CHAPTER NO V

CONDUCT OF THE EXPERIMENT AND RESULTS
Conduct of Experiment and Result:

This chapter includes the following points -

5.1. Conduct of the experiment

5.2. Results

5.1 Conduct of the Experiment:

In this section the procedure of conducting the field trials have been discussed as they were followed in Urban, Rural and Adivasi areas. The procedure aimed at realizing internal as well as external validity of the experiment.

Randomization is the key to generalization. The randomized group factorial design $3 \times 3$ was used to ensure the generalizability, i.e., external validity, of the experiment as discussed earlier. The variables which were controlled are the previous knowledge and age group of the students. The variable of previous knowledge was controlled by administering pre-test and selecting the students on the basis of their achievements as referred to in chapter IV (page ). The variable of age group was controlled by selecting the children of the ages 11 to 12 years. All other intervening variables were controlled by using random sampling procedure.

The problem of internal validity has also been discussed earlier in chapter III (page no. 87). In this
respect the problem is to establish a good standardized and uniform working procedure for the administration of the programmes and the post-test. Thus criterion of functional equivalence as discussed in chapter II (page no 25) is satisfied.

This procedure also helps to produce comparable data in the form of raw scores with regard to the different groups, thus establishing the criteria of metric equivalence as discussed in chapter III.

Thus every attempt is made to adopt a standardized procedure for sampling and conducting field trials.

Hence this section contains the following points:

A) Sampling procedure which explains how samples were formed by using random sampling methods.

B) Administrative procedure which explains how programmes and the post-test were administered to the samples.

5.1.1. Samples and sampling procedure:

The population was defined as children of the age group of 11 to 12 years.

Areas in Maharashtra state were selected as typically representative of population of different areas. Schools in Pune city were selected as typical representatives of population in urban areas. Pune city
with population over a million, is an industrial center and educationally developed with progressive universities and all types of schools and colleges. Student population in this area reflects all strata of the society social, cultural, economics etc.

Schools in the villages from Saswad area near Pune city were selected as typical representatives of rural areas. Villages with the population of 5,000 people having an agricultural bias were selected. Student population in this area reflects the strata of the society which is different from that of urban area as discussed in chapter II & III (page no. )

Schools in Thane district represented the population of Adivasi area where people do not have stable profession. The student population reflects the living style of the people in this area.

5.1.1.1. Adivasi Sample:

The field trial started by conducting the experiments in Adivasi area.

To represent Adivasi population, schools at Kosbad from Thane district were selected. There are many Ashram schools in this area. They are specially meant for adivasi children. From among them following schools were selected.
1) Vikas wadi Bal Shikshan Kendra, Primary School, Kosbad.

2) Ashram School, Kosbad.

Kosbad is situated in the hilly area in Thane district. The school at Vikaswadi is having the population of nearly 400 students coming from the distance of 10 meters. These children belong to the families, whose occupation is collection of jungle wood. Ashram School is also situated near Vikaswadi and is a residential school. Children from nearby Adivasi areas come to stay in this school. There are nearly 200 students in this school. The families they belong to are backward with respect to the advancements in urban and rural areas. Most of the children in these school are the first generation learners. They have to face many problems due to poverty.

The pre-test was administered to 120 students in both the schools who were within the age groups of 11 to 12 and to these whom the topics, viz; sum of the interior angles of polygon and expansion of algebraic identities, were not taught. On the basis of results about 80 students who secured 7 to 14 marks were selected. They were listed alphabetically according to their surnames and were given numbers accordingly i.e. 1 to 120 by using the table of random number by Fisher and
Yates (1963). Finally 75 students were selected. Three groups of 25 each were formed and were assigned again randomly to three experimental methods.

Table No. 5.1.

<table>
<thead>
<tr>
<th>NO</th>
<th>School</th>
<th>No. of Students pre tested</th>
<th>No. of students passed</th>
<th>No. of Students selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vīkas Wadi School</td>
<td>80</td>
<td>60</td>
<td>42</td>
</tr>
<tr>
<td>2.</td>
<td>Ashram School</td>
<td>40</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>120</td>
<td>90</td>
<td>60</td>
</tr>
</tbody>
</table>

At the end of trials, allowing for drop-outs due to sickness, absence etc. each group consisted of 20 students each. The data for the post test were assembled.

Both the schools are co-educational schools giving instructions to both the sexes - boys and girls. The pre-test was given to all the students irrespective of their sex and finally when the selection of 60 students in each group was made. It was represented as follows :-
Table No. 5.2.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Methods</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>14</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>15</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>S</td>
<td>16</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>45</td>
<td>15</td>
<td>60</td>
</tr>
</tbody>
</table>

E - Enactive Programme
I - Ikonic Programme
S - Symbolic Programme.

