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Chapter- IV

PLANNING AND DEVELOPMENT

4.0 Introduction:

Planning is an important aspect of the research process. In the absence of careful planning research is reduced to chaos and the results will become irrelevant. Such a situation could be avoided by developing a suitable research design.

A research design is comparable to a blue-print. Before building a house or factory the needs are ascertained and a blue-print of the desired structure showing all the essential features is prepared. This is followed by the collection of materials. Then only one begins the construction. In the same way a researcher carefully prepared the research design before starting research. In this attempt he is guided by the nature and objectives of his research.

4.1 Title of the Study:

The title of the present study is "The effect of a Creative teaching model in mathematics on the achievement and the attitude of ninth class students."
The study consists of two parts:

1. The development of a creative teaching model in mathematics for ninth class.

2. The investigation of its effect on achievement and attitude of students.

4.2 Objectives of developing the CTM:

This programme was developed by the investigator to improve the achievement and attitude of school children in mathematics. This general aim leads to the following specific objectives.

1. To develop both thinking and feeling abilities of students.

2. To provide the teacher with strategies that are capable of attaining the cognitive and affective goals.

3. To develop a model of teaching that gives importance to the learner.

4. To develop a model that could be used without disturbing the regular classroom structure or teaching.

5. To develop a model that is inexpensive, and simple to use.

6. To develop a model which could be used by an ordinary teacher in an ordinary classroom.

Creative Teaching Model was developed to attain the above objectives.
4.3 **Planning of CTM:**

In the beginning the investigator studied the various teaching models explained in the writings of Joyce and Weil (1972) and Sharma (1988). All the available teaching models can be classified into five groups. They are:

1. Historical Models of Teaching
2. Philosophical Models of Teaching
3. Psychological Models of Teaching
4. Models of teaching for Teacher Education
5. Modern Models of Teaching.

Most of the above mentioned models laid emphasis on one aspect or the other of teaching learning process.

The Historical models have some the features of the Basic teaching model of Glaser. They laid emphasis on Speaking, Writing and reasoning. The feedback and evaluation procedures are not satisfactory.

The philosophical models are lacking in making provision for the learner's innovation, and development of his attitudes.

The psychological models explain the teaching and learning conditions. Still they lack one important aspect or the other. Some models do not deal with objectives or assessment.
Among the modern models of teaching the cognitive affective behaviour model developed by F.E. Williams was found suitable for the purpose of developing C.T.M. In our educational system the curriculum, syllabus, text books and examinations are designed by the respective state departments of education. The teacher cannot make radical changes in them. But he can supplement them with appropriate instructional materials and activities.

The creative Teaching Model was developed on the basis of Williams' Model. The content was that of ninth class mathematics. It was meant for students of Andhra Pradesh.

4.4 Content of C.T.M.

The investigator prepared 30 ideas relating to ninth class mathematics. The following topics were chosen:

1. Sets
2. Relations and Functions
3. Simultaneous Equations
4. Matrices
5. Inequations
6. Statistics
7. Permutations and Combinations
8. Binomial Theorem
4.5 **Pupil Behaviours:**

The following cognitive, affective pupil behaviours are expected to be developed through C T M:

**Cognitive:**
1. Elaborative thinking (To add on to ...)
2. Fluent thinking (To think of the most...)
3. Flexible thinking (To take different approaches...)
4. Original thinking (To think in novel or unique ways...)

**Affective:**
5. Imagination (To have the power to ...)
6. Complexity (To be challenged to ...)
7. Curiosity (To be willing to ...)
8. Risk taking (To have courage to ...)

