program on the computer). Analysis, use of another method or technique to solve the given problem, come under review and modification. When these ideas are translated into the world of turtle graphics we can devise the following strategies for problem solving, viz., i) look for a pattern, ii) representation of data using Table and variables, iii) Guess and test iv) logical decision, v) breaking the problem into smaller parts and vi) working backwards. The above mentioned strategies were developed in the workshop by citing numerous examples. For looking at a pattern, the Logo user can be asked to draw pictures of a square and a triangle using the turtle. Using REPEAT commands the programs are written as follows:

```
REPEAT 4 [ FD 40 RT 360/4 ]
```

```
REPEAT 3 [ FD 30 RT 360/3 ]
```

Here the user is not only exposed to REPEAT commands, but also to the pattern in the turtle turns (total angle divided by the number of sides). We can also do the above exercise by means of data representation and looking for a pattern as indicated below:

Table 1

Figure	No. of sides (N)	No. of REPEATS	Turtle Turns (360/N)	Pattern
Square	4	4	90	REPEAT 4 []
Triangle	3	3	120	REPEAT 3 []
Polygon	5	5	72	REPEAT 5 []
.....				
.....				

Table 2

No. of Squares	Pattern
1	REPEAT 4 []
2	REPEAT 2 [REPEAT 4 []]
...	
...	

By analysing the above tables, it is possible to predict and write the programs for complex n-sided polygons.

Guess and test is a way of writing complex programs from simple programs. In turtle graphics we call the programs as procedures. The participants were introduced to the concept of writing procedures, sub procedures and super procedures. Using a given procedure another procedure can be written. This concept of calling a procedure in another procedure is being extensively used in artificial intelligence. In the guess and test method the participants were asked to draw a circle, draw a petal, draw stars (5-pointed star, 6-pointed star) and different designs with square.

In the logical decision making, complex pictures like flags, etc. were to be produced on the monitor screen. When writing procedures for drawing these patterns one has to use 'data variables'. Variables can also be used to draw pictures of different sizes and shapes. For example, to draw curves of different shapes and lengths, the following procedure can be written and tried out on the computer.

```
TO CURVE :R :A :S
REPEAT :R [ RT :A FD :S ]
END
```

If we type different values in the CURVE procedure, then we get different types of curves.

Any given problem, say, drawing a complex picture in turtle graphics, can be broken into parts. Each part is then executed by writing a procedure. Finally, all the procedures are put together to form a super procedure. The participants were given tasks to try out these methods.

Recursion:

Logo is often referred to as a language in which users can discover powerful ideas on their own by experimenting in a Logo environment. Recursion is one such powerful idea. All the artificial intelligence languages use recursion. Since Logo was born out of an AI language, LISP, it also uses recursion. Recursion can simply be described as the ability of a procedure to call a copy of itself. However, this simple description disguises the power of recursion!

The participants of the workshop were introduced to the concepts of i) Tail-end recursion and ii) Embedded recursion. These recursions were illustrated by writing out a number of programs and analysing them. Conditional statements like, IF-THEN, TEST, IF TRUE and IF FALSE were required to be used to stop the recursions. Again, the use of variables in recursion was also illustrated by giving examples. Each group worked on a project (a design of their choice) by using recursions.

Words and Lists:

The objectives of introducing words and lists in the workshop were :

1. To understand list processing.
2. To understand data processing.
3. To be able to write interactive procedures, and
4. To be able to use random commands to generate random information in procedures and hence write random poetry.

Usually most people associate Logo with turtle graphics only! However, Words and Lists are also important attributes of Logo. A word is made of characters. For example, WHO or NOW or HELLO are words. Each character is an element of the word. The word HELLO contains six elements, viz. H E L L O. A word is usually delimited by spaces, which means that there is a space before the word and a space after the word. A word with no characters, denoted by a quotation mark followed by a space is called the empty word.

A List is made up of Logo objects, each of which is a word or another list. We indicate that something is a List by enclosing it in square brackets. For example, [Hello, How are you?] is an example of a List and this contains four elements viz., "Hello", "How", "are" and "you?". The List [] i.e. a list with no elements, is called the empty list.

Participants of the workshop were shown as how parts of Words and Lists can be combined or broken apart. A number of worksheets were provided and assignments were given on Words and Lists (see Annexure III). Using random commands how to generate random information in procedures were also demonstrated. The working groups produced random poetry too !

Conclusion:

Logo by itself cannot create an ideal educational environment. We want our students to write and debug programs to solve problems. We also want them to develop insights into top-down analysis, step wise refinement and program segmentation. Further, we would like our students to learn through discovery approach and learn problem solving strategies. Since Logo offers all of these it is a powerful tool. Needless to say that in order to implement Logo we need skilled, well trained and committed teachers. Since the participants of this workshop have been exposed to all the features of Logo in a rigorous manner, it is our belief that their expertise can be utilised to conduct Logo workshops for other teachers, teacher educators and children. Further, they can teach Logo to students in their own institutions, and possibly carry out research studies in this exciting field of computer education.