5.1.1.2. Rural Sampling:

To represent rural population two villages viz; Bopgaon and Hivare near Saswad were selected. Both the villages are small with population of about 5,000 people. The schools are having student population of about 400 students, catering the needs of the students living within the radius of 10 km. These areas are mainly agricultural and hence the schools have strong agricultural bias which is well reflected in the schools. Both the schools work in one shift only.
Pre - test was administered to 200 students from both the schools within the age group of 11 to 12 years. On the basis of the results, about 120 students who secured marks within 7 to 14 were selected. They were listed alphabetically according to their surnames and were given number accordingly 1 to 120. By using the table of random numbers by Fisher. Finally 75 students were selected. Three groups of 30 each were assigned again randomly to three experimental methods.

The following table represents the whole procedure—

Table No. 5.3.

<table>
<thead>
<tr>
<th>NO</th>
<th>School</th>
<th>No. of Students pre tested</th>
<th>No. of students passed</th>
<th>No. of Student selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Jeevan Shikshan Mandir, Bopgaon</td>
<td>100</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>2.</td>
<td>Jeevan Shikshan Mandir, Hivare</td>
<td>100</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>TOTAL:</td>
<td>200</td>
<td>120</td>
<td>60</td>
</tr>
</tbody>
</table>

At the end of trials, allowing for drop-outs due to sickness, absence etc. each group consisted of 20 students each. The data for the post test was assembled.

Both the schools are co-educational schools giving instructions to both the sexes—boys and girls. The pre-test was given to all the students irrespective of the their sex and finally when the selection of 20 students in each group was made.
It was represented as follows:-

Table No. 5.4.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Methods</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>11</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>9</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>S</td>
<td>15</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>35</td>
<td>25</td>
<td>60</td>
</tr>
</tbody>
</table>

E - Enactive Programme
I - Ikonic Programme
S - Symbolic Programme.

5.1.1.3. Urban sampling:

To represent Urban population Pune city was considered. Pune is an industrial center. It has many educational institutions imparting scholastic and vocational education. Pune university is a well known university. It is a typical urban society. The schools selected were not co-educated schools. They were separate schools for girls and boys.

The schools selected arbitrarily were -
1. N. M. V. Boys Highschool, Pune – 2
2. Ethel Garden School for Girls, Pune – 11.
These schools selected truly represent the society in urban areas. The students coming in the N.M.V. Highschool, which is situated in the central part of the city, are coming from higher and middle classes of the society. While the students, coming to Ether Garden School which is situated in western part of the city belong to the middle and lower middle classes of the society.

In all about 180 students were administered for pre-test out of which 160 students having marks from 7 to 14 were selected. They were again alphabetically arranged according to their surnames, numbered serially and by using random number by Fisher and Yates, 90 students were selected. The following table represents the whole procedure:-

Table No. 5.5.

<table>
<thead>
<tr>
<th>No</th>
<th>School</th>
<th>No. Of Students pre tested</th>
<th>No. of students passed</th>
<th>No. of Student selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>N.M.V. Boys Highschool</td>
<td>120</td>
<td>110</td>
<td>42</td>
</tr>
<tr>
<td>2.</td>
<td>Ethel Garden School</td>
<td>60</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>TOTAL :</td>
<td>180</td>
<td>160</td>
<td>60</td>
</tr>
</tbody>
</table>

At the end of the trials, allowing for drop-outs due to sickness, absence etc. each group consisted of 20 students each. The data for the post test was assembled.
After pre-test the distribution of group according to sex was as follows:—

Table No. 5.6.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Methods</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>14</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>14</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>S</td>
<td>14</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>42</td>
<td>18</td>
<td>60</td>
</tr>
</tbody>
</table>

E - Enactive Programme
I - Iconic Programme
S - Symbolic Programme.

5.1.1.2. Administrative Procedure:

The following are the consideration to be kept in mind from the point of view of the discussion drawn at the beginning.

(i) Arrangements of the programme should be such that external validity is as high as possible.

(ii) The programme should create minimum disturbance in the normal working and time-table of the school in which field trials were conducted.
(iii) Collection and processing of large amount of data should be made as sufficient as possible for the experiment.

It was not possible to follow a single, inflexible time-table for field trials on the different schools which observe different routine and different time schedule. Hence to seek cooperation of the school, flexibility of field trials was arranged taking into consideration school working and timings.

In order to eliminate the error variance due to different teachers teaching different groups it was thought desirable that the programme should be taught by one teacher only. So the investigator, herself, administered the programme everywhere.