4.6 **Teacher Behaviours:**

To teach for thinking and feeling appropriate teacher behaviours are needed. Williams described them as strategies or modes of teaching. The Williams' Model had 18 modes of teaching of them the following nine modes or
Strategies were selected:
1. Skills of search (historical, descriptive, experimental)
2. Evaluate situations (deciding upon possibilities, checking, verifying).
3. Analogies (Situations of likeness, Comparing)
4. Attributes (Inherent properties)
5. Organised random search (An example from which new approaches occur at random)
6. Visualisation Skill (express ideas in visual forms)
7. Provocative Questions (Incite knowledge exploration)
8. Discrepancies (Missing links in information)
9. Examples of change (opportunities for alteration)

4.7 The Format of C T M:

The programme consists of 30 ideas. Each idea is classified to indicate a thinking process (cognitive) with a feeling process (affective). Certain teaching strategies are listed for developing the pupil behaviour through content (subject matter). The following example makes the description clearer:

Idea No. 9:
To encourage : Flexible Thinking and Imagination
Through : Simultaneous equations
Using : Provocative Questions
Attributes

The goal of this idea is to develop Flexible Thinking and Imagination in pupils. Each child is provided with a graph
paper, and a pair of transperancies each having a black line on them. The pupils are asked to arrange the lines such that they intersected at a point.

What are the equations of two lines?
Where do they intersect?

The strategy used by the teacher either produces the affective behaviour which brings forth the cognitive behaviour or first produces the cognitive behaviour which brings out the affective behaviour. According to Williams they go together.

4.8 Time Period:

Next question to be answered is 'how long the pupils need the programme so that the effect of the programme could be measured.

There was no general agreement among the authorities regarding the minimum period. Guilford thinks that a period of one month is enough for pupils of all levels. Torrence claims that a period of two months is needed.

After taking into consideration various factors like student readiness, syllabus, class size and content base a period of thirty weeks was selected.
Table 4.1
Cognitive Behaviour

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Fluent Thinking</th>
<th>Flexible thinking</th>
<th>Original Thinking</th>
<th>Elaborative Thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>C</td>
<td>G</td>
<td>S</td>
</tr>
<tr>
<td>Skill of Search</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate Situations</td>
<td></td>
<td>8,22</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Analogies</td>
<td>2,13</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Attributes</td>
<td>6,11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organised Random Search</td>
<td>2,11</td>
<td></td>
<td>8,12,15</td>
<td></td>
</tr>
<tr>
<td>Visualisation Skill</td>
<td></td>
<td>3</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>Provocative Questions</td>
<td>4,6,11,21</td>
<td>5,9</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Discrepancies</td>
<td>4,6,13</td>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Examples of Changes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 4.2

#### Affective Behaviour

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Risk Taking</th>
<th>Complexity</th>
<th>Curiosity</th>
<th>Imagination</th>
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</thead>
<tbody>
<tr>
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<td>A C G S</td>
<td>A C G S</td>
<td>A C G S</td>
<td>A C G S</td>
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<tr>
<td>Skills of Search</td>
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<td></td>
<td>24</td>
<td>20</td>
<td>4, 12</td>
<td>27</td>
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<tr>
<td>Evaluate Situations</td>
<td>8</td>
<td>18, 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analogies</td>
<td>13</td>
<td>2</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>Attributes</td>
<td></td>
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<tr>
<td></td>
<td>3, 5</td>
<td>17</td>
<td>6</td>
<td>9, 11</td>
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<tr>
<td>Organised random search</td>
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<td>8</td>
<td>2, 14, 16</td>
<td>19</td>
<td>12</td>
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<td>22</td>
<td>17</td>
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<td>Visualisation Skill</td>
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<td>3, 24</td>
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<td>27, 28</td>
<td>7</td>
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<td>29, 30</td>
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<td>Provocative Questions</td>
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<td>5</td>
<td>16</td>
<td>4, 6</td>
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<tr>
<td>Discrepancies</td>
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<td>19</td>
<td>4, 6</td>
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<tr>
<td>Examples of Change</td>
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<td></td>
<td>10</td>
<td>18</td>
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</tbody>
</table>
4.9 **Blue Print:**

A blue - print of the programme showing the cognitive and affective behaviours through content, using various strategies was prepared. In the two tables the numbers in the cell refer to ideas in CTM. The topics are Algebra (A), Coordinate Geometry (C), Geometry (G) and Statistics (S).