List of Participants

1. Dr.S.S.Raghavan
Reader in Computer Education
Regional College of Education
Mysore-6 **Academic Coordinator**
2. Dr.(Mrs) Purnima Banerji
7612, Woodlawn Avenue
Melrose Park
Pa 19226, U.S.A. **Resource Person**
3. Ms.Sukanya
Hindi Teacher
Nirmala High School
V.V.Mohalla
Mysore-2 **Participant**
4. Mr.D.Basavayya
Lecturer in Mathematics
Regional College of Education
Mysore-6 **Participant**
5. Ms.Sabita Prava Patnaik
Lecturer in Education
Regional College of Education
Mysore-6 **Participant**
6. Mr.Y.K.Gupta
Reader in Commerce
Regional College of Education
Mysore-6 **Participant**
7. Mr.H.L.Sateesh
TGT in Science
Demonstration School, RCE
Mysore-6 **Participant**
8. Mr.B.Jayarama Bhat
TGT in Mathematics
Demonstration School, RCE
Mysore-6 **Participant**
9. Mr.H.S.Subbanarasimha Sastry
TGT in Mathematics
Demonstration School, RCE
Mysore-6 **Participant**
10. Mrs.M.Sharada
Primary Teacher
Demonstration School, RCE
Mysore-6 **Participant**

(ii)

- | | | |
|-----|---|-------------|
| 11. | Mr.G.R.Prakash
TGT in Chemistry
Demonstration School, RCE
Mysore-6 | Participant |
| 12. | Miss. P.Devaki
Project Fellow
Regional College of Education
Mysore-6 | Participant |

Workshop on LOGO in Problem Solving Techniques

2nd July - 13th July 1990

SCHEDULE OF WORK

Date	Time	Programme
2.7.1990	10.00 a.m. - 1.00 p.m.	Philosophy of LOGO Introduction to LOGO Primitive Commands Lab. work
	2.00 p.m. - 5.00 p.m.	Lab. work (REPEAT and Writing Procedures and Sub-procedures)
3.7.1990	10.00 a.m. - 1.00 p.m.	Developing Problem-Solving skills by using LOGO (lecture) Computer Lab. (Testing the Programs)
	2.00 p.m. - 5.00 p.m.	Continuation of morning's lecture and Computer Lab.
4.7.1990	10.00 a.m. - 1.00 p.m.	Recursion (Tail end) - Lecture Computer Lab.
5.7.1990	10.00a.m. - 1.00 p.m.	Recursion (Tail-End and Embedded) Conditional Statement Use of Variable (lecture) Computer Lab.
	2.00 p.m. - 5.00 p.m.	Computer Lab (drawing designs with Recursions)
6.7.1990	10.00 a.m. - 1.00 p.m.	Words and Lists (lecture) Introduction Commands Computer Lab. (worksheet)
	2.00 p.m. - 3.30 p.m.	Computer Lab.
	3.30 p.m. - 5.00 p.m.	Lecture on A.I.

(ii)

Date	Time	Programme
7.7.1990	10.00 a.m. - 1.00 p.m.	Words and Lists Use of variables and examples (Lecture)
	2.00 p.m. - 5.00 p.m.	Computer Lab.
9.7.1990	10.00 a.m. - 1.00 p.m.	Words and Lists (Lecture) Property of Lists Assignment Computer Lab.
	2.00 p.m. - 5.00 p.m.	Computer Lab.
10.7.1990	10.00 a.m. - 1.00 p.m.	Random Poetry (lecture) Computer Lab.
	2.00 p.m. - 5.00 p.m.	Assignment - Generate your poetry Computer Lab.
11.7.1990	10.00 a.m. - 1.00 p.m.	How to design a course for teaching Logo (Lecture) and Computer Lab.
	2.00 p.m. - 5.00 p.m.	Computer Lab.
12.7.1990	10.00 a.m. - 1.00 p.m.	Project work by participants
	2.00 p.m. - 5.00 p.m.	Computer Lab.
13.7.1990	10.00 a.m. - 1.00 p.m.	Wrap Up Session
	2.00 p.m. - 5.00 p.m.	Computer Lab. Valediction

WORKSHEET 1

INPUT

PR "HELLO

PR "VACATION

PR WORD "ENJOY "ABLE

PR WORD "HAPPY "VACATION

PR (WORD "123 "456 "789

PR [HELLO]

PR [HELLO THERE]

PR [A]

PR SE "LOGO "TIME

PR SE [HELLO THERE] [BEN]

PR (SE "THIS [IS MY] [LOGO] "DISK)

PR SE "PAPER "BOOKS

PR (SE "APPLE "PEAR "PEACH)

PR "PIG - LATIN

PR "

PR []

PR SE [THE DOG] [LIKES [GREEN MICE]]

OUTPUT

WORKSHEET 2

Assignment:

INPUT

1. PR 6
2. PR "HAPPY
3. PR "HAPPY VACATION
4. PR WORD "HAPPY "VACATION
5. PR [231]
6. PR [I AM A TEACHER]
7. PR "
8. PR []
9. PR (WORD "VA "CA "TION)

OUTPUT

Assignment:

1. PR FIRST "LOGO
2. PR LAST "LOGO
3. PR FIRST [TURTLE GEOM]
4. PR LAST [TURTLE GEOM]
5. PR BF [TURTLE GEOM]
6. PR BL [TURTLE GEOM]
7. PR BF FIRST [LOGO]
8. PR FIRST BF [LOGO]
9. PR LAST BF [LOGO]
10. PR LAST BF "LOGO
11. PR BF BF BF "ONE

WORKSHEET 3

Assignment:

Use the Command to Print the following output.