The whole experimental procedure of administration of pre-test, programme material and the post-test was carried out from October 87 to January 88. As the topics selected were from the syllabus of standard seven, it was not possible to teach it to the students at the beginning of the academic year. Hence it was decided to conduct the experiment in the second term of the year. It was first administered in adivasi area during October 1987. Then during November 1987 and December 1987 the field trials were conducted in rural areas, and by the third week of December 1987 to the end of January 1988 the whole programme was administered in urban areas.
5.1.2.1. Working scheme followed in Adivasi area:

The schools selected for this area were the two schools from Kosbad, i.e. Vikaswadi school and Ashram school. They work from 11 a.m. to 5 p.m. Students come from distant places. They have to walk the distance of 5 to 6 k.m. to attend the school, especially the students from Vikaswadi school. As such in case of Vikaswadi school it was not possible to administer the programme out of school hours. Hence the students were taught and tested during school hours. Ashram school being a residential school, students could be available at any time, out of school hours. But the programme was conducted during the school timings as the investigator found it suitable for her to do so.

Both the schools were in close proximity, hence it was possible to gather the students together and conduct the field trials simultaneously.

5.1.2.1.1. Administration of Pre-test:

The pre-test was administered to the whole group. Students were asked to write down the answers on the test sheet. The time allotted for the pre-test was forty minutes. Only those children who belong to the age group of 11 to 12 years were given the test. The test sheets were scanned and the students were selected according to the criteria selected by the investigator. (The students
scoring between 7 to 14 points out of 20 points were selected) They were randomly selected in different groups of 20 and assigned to different treatments also randomly as explained before.

5.1.2.1.2. Working scheme for the administration of programme:

The programme was divided into 2 sessions - Each session dealing with each topic, involving the necessary lessons to teach that topic.

(i) Session First: 5 Lessons. Each lesson of 40 minutes.

(ii) Session Two: 4 Lessons. Each lesson of 40 minutes.

There was an immediate post-test after each session (I a), and there was another post-test after both the sessions [ I b and II ].

5.1.2.1.2.1. First Session: The groups were divided into 3 sub groups. Each group was accommodated in a separate room.

In the first session first topic, viz; sum of the interior angles of a polygon was taught using three different methods, for three different groups separately.

Each group of 20 students were taught the topic using one method only.
This topic was divided into 5 lessons, each lesson of forty minutes. There were three different programmes for five lessons separately. Hence there were altogether 15 lessons conducted on the whole group.

Table No. 5.7.

<table>
<thead>
<tr>
<th>Programmes</th>
<th>No. of lessons</th>
<th>No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>I</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>S</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>60</td>
</tr>
</tbody>
</table>

5.1.2.1.2.1.1. Programme E:

Lesson No. 1: Children were shown different angles. They were asked to name them. They had to differentiate between the right angle and acute angle and obtuse angle. They must know the relation between the right angle and straight angle. They were asked to handle the figures and learn the matter.

Lesson No. 2: Students are given triangles. They have to show its sides and its interior angles. Then they are asked to fold the triangle in such a way that all the angles join at a common point on the base line. Thus forming a
straight angle. It is shown in the figure given above. The sum of these 3 angles joining at one point is equal to two right angles, hence the sum of interior angles of a triangle is two right angles.

Lesson No. 3: The students are given different types of polygons. They have to count the number of sides of the polygon. They have to show its interior angles. They have to count its interior angles. They have to show its exterior angles. They have to name these figures either according to their sides or according to their angles.

Lesson No. 4: The children are given different types of polygons. They are asked to cut out the polygons into triangles which have common vertex, as shown in the figures below.

The children are asked to count the number of triangles they have cut.
Lesson No. 5: When the children have cut the polygons into triangles they have to find out the sums of interior angles of these triangles. They already know the sum of the interior angles of a triangle. With the help of this knowledge they have to count the sum of the interior angles of triangles in their hands. By adding the sum of interior angles of these triangles they get the sum of interior angles of a polygon.
5.1.2.1.2.1.2. Programme I:

Lesson No. 1: Children were shown different figures drawn on the chart. They were asked to name them. They have to differentiate between right angles and acute angles, right angles and obtuse angles. They have to find out the relation between the right angle and straight angle.

Lesson No. 2: Children are shown the figure of triangle. They have to count its sides and angles. The vertices of the triangle are joint at a common point on the base line; forming a straight angle. Measurement of a straight angle is equal to two right angles. Hence the sum of the interior of a triangle is equal to two right angles.

Lesson No. 3: The children are shown the figure of different types of polygon drawn on the chart. They have to count the number of sides and angles of the polygon and name them accordingly. They have to show the interior angles of the polygon. They also have to show the exterior angles of the polygon.
Lesson No. 4: The children are shown different types of polygon after joining the vertices at the common vertex, they have to count the number of triangles formed in the polygon. They have to find out the relation between these numbers of triangles and sides of the polygon.

Lesson No. 5: The children are shown the figures of polygon with the triangles formed in it by joining the vertices at the common vertex. They already know the sum of interior angles of a triangle. With the help of this knowledge they have to find out the sum of the angles of different triangles and by adding these sums they have to find out the sum of interior angles of polygon. They have to find out the formula of measuring the sum of interior angles of a polygon.