4.10 **Programme Content:**

The content of the creative teaching model is described in greater detail. Each idea and its characteristics are explained.

**Idea No. 1:**

This idea deals with set and an element of a set. Set is an undefined term. To know a set its elements must be specified. It could be done by listing the elements of the sets. One can write a set if he knows all its elements or if he knows the rule which specifies the element. When pupils are asked to name great rivers of the country they have to make a choice. Some call a river great if it is long. Others take the duration of flow of water into consideration. Rivers like Krishna and Tapati dry up during summer, while Ganga flows throughout the year. This makes them choose or frame a rule.
Idea No. 2:

The idea of a set is further strengthened and expanded. Just like an empty box it is possible to have an empty set. Whenever players are needed for class team they are drawn from the members of the class. The universal set is just like the class. From it one gets the needed elements. It is not possible for two rival teams A and B to have a common member which is denoted by $A \cap B = \emptyset$. It is also possible to construct a new set taking the elements from both the sets. This is the union of A and B.

Idea No. 3:

Comparison of two sets is taken in this idea. Two sets could be equivalent. Here the teacher is dealing with finite sets. If the number of elements in two sets are equal than the two sets are called equivalent sets. If a family had four members they need four chairs for sitting. The set of chairs and set of family members have the same number of elements. This idea enables the pupils to know what equivalent sets are. Next pupils are encouraged to extend this idea to infinite sets. This leads to one-one correspondence.

Idea No. 4:

Here the idea of a subset is explained. The teacher employed provocative questions and skills of search. The pupils experiment with dolls and come up with various subsets.
The child faces the challenge of ideas like, 'Can a set be a subset of itself.' This in turn produces fluent thinking 'Is it possible for an empty set to be a subset of itself.' or 'Could $\emptyset$ be a subset of any set?'

**Idea No. 5:**

This lesson explains the idea of an ordered pair.

In a set the order of elements is not important. \{a, b\}, \{b, a\} are same sets. The students were asked to form chess teams out of two eighth class students Ramu, Venu and three ninth class students Gopal, Raghu, Krishna.

The students come up with answers like Ramu, Gopal, Raghu, Venu etc. Through a similar procedure the student forms such pairs of numbers like \{1, 5\}, \{5,1\}, \{2,7\} etc.

Now he sees that (1,5), (5,1) though have the same elements show that 1 was chosen first and 5 was chosen later while in the second case the order was reversed. To indicate this additional property they need a different symbol. Hence (1,5) and (5,1).

The set of all such ordered parts (a,b) where a \in A and b \in B is called the cartesian product $A \times B$. Finally (1,5) $\neq$ (5,1).
Idea No. 6:

The goal of this lesson is to develop the concept of relation. When the teacher asks the students to give out the names of states and their capital cities they will readily come out with a list like Tamil nadu - Madras, Andhra Pradesh - Hyderabad, Maharashtra - Bombay. Can they write it differently. They toy with this idea and come up with their newly acquired idea of an ordered pair (Tamil nadu, Madras) etc. Next the teacher provides a set of ordered pairs (Dasaratha, Rama), (Humayun, Akbar), (Arjun, Abhimanyu). They readily see the first member is the father of second member. It is a father - son relation. Next they try with number pairs (1,3), (2,4), (3,5), (4, -) What could one write in the blank? They come to the conclusion that two sets are needed for writing a relation.

Idea No. 7:

In this lesson the idea of a function is developed. Pupils draw the graph of this function. The strategies used by the teacher are visualisation skill and evaluate situations. From the function machine they are getting such pairs as (1,0), (2,1), (3,2) etc. What is happening to the number they have
They could see that the numbers are reduced by 1. That is the rule. The students mark these points on a graph paper. They get the graph of a function. Can they do it the other way? Is it possible to write a function from its graph?