INPUT	OUTPUT	COMMANDS
1. OUT TO LUNCH	OUT	
2. ALGEBRA	GEBRA	
3. ART	R	
4. ROCK AND ROLL	L	
5. THE END	HE	
6. [I HAVE A DOG]	D	
7. [I HAVE A DOG]	A	
8. [WHO ARE YOU?]	Y	
9. [WHO ARE YOU?]	O	
10. [WHO ARE YOU?]	WHO	
11. [WHO ARE YOU?]	YOU?	
12. [WHO ARE YOU?]	ARE	

WORKSHEET 4

Words & Lists

INPUT

OUTPUT

FIRST "ERIC

BF "ERIC

LAST "ERIC

BL "ERIC

FIRST [SUSAN ERIC LISE]

LAST [SUSAN ERIC LISE]

BF [SUSAN ERIC LISE]

BL [SUSAN ERIC LISE]

FIRST [{SUSAN ERIC} LISE]

BF [[SUSAN ERIC] LISE]

FIRST [SUSAN [ERIC LISE]]

BF [SUSAN [ERIC LISE]]

LAST [[SUSAN ERIC] LISE]

BL [[SUSAN ERIC] LISE]

FIRST [SUSAN [ERIC LISE]]

LAST [SUSAN [ERIC LISE]]

BL [SUSAN [ERIC LISE]]

FIRST [2 4 6]

BF [2 4 6]

WORD FIRST [CATS ARE FUN] "UP

(WORD BL "COME "PUT BF "HERS)

WORD LAST [I LOVE SUMMER] FIRST [TIME TO GO HOME]

WORKSHEET 5

Words & Lists

INPUT

OUTPUT

PR SE BL [COME TO THE SECRET MEETING] "HIDEOUT

PR SE BL [THE OLYMPICS ARE FUN] LAST [BASEBALL IS EXCITING]

PR BF BL [THE JOGGER RUNS]

PR FIRST BF [A STAR IS SHINING]

PR FIRST LAST [I HAVE A DOG]

PR LAST BL [I HAVE A DOG]

PREDICT THE OUTCOME FOR THE COMMANDS LISTED BELOW

[WHO ARE YOU?] "PICKLE

PR FIRST LAST

PR LAST FIRST

PR FIRST BL

PR LAST BF

PR BF BL

PR BF BF

PR BL BL BL

WORKSHEET 6

Assignment:

TO QUIZ

PR [WHERE DO YOU LIVE?]

MAKE "ANSWER1 REQUEST

IF : ANSWER 1 = [PHILA] PR [CORRECT] STOP

PR [NO, THAT'S NOT IT]

PR [WOULD YOU LIKE TO TRY AGAIN?]

MAKE "TRY REQUEST

IF : TRY = [NO] PR [THE ANSWER IS : PHILA] STOP

IF : TRY = [YES] QUIZ STOP

PR [I QUIT, YOU DID'NT ANSWER THE QUESTION]

END

WORKSHEET 7

Words & Lists

INPUT

OUTPUT

```
WORD "LO "GO
(WORD "PHILA "DEL "PHIA)
LIST [AMY MARY] [PEG]
LIST "LO [GO]
[I LOVE] [SCHOOL]
SE "LO "GO
SE [LO] [GO]
(SE "I "LOVE "LOGO)
(SE I LOVE LOGO )
FIRST "LOGO
FIRST [LOGO]
LAST "LOGO
LAST [LOGO]
FIRST BF "LOGO
FIRST BL "LOGO
FIRST BF [I LOVE LOGO]
FIRST BL [I LOVE LOGO]
BL FIRST [I LOVE LOGO]
" [ ]
FIRST BL BL [I LOVE LOGO]
BL BL FIRST [I LOVE LOGO]
'FPUT "LO "GO
FPUT "LO [GO]
LPUT "LO "GO
LPUT "LO [GO]
```

WORKSHEET 8

Words & Lists

Putting Words and Lists Together

OPERATION	INPUT 1	INPUT 2	OUTPUT
FPUT	"LOGO	"TIME	
FPUT	"TURTLE	[IS FUN]	
FPUT	[AND MORE]	[TO COME]	
LPUT	"LOGO	"TIME	
LPUT	"TURTLE	[IS FUN]	
LPUT	[AND MORE]	[TO COME]	
LIST	"LOGO	"TIME	
LIST	"TURTLE	[IS FUN]	
LIST	[AND MORE]	[TO COME]	
SE	"LOGO	"TIME	
SE	"TURTLE	[IS FUN]	
WORD	"LOGO	"TIME	
WORD	"TURTLE	[IS FUN]	
WORD	[AND MORE]	[TO COME]	

FPUT stands for first put

LPUT stands for last put