5.1.2.1.2.1.3. Programme S:

Lesson No. 1: The children are shown the figures of different angles along with their measurement. They have to name the angles from their measurement, whether the angle was acute angle, right angle, obtuse angle or straight angle. They must be able to tell the relation between the right angle and straight angle.
Lesson No. 2: The children are shown the figure of a triangle. They have to count the number of sides and angles of the triangle. They are given the measurements of the angles in the triangle. By adding these measurements they have to find out the sum of interior angles of a triangle.

Lesson No. 3: Some figures of polygon, square, pentagon, septagon are drawn on the blackboard. Students have to count their sides and interior angles. They have to name those figures according to their sides or according to their angles. They have to know about the exterior angles of the figures. They have to tell the number of sides or number of angles, if they are asked the name of the polygon, without seeing the figure of that polygon.

Lesson No. 4: The chart drawn on the board. With the help of the chart the students have to tell the number of sides of the polygon and the number of triangles formed in it.
The chart is as follows:

Table No. 5.8.

<table>
<thead>
<tr>
<th>Figures</th>
<th>Name of the figure</th>
<th>No. of sides</th>
<th>No. of triangle</th>
<th>Sum of interior angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Diagram of Triangle]</td>
<td>TRIANGLE</td>
<td>3</td>
<td>1</td>
<td>2 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Square]</td>
<td>SQUARE</td>
<td>4</td>
<td>2</td>
<td>4 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Pentagon]</td>
<td>PENTAGON</td>
<td>5</td>
<td>3</td>
<td>6 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Hexagon]</td>
<td>HEXAGON</td>
<td>6</td>
<td>4</td>
<td>8 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Septagon]</td>
<td>SEPTAGON</td>
<td>7</td>
<td>5</td>
<td>10 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Octagon]</td>
<td>OCTAGON</td>
<td>8</td>
<td>6</td>
<td>12 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Nonagon]</td>
<td>NONAGON</td>
<td>9</td>
<td>7</td>
<td>14 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of Dodecagon]</td>
<td>DODECAGON</td>
<td>12</td>
<td>10</td>
<td>20 RIGHT ANGLES</td>
</tr>
<tr>
<td>[Diagram of 20-sided polygon]</td>
<td>20 Sided Figure</td>
<td>20</td>
<td>18</td>
<td>36 RIGHT ANGLES</td>
</tr>
<tr>
<td>'n' Sided Figure</td>
<td>n sided Figure</td>
<td>n</td>
<td>n - 2</td>
<td>(n-2)^2</td>
</tr>
</tbody>
</table>
They have to find the relation between the number of sides of polygon and the number of triangles formed in it by doing calculations.

Lesson No. 5: Again using the chart they have to fill the last column in the chart. They know the sum of interior angles of a triangle. With the help of this measurement they have to count the sum of interior angles of many triangles. Hence finding the sum of interior angles of a polygon, with the help of the chart they have to do the essential mathematical operations. As they know the relation between the sides of the polygon with the number of triangles formed in it, they have to proceed further to find out the sum of the interior angles of a polygon. Hence they have to multiply the number of triangles by two right angles. Thus with the help of this they find out the formula to find out the sum of interior angles of a polygon.

Thus five lessons are conducted in each mode programme.

As the first topic was taught to all the groups, they were given the post-test (I a), which include the enactive mode questions on the topic taught. All the groups were combined together and were given the same
test simultaneously. As the questions in the test were
enactive mode questions, they were evaluated then and
there.

After the test second session was conducted to
teach the topic II.

5.1.2.1.2.2. Session II:

In this session again the group was divided into
three sub groups as they were divided for the first
session. The same group which was selected for Programme
E in first session was also selected for Programme E in
the second session. Same process was followed with
respect to the other programme i.e. Programme E and S.

Topic II covered four lessons, each lesson of forty
minutes. There were three different programmes for 4
lessons. Hence there were 12 lessons conducted on the
whole group.

<table>
<thead>
<tr>
<th>PROGRAMMES</th>
<th>NO. OF LESSONS</th>
<th>NO. OF STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>I</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>S</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12</td>
<td>60</td>
</tr>
</tbody>
</table>

Thus there were four lessons in each mode
programmes which were conducted separately on each
separate group of twenty samples. The different
programmes on this topic were as follows :-
Topic II :- Expansion of Algebraic Identities :

5.1.2.1.2.2.1. Programme E :

Lesson No. 1: The children were given squares and rectangles. They were asked to find out their areas.

\[
\begin{align*}
&\text{a} \\
&\phantom{a} + b
\end{align*}
\]

With the help of these figures and their areas they were asked to do the operations of multiplication, addition and subtraction by using different integers.