Idea No. 8:

In this idea students explore the properties of a linear graph. The black line on a transperancy allows the students to manipulate with the line. With only one point they could place the line in several ways. The strategies used by the teacher are organised random search and evaluate situations. Students choose different points and get different lines. Suppose they choose the points (2,3), (2,7) what will be the position of the line? Students guess. Some may be wrong. Through risk taking they become flexible in their thinking. While looking at the different lines they get the idea of a slope.

Idea No. 9:

In this lesson students learn about simultaneous equations and their solution. The transperancies allow the students to manipulate the lines. They could place them in different positions. They recall that each line represents an equation. The teacher uses provocative questions which make the pupils think in various ways. When they arrange the lines sometimes they intersect at other times they do not.
They could find out the Coordinates of point of intersection. They will finally arrive at the conclusion. Both the equations are satisfied by this ordered pair.

Flexible thinking and Imagination are the pupil behaviours. They give out a number of relevant responses to the provocative questions posed by the teacher.

Idea No. 10:

In this lesson the properties of simultaneous equations are further explored. Here the equations of two non-intersecting lines are considered. The elaborative thinking behaviour is developed through provocative questions. They will become inquisitive and wonder about the various possibilities. The pupils arrive at the conclusion after a number of attempts that the two equations differ by a constant. Also when two lines are parallel they have the same slope.

Idea No. 11:

This lesson is concerned with the idea of a matrix and the different types of matrices. Here the pupils are provided with a number of activities. They prepare a table of the costs of different brands of tea. They may repeat the activity for coffee or say coconut oil. In the same way they prepare a table of marks. The strategies of teaching used are 1. attributes, 2. provocative questions and 3. Organised random search.
Students learn the various uses of matrices. They could be used for recording information, for coding a message, or for indicating route.

Students understand that names are given to matrices depending on the purpose for which they are used. When a matrix is used for recording information it is called information matrix.

Idea No. 12:

Properties of matrices are further explored. It could be used for representing a pair of equations. The teacher uses skills of search and organised random search for producing flexible thinking and curiosity. They explore different ways of writing the information contained in the equations. Through careful questioning their responses can be improved. In the end the teacher gives a matrix form like $\begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix} \begin{pmatrix} p \\ q \end{pmatrix} = \begin{pmatrix} q \\ 12 \end{pmatrix}$ the pupils write the equations in the standard form.

Idea No. 13:

In this lesson addition of matrices was taken up. Risk taking and fluent thinking are the pupil behaviours. The teacher uses analogies and discrepancies to guide the pupil behaviour.
When two numbers are given say 5, 9 the pupils perform various operations with them. They can add to get 14, subtract to get 4 or even -4. Next they try to add matrices say
\[
\begin{pmatrix}
3 & 4 \\
5 & 6
\end{pmatrix} + \begin{pmatrix}
4 & 5 \\
2 & 9
\end{pmatrix}
\]

The most natural thing they do is adding the corresponding elements. Then the teacher uses the discrepancy.

Can the pupil add
\[
\begin{pmatrix}
1 & 2 \\
3 & 4
\end{pmatrix} \quad \text{and} \quad \begin{pmatrix}
5 & 4 & 6 \\
7 & 8 & 9 \\
3 & 4 & 2
\end{pmatrix}
\]

**Idea No. 14:**

This lesson encourages flexible thinking and complexity in pupil behaviour. Matrix multiplication is developed in this lesson. Teaching strategies are attributes and organised random search. Pupils are well aware of the fact that to get the cost of anything they have to multiply the price by quantity. Students start with two information matrices. When the titles are removed the quantity matrix and the price matrix look like this
\[
\begin{pmatrix}
2 & 3 \\
4 & 5
\end{pmatrix} \quad \text{and} \quad \begin{pmatrix}
3.00 & 2.50 \\
2.00 & 3.00
\end{pmatrix}
\]
The students write the cost matrix:
\[
\begin{pmatrix}
2 \times 3 + 3 \times 2 & 2 \times 2.50 + 3 \times 3 \\
4 \times 3 + 5 \times 2 & 4 \times 2.50 + 5 \times 3
\end{pmatrix}
\]
Inner product is formed by multiplying the row of the first matrix by the column of the second matrix.
Idea No. 15:

Here the students learn that an inequation represents a half-plane. The line divides the plane into three mutually disjoint subsets. If \( P \) is the set of points in the plane and the line is \( l \) then \( H_1, H_2 \) represent the two half planes. \( l \cap H_1 = \emptyset, H_1 \cap H_2 = \emptyset, l \cap H_2 = \emptyset \). These are the three mutually disjoint subsets of \( P \). Hence \( P \) can be written as \( P = H_1 \cup l \cup H_2 \). When pupils substitute the ordered pairs \((0, 0), (1, 1), (3, 2)\) in the expression they find \( 2x + 3y < 6, 2x + 3y < 6 \) and \( 2x + 3y > 6 \). This shows that points \((0, 0), (1, 1)\) lie on the same side of the line or in other words in the same half-plane. \((3,2)\) lies in the other half plane.

Teacher uses organised random search and visualisation skill.

Idea No. 16:

Inequations are further explored. Pupils develop elaborative thinking and complexity in this lesson. Teacher uses provocative questions and organised random search to get the desired pupil responses. Given the slope of a line and a point on it students can find the equation to the line using the standard formula \( y - y_1 = m(x - x_1) \). Then they mark the line on the graph and shade the half plane containing the origin.

The equation to the line is
\[
y - 4 = 3(x - 3) \text{ or } y - 3x + 5 = 0
\]
The equation to the half-plane must be an inequation. They have to choose from
\[ y - 3x + 5 > 0 \quad \text{and} \quad y - 3x + 5 < 0 \]

Idea No. 17:

This lesson explores the idea of finding optimum values of a given function. Some times we desire the function should be maximum and some times we want it to be minimum. In the case of cost one wants the minimum. When it is profit the tendency is to get the maximum. Teaching strategies used are analogies, provocative questions and organised Random Search.

A quadrilateral has four sides. The coordinate axes form two sides. Two more lines are needed to complete the quadrilateral. After drawing the quadrilateral they mark the four vertices. They take various points in the region and calculate the value of the function \( f(x,y) = 2x + 3y \).

Some of them may guess that \( f \) will be maximum at the vertex opposite origin.

Idea No. 18:

Here inequations are used in a practical situation. Such situations are quite common in our daily lives. The money in a person's pocket is limited. He had to buy different things with it. There are several alternatives for the buyer.
In the problem under consideration the total money is Rs. 15. The pen costs Rs. 5 and the ball pen costs Rs. 2. In addition to the restriction of money there is another restriction. He cannot buy more than six articles.

Mathematically the problem is find $x, y$ such that $x + y \leq 6, \quad 5x + 2y \leq 15$ where $x, y$ stand for number of pens and number of ball pens. It must be remembered that $x$ and $y$ cannot be fractions.

Teaching strategies used are examples of change, organised random search and evaluate situations.

Idea No. 19:

This lesson introduces the statistical measure, Arithmetic mean. It is usually called average. Here the teacher wishes to teach the deviation-method of finding Arithmetic Mean.

Teacher uses the strategies organised random search and discrepancies. The pupils make a guess of the average for the data:

$$40, 45, 50, 52, 52, 60, 70$$

Some of the answers are like $40, 62, 58, 52$

They argue and reject some. Tentatively they agree upon 52. The usual method of finding the average gives it as 53.
Now starting with the crude value 52 using deviations one can get the exact value 53. This is true even when one begins the search with 58 or 62.

Idea No. 20:

This is also a lesson in Statistics. In this lesson standard deviation is calculated. Standard deviation provides a measure of variability of items in a group from its arithmetic mean. It is one of the most widely used measures of dispersion.

The teacher uses analogies and skills of search. Pupils develop elaborative thinking and complexity. When asked to find the average or Arithmetic Mean of 40, 45, 50, 52, 52, 60, 72 they follow different methods and find it as 53.

Next they find the deviations from 53.

-13, -8, -3, -1, -1, 7, 19.