Lesson No. 2: The children were given the squares and they were asked to cut the figures into small rectangles and squares according to the size given. They were asked to find out the areas of these figures. Then they are asked to add the areas of the figure to find out the area of the original figure. This enables them to learn the expansion of algebraic expression \((a + b)^2\).
Lesson No. 3: The children were given the squares are were asked to cut them into rectangle and square. They were asked to find out the areas of these figures according to their sizes and shapes, to find the area of the original figure. They are asked to add the areas of all these figures and subtract them from the area of original figure. Hence it enables them to learn the expansion of algebraic expression \((a - b)^2\).
Lesson No. 4: Children are given the squares. They are asked to cut the squares as per the given instructions. They have to find out the area of these figures they have cut. In order to get the area of the figures cut, they have to do the necessary operations, i.e. addition and subtraction. This enables them to learn the expansion of \((a)^2 - (b)^2\).

5.1.2.1.2.2.2. Programme I :

Lesson No. 1: The children were shown the figures of squares and rectangles drawn on the chart. They were asked to find out the areas of those figures. With the help of these figures and their areas, they were asked to do the operations of Multiplication, addition and subtraction by using different integers.
Lesson No. 2: The children were shown the figure of a square. The square was divided into rectangle and square by drawing lines in it. Children were asked to find the area of the square. The addition of these areas gave the area of the original figure. It enables the children to expand the algebraic expression \((a + b)^2\).

Lesson No. 3: The children were shown the figure of a square. The square was divided in different rectangles and squares by drawing lines in it. The children were asked to find the areas of these new figures. To get the area of the original figure as a whole they had to add the areas of all these figures. This enables the children to expand the algebraic expression \((a - b)^2\).

Lesson No. 4: The children were shown a square. Some changes were made in it and it was divided into rectangles and squares. The children were asked to find the area of these figures. To find the area of that figure the children were asked to do the necessary operations of addition and subtraction. This
enabled the children to expand the algebraic expansion \((a\,)^2 - (b\,)^2\).

5.1.2.1.2.2.3. Programme S:

Lesson No. 1: Children were asked to do the mathematical operations of multiplication, addition and subtraction by using different integers.

Lesson No. 2: Children were asked to work out the binomial expression having positive sign by doing actual multiplication. This enabled the children to expand the algebraic expression \((a + b)^2\).

Lesson No. 3: Children were asked to do multiplication of binomial expression having negative sign which would enable them to expand the algebraic expression \((a - b)^2\).

Lesson No. 4: Children were asked to do the multiplication of binomial expression having different (positive and negative) signs. This would enable them to expand the algebraic expression \((a)^2 - (b)^2\).

Thus four lessons were conducted in each mode programme. Each programme was conducted separately on the separate group, selected for that particular programme. Hence three mode programmes were conducted separately on three separate groups. Thus conducting 12 lessons on 60 students in this area.
The children selected for this session were the same which were selected for the session no I. The children selected for enactive programme in session I were also given enactive programme in this session. Same process is followed in case of the two programmes.

After conducting these 12 lessons in session II all the three groups were given immediate post-test. Which included enactive mode questions on the topic II. Same test was conducted at the same time on all the three groups in the common place. As the questions were enactive mode questions responses were judged immediately.

After that the children were given one more post-test using ikonic mode questions and symbolic mode questions.

5.1.2.1.3. Administration of Post-test:

Test I (a) : Part I (a):

The post-test was administered immediately after each session of field trials.

After the first session, the test was administered which included enactive mode questions. There were 20 questions in this section of the test. As it had enactive mode questions it required action on part of the students. It also required different material. That material was provided to the students according to the nature of the question.
The investigator had to go each student individually to enable him to understand the nature of the question and act accordingly.

It was a different type of test which had enactive mode questions involving actions on the part of the students. Hence there was no time limit to answer the whole test. It took nearly two hours for the students to solve all the questions.

For every question the investigator had to give instruction. The students were provided polythin bags to put the material in the form of answers.

The students were asked to sit in circle. They were first given the question paper. There were some questions of which the answers had to be written on the question paper. There were some questions which were solved on other paper sheet. There were some questions which required actions of cutting out the figures or drawing the figures on the part of the students. Thus it was a mixture of different types of activities which required same sort of guidance to solve the questions. Hence it was convenient for the investigator to pay attention on each student, in this respect when they were sitting in a single circle.

The responses of some enactive mode questions were evaluated on the spot. Answers of other questions were gathered in the polythin bag and then were evaluated.
Test I (b):

This test was administered on the next day after session II was over. This test also involved enactive mode questions. It consisted of 15 questions. As it had enactive mode questions it required test material which was provided to the students.

This test was just like the test I (a) but the questions were asked on topic II. Hence the same procedure was followed for this test also.

It took nearly one and a half hour for the children to complete the test. They were asked to sit in a single circle and under the observation and instructions of the investigator the students gave the test.

Test II:

This part was administered on the next day. This test included iconic mode questions and symbolic mode questions. Test was prepared on both the topics. As it included iconic mode questions it required material. There were 28 questions in the test. Some questions had to be solved on the question paper. Some questions had to be solved on a different sheet of paper. Some questions were solved with the help of different test material. Even for this test it was necessary to give some instructions for particular questions. For this test no time was fixed. But generally students took nearly two hours to solve all the questions.
Even in this case the students were asked to sit a circular form, so that the investigator could pay attention on each and every student.