Their sum is zero and hence could not be taken as a measure of dispersion.

Then they square and add, find its average. They get 50.5. Since we have squared the deviations it is reasonable to find its square root. Hence it is called root mean square deviation. The popular name is standard deviation.
Idea No. 21:

In this lesson permutations are studied. Permutation is an arrangement of certain number of objects. The order is taken into consideration. There are three pens of three colours. Let the colours be Red, Blue and Green. In how many ways can one give two pens to two persons?

Symbolically it can be shown as

RB, RG, BG, BR, GR, GB.

Each arrangement is a permutation. There are six permutations. If necessary the students can enact this situation. Through provocative questions teacher could motivate them into Fluent Thinking.

The factorial notation is introduced with the help of continued products like 3.2.1, 4.3.2.1 etc. Pupils explore various ways of indicating the product.

Idea No. 22:

In this lesson Meru Prastar is used to develop the expansion of a Binomial. The teacher uses organised random search starting with \((a+b)^2\), \((a+b)^3\), etc. Students readily give out answers as they were familiar with. The teacher asks them to write only the coefficients.

\[
\begin{array}{c}
1 \\
1 1 \\
1 2 1 \\
1 3 3 1 \\
\end{array}
\]
What should be the coefficient in the expansion of \((a + b)^4\). It should begin with 1 and end with 1. What could be the others? Pupils try to fill up the gaps. They exhibit complexity and flexible thinking.

**Idea No. 23:**

This lesson explains the order relation with the help of a number line. Teacher uses organised random search and examples of change. This leads to elaborate thinking through imagination.

It is easy to compare natural numbers. Hence the teacher starts with natural number and extends the idea to other numbers

\[
\begin{align*}
1, & \ 3 \\
3, & \ 4 \\
-2, & \ 0 \\
-3, & \ -2
\end{align*}
\]

The pupils are quite sure of the two cases and say 3 is greater than 1 and 4 is greater than 3. The last two cases present certain difficulties. Students make a guess and refer to the number line for check.

**Idea No. 24:**

This idea deals with the addition and multiplication properties of order relation. The strategies used are skills of search and visualisation skill. Students must be able to
visualise the positions of the numbers on a number line. For example they take 36, 24. What is the relation between these two?

\[ 36 > 24 \]

Suppose we add 10 to both sides. Then the numbers will be

\[ 46 □ 34 \]

Pupils fill the gap with \[ > \] and say that the inequality still holds.

The case of multiplication presents two cases

\[ 5 > 3 \]

If it is multiplied by 2 we get

\[ 10 > 6 \]

Suppose the inequality is multiplied by -2

\[ -10 □ -6 \]

Pupils see that the direction of inequality changes. They state this result in words.

**Idea No. 25:**

This lesson teaches logarithm with the help of theory of indices. Teacher uses the strategies of analogies and skills of search to produce flexible thinking through curiosity. The search begins with small numbers like 16, 81, 100 etc. which could be expressed as powers of 2, 3, 10.

\[ 16 = 2^4, \quad 81 = 3^4, \quad 100 = 10^2 \]
The pupils search for different ways of stating the above facts. The logarithmic form is then taught.

Students explore the possibility of using 1 as a base. They face contradiction.

**Idea No. 26:**

This lesson is intended to develop flexible thinking and Imagination through Geometry. Modes of teaching are attributes, skills of search and visualisation.

Pupils place the lines in different positions and observe the result. At how many points can they intersect. Their number could be 0, 1, 2 and 3.

The case where the lines intersected at two points was specially studied.

$$\begin{array}{c}
\text{m} \\
\hline
\text{n} \\
\text{p} \\
\text{q}
\end{array}$$

Measurement shows $m = n$ and $p \neq q$. In the first case the lines are parallel. Students state the result as a theorem.

**Idea No. 27:**

This lesson introduces orthocenter as a point of concurrency of altitudes. Pupils are engaged in paper folding activity. The teacher uses skills of search to produce Flexible Thinking. The triangles are cut from lac paper such that
the crease shows. The paper triangle is folded along the line passing through vertex such that the two parts of the opposite side overlap.