Thus the post tests were administered. The results of these three tests were taken together for further analysis.

5.1.2.1.4. Administration of delayed post test:

After a months period delayed post test was administered. This was the II part of the immediate post test including Iconic and Symbolic questions only. In this test the questions concerning enactive mode were excluded. The students were not informed about the test. In order to eliminate error variance arising due to their practice at home in between the two tests, it was administered during the surprised visit to them.

5.1.2.2. Working scheme followed in Rural area:

The schools in this area work from 11 a.m. to 5.30 p.m. Students from nearby places come to the school. They have to walk the distance of about 5 to 6 k.m. to attend the school. Hence, it was not possible to call them before the school hours and make them wait after the school hours, for administration of the programme. So the whole programme was conducted during school hours convenience of the school.
All the procedure, material, forming of groups and other details were observed exactly the same way as was done in case of Adivasi area.

But in case of Rural area the schools, selected for the field trials were far away from each other. Hence it was not possible to conduct the experiment simultaneously by bringing the students from both the schools together. For this purpose the whole procedure was repeated in both the schools. After pre-test, all together 90 students from both the schools were selected for this field trial using random sampling. They were further divided into three groups including 30 students in each. Out of these 30, some were from Bopgaon, some belonged to Hivare school. All the three programmes were repeated in both the schools i.e. The programme ‘E’ was conducted on 18 students of Bopgaon school. Same programme ‘E’ was repeated on 12 students from Hivare school students. Thus the whole programme was repeated in different schools. All the procedure, material forming of groups and other details were observed exactly the same as was done in case of Rural area.

Just like rural area, even in this area the whole programme had to be repeated in both schools of Pune as they are away from each other.
5.1.2.3. Working Scheme followed in Urban Area:

The schools selected for the representation of this area were the schools from Pune city i.e. N.M.V. Boys School, Pune - 2 and Ethel Garden School, Pune 11. Both the schools work from 11 a.m. to 5 p.m. everyday. The children in this area were neither able to come to school before 11 a.m. i.e. before school hours nor were they ready to wait after 5 p.m. i.e. after the school hours. This is because they were either engaged in certain activities like games or cultural activity or to attend some tuition classes. Hence the whole programme was conducted during the school hours. Time for the field trial was not fixed as such. But nearly two hours with the convenience of the time table of the class, the programme was carried for nearly two weeks.

5.2. Result of the Experiment:

This section intends to report the result from the experiment conducted in all the three areas i.e. Urban, Rural and Adivasi. The copies of tests in Marathi and tables showing maximum marks awarded to each question will be found in Appendix (Page No. 415).

Copies of the table showing raw scores for all subjects in the test will be found in Appendix (Page No. 437). Table showing mean scores for all the groups for the test as a whole and separately for each mode questions are given in this section.
5.2.1. Procedure for calculating the results:

5.2.1.1. The same procedure was used in calculating the result from each of the section of the test. In this way the criteria of metric equivalence referred in chapter III was realized.

5.2.1.2. Two-way analysis of variance was done for the raw scores for all the subjects on post-test for each type of question separately i.e. enactive mode questions, ikonic mode questions and symbolic mode questions. There are in all three two-way analysis of variance results. One for the effects of the methods on immediate post-test, one for the expressive capacity on immediate post-test and one for the effects of methods on delayed post-test.

5.2.1.3. The levels of significance used for two-way analysis are .001, .01, .05 respectively.

5.2.1.4. Method of one way analysis of variance was used to compare the effect of methods to compare the achievements of the cultural groups. It was also used to find the expressive capacity of different cultural groups in different modes.

5.2.1.5. A procedure for making multiple comparison and between different means has been developed by Scheffe test. Which is more rigorous. The Scheffe test is the most rigorous method with respect to type 1 error. It
involves the criterion that the probability of rejecting the null hypotheses when it is true, a type 1 error should not exceed .01 and .05 for any other comparison made. Scheffe method will lead to few significant results, but it is easy to apply, used readily available F-test is not affected by violation of assumptions of normality and homogeneity of variance, and can be used for making any comparison the investigator has to make. Hence Scheffe test was used for multiple comparison.

Considering the rigorous nature of the Scheffe procedure a less rigorous significance level i.e. .10 level was used. This is in accordance with Scheffes own recommendations. (Ferguson ~ 1971, Page 271). Table showing .10 critical values are given in Fisher and Yates (1963) and also in Winer (1962)

Tables of two-way analysis, one-way analysis of variance with the result of the Scheffe test are given in Appendix (Page No.468).

The Scheffe procedure for multiple comparison (Burrow 1971, Winer 1962) is explained in Appendix(Page No.464), by applying it to one of the comparisons under consideration.
5.2.2. The mean scores for different groups for different methods ‘E’, ‘I’ and ‘S’ respectively are provided in the following tables. The symbols used are as follows:

Three methods are differentially based on three different stimulus modes.

Method ‘E’ - Programmes using ‘E’ mode as stimulus mode for the development of instructional material.

Method ‘I’ - Programmes using ‘I’ mode as stimulus mode for the development of instructional material.

Method ‘S’ - Programmes using ‘S’ mode as stimulus mode for the development of instructional material.

A - Groups representing Adivasi area.

R - Groups representing Rural area.

U - Groups representing Urban area.

Total maximum possible scores are shown against these symbols.

Test 1 - Immediate post test.

Test 2 - Delayed post test.

T 1 - Total score on Test 1.

T 2 - Total scores on Test 2.

The maximum possible scores on Test 1 and Test 2 are shown by symbols T 1 and T 2.
5.2.3. Mean scores for different groups for different methods:

Table No. 5.10

Mean scores for Adivasi groups for different modes / methods respectively on Test 1.

<table>
<thead>
<tr>
<th>MODES $\rightarrow$ METHODS</th>
<th>Enactive Mode Questions $= 42$</th>
<th>Ikonic Mode Questions $= 42$</th>
<th>Symbolic Mode Questions $= 42$</th>
<th>Total Scores $= 126$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E$</td>
<td>10.825</td>
<td>16.35</td>
<td>13.125</td>
<td>40.1</td>
</tr>
<tr>
<td>$I$</td>
<td>18.1</td>
<td>22.5</td>
<td>19</td>
<td>59.125</td>
</tr>
<tr>
<td>$S$</td>
<td>10.15</td>
<td>12.575</td>
<td>8.6</td>
<td>31.325</td>
</tr>
</tbody>
</table>

Table No. 5.11

Mean scores for Rural groups for different modes / methods respectively on Test 1.

<table>
<thead>
<tr>
<th>MODES $\rightarrow$ METHODS</th>
<th>Enactive Mode Questions $= 42$</th>
<th>Ikonic Mode Questions $= 42$</th>
<th>Symbolic Mode Questions $= 42$</th>
<th>Total Scores $= 126$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E$</td>
<td>24.025</td>
<td>26.05</td>
<td>20.175</td>
<td>70.25</td>
</tr>
<tr>
<td>$I$</td>
<td>18.4</td>
<td>18.175</td>
<td>13.6</td>
<td>50.175</td>
</tr>
<tr>
<td>$S$</td>
<td>21.375</td>
<td>21.625</td>
<td>19.775</td>
<td>62.775</td>
</tr>
</tbody>
</table>
(178)

Table No. 5.12
Mean scores for Urban groups for different modes / methods respectively on Test 1.

<table>
<thead>
<tr>
<th>MODES ——&gt;</th>
<th>Enactive Mode Questions = 42</th>
<th>Ikonic Mode Questions = 42</th>
<th>Symbolic Mode Questions = 42</th>
<th>Total Scores = 126</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>30.15</td>
<td>28.25</td>
<td>28.95</td>
<td>87.25</td>
</tr>
<tr>
<td>I</td>
<td>30.95</td>
<td>29.5</td>
<td>29.35</td>
<td>89.75</td>
</tr>
<tr>
<td>S</td>
<td>22.95</td>
<td>28.55</td>
<td>35.775</td>
<td>91.375</td>
</tr>
</tbody>
</table>

Mean scores for the achievement of different groups on different mode questions:

Table No. 5.13

<table>
<thead>
<tr>
<th>Mode Que.</th>
<th>E Score = 42</th>
<th>I Score = 42</th>
<th>S Score = 42</th>
<th>MEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 180</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>21.26</td>
<td>21.95</td>
<td>17.85</td>
<td>20.355</td>
</tr>
<tr>
<td>N = 180</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>29.683</td>
<td>28.776</td>
<td>31.08</td>
<td>31.58</td>
</tr>
<tr>
<td>N = 180</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEAN</td>
<td>21.3</td>
<td>22.56</td>
<td>20.83</td>
<td></td>
</tr>
</tbody>
</table>
The above table gives the mean scores of the same results on immediate post test which were reclassified according to the different mode questions.

**Mean scores for different groups for different methods on delayed post-test:**

Table No. 5.14.

Mean scores for Adivasi groups for different modes / methods respectively on Test 2.

<table>
<thead>
<tr>
<th>MODES --&gt;</th>
<th>Ikonic Mode Questions = 28</th>
<th>Symbolic Mode Questions = 28</th>
<th>Total Scores = 56</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>10.825</td>
<td>8.05</td>
<td>18.875</td>
</tr>
<tr>
<td>I</td>
<td>14.075</td>
<td>8.725</td>
<td>22.8</td>
</tr>
<tr>
<td>S</td>
<td>9.075</td>
<td>4.35</td>
<td>13.425</td>
</tr>
</tbody>
</table>

Table No. 5.15.