The students not only search for a suitable folding but also imagine that these lines could meet at a point. They write the statement of their finding in an acceptable form.

Idea No. 28:

This idea teaches the concurrency property related to the triangles. The perpendicular bisectors of the sides of a triangle are concurrent. This property can be easily seen through the paper folding activity. The given triangle is folded along the middle point of a side such that the two portions of the side overlap. The process is repeated for the other sides.

After the second fold some of the pupils venture the response "These three are likely to meet." They state the fact as a proposition. The teacher used visualisation to get flexible thinking.

Idea No. 29:

This lesson gives another property of the triangle. The medians of a triangle are concurrent. This lesson attempts develop flexible thinking through curiosity.
The teacher strategies are visualisation and skills of search. The teacher encourages the pupils to fold the triangle such that they get the median. The pupils have to recall the meaning of median. They will think of various alternatives and will arrive at the correct method. They will write the property in the form of a statement.

Idea No. 30:

In this lesson pupils study another concurrency property. The angle bisectors of a triangle are concurrent. Pupils recall the meaning of an angle bisector.

This lesson also had the paper folding activity. They have to fold the triangle in a particular way.

The teacher uses the strategy of visualisation so that pupils after several responses identify the correct method. At the end of the activity pupils state the result.

A programme however carefully planned needs improvement. When it is put into practice it may not go as expected. For this reason a pilot tryout is made.

4.11 Pilot Tryout:

A pilot tryout of the proposed teaching model is necessary. Johnson (1980) found this important step is missing in many research studies. Travers (1969) while discussing the
rationale of a pilot study stated "Brief trial runs demonstrate whether it is practical to undertake the research, whether the available techniques are sufficiently sensitive to measure differences that it is desired to measure, and whether one can obtain the necessary cooperation of others involved in the study."

In this investigation the pilot tryout of the programme was undertaken to remove ambiguities, to enhance clarity and to study students' reaction.

Five copies of the programme were prepared and Five experienced Teachers including the investigator tried the Model with a small group of 5 or 6 children. At the end of each lesson the teachers recorded the reactions of the students and also their own opinions. The entire procedure took 15 weeks. The five teachers met once in a fortnight and exchanged notes.

The investigator made changes in the programmes and again taught it to a group of 10 students. The groups were kept small so that the teacher can observe and note the student responses. With a big group of 50 students it becomes difficult to get direct feedback.

It was again revised. The final form of the CTM is included in the appendix. The number of ideas and their content remained the same. Modifications are made regarding
sequencing of ideas, and strategies employed, some intermediate questions are added to certain ideas.

4.12 Observations of the tryout:

Responses of the teachers who made the initial tryout and the reactions of the children provided important feedback to the investigator. It greatly facilitated the improvement of the creative teaching model. Also it provided guidance to the teacher in implementing the model.

The teachers who tried the model have expressed satisfaction of varying degrees. All of them agreed that the model could be used in an ordinary classroom without any inconvenience. They also expressed the opinion that low achievers displayed interest in their lessons and showed some improvement in learning mathematics. They also brought to the notice of the investigator the problems they encountered while teaching ideas Nos. 1, 3, 5, 10, 15, 23. After a discussion with these teachers the investigator made suitable modifications in them.

The investigator found that the ideas could be taught to any type of student (low, average or brilliant) without much difficulty. The students displayed enthusiasm and carried the activities easily. At times the teacher has
to supply information or ask intermediate questions, give additional examples to help the students. For example when instructed to fold a triangle along a median some students were confused. They could not recall what a median is. To aid their memory one median is drawn on the triangle given to them and they are asked to fold along it. On the whole the investigator found the CTM could be implemented effectively.

4.13 **Summary:**

This chapter contains the description of the CTM, the stages of its development, the pilot tryout, and the reactions of the teachers and students who participated in the try out. Out of these efforts the final form of CTM had evolved. Its English version is in the Appendix.