Mean scores for Rural groups for different mode / methods respectively on Test 2.

<table>
<thead>
<tr>
<th>MODES --&gt;</th>
<th>Ikonic Mode Questions = 28</th>
<th>Symbolic Mode Questions = 28</th>
<th>Total Scores = 56</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>14.025</td>
<td>11.125</td>
<td>25.75</td>
</tr>
<tr>
<td>I</td>
<td>11.55</td>
<td>8.575</td>
<td>20.125</td>
</tr>
<tr>
<td>S</td>
<td>12.35</td>
<td>9.425</td>
<td>21.775</td>
</tr>
</tbody>
</table>
Table No. 16
Mean scores for Urban groups for different modes / methods respectively on Test 2.

<table>
<thead>
<tr>
<th>MODES</th>
<th>Ikonic Mode Questions = 28</th>
<th>Symbolic Mode Questions = 28</th>
<th>Total Scores = 56</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>17.125</td>
<td>19.175</td>
<td>36.3</td>
</tr>
<tr>
<td>I</td>
<td>19.1</td>
<td>16.95</td>
<td>36.05</td>
</tr>
<tr>
<td>S</td>
<td>18.25</td>
<td>21.05</td>
<td>39.3</td>
</tr>
</tbody>
</table>
5.2.4. Figures representing the mean scores for different groups for different methods:

The figures given below under the following groups.

5.2.4.1.1. Figures representing the mean scores on Test 1 as a whole for different methods for different groups i.e. showing the effectiveness of the three methods 'E', 'A' and 'S' respectively with respect to each of the three groups one shown in figures 1, 8, 3, 4, 5.

5.2.4.1.2. Figures representing the mean scores for each type of methods on test 1 as a whole i.e. showing the effects of each method on different groups 'A', 'R' and 'U' respectively are shown in figures 2, 6, 7, 9.

5.2.4.2.1. Figures representing the mean scores on the different response mode 1 pertaining to three different groups on test 1 only are shown in figures 9, 11, 12, 13.

5.2.4.2.2. Figures representing the mean scores on each response mode pertaining to three different groups on test 1 taken as a whole on shown in figures 10, 14, 15, 16.

5.2.4.3.1. Figures representing the mean scores on test 2 as a whole for different methods for different groups i.e. showing the effectiveness of the three methods 'E', 'J' and 's' respectively with respect to each of the three groups are shown in figures 17, 19, 20, 21.

5.2.4.3.2. Figures representing the mean scores for each type of methods on Test-2 as a whole i.e. showing the effect of each method on different groups 'A', 'R' and 'U' respectively are shown in figures 18, 22, 23, 24.
Figure 1
Mean scores for Different Methods 'E', 'I' & 'S' for Different Groups on Test 1, as a whole.
Maximum scores = 126
Figure 2
Mean scores for the Different Groups 'A' 'R' & 'U' for Different Methods on Test 1 as a whole
Maximum scores = 126
Figure 3
Mean scores for Different Methods 'E' 'I' & 'S'
for Adivasi Groups on Test 1

Maximum Scores = 126
Figure 4

Mean scores for Different Methods 'E', 'I', & 'S' for Rural Groups on Test 1.

Maximum Scores = 126
Figure 5

Mean scores for Different Methods 'E' 'I' & 'S' for Urban Groups on Test 1.

Maximum Scores = 126
Figure 6
Mean scores for the Different Groups 'A', 'R' & 'U' for Enactive Methods on Test 1.

Maximum scores = 126
Figure 7
Mean scores for the Different Groups 'A' 'R' & 'U' for Ikonic Method on Test 1

Maximum scores = 126
Figure 8

Mean scores for the Different Groups 'A1', 'R', & 'U' for Symbolic Method on Test 1.

Maximum scores = 126
Figure 9

Mean scores for Different Mode Questions 'E' 'I' & 'S' on Test 1 as a whole.

Maximum scores = 42
Figure 10

Mean scores for the Different Groups 'A', 'R', & 'U' with respect to the responses on Different Mode Questions on Test 1 as a whole

Maximum = 42

![Graph showing mean scores for different groups 'A', 'R', and 'U'. The y-axis represents mean scores ranging from 0 to 42, and the x-axis represents groups 'A', 'R', and 'U'. The line graph shows an increasing trend from left to right.]
Figure 11

Mean scores for Adivasi Groups on Different Mode Questions 'E' 'I' & 'S' on Test 1.

Maximum scores = 42
Figure 12

Mean scores for Rural Groups on Different Mode Questions 'E', 'I', & 'S' on Test 1.

Maximum scores = 42
Figure 13
Mean scores for Urban Groups on Different Mode Questions 'E' 'I' & 'S' on Test 1.

Maximum scores = 42
Figure 14
Mean scores for Different Groups 'A', 'R', & 'U' on Enactive-Mode Questions on Test 1.

Maximum scores = 42
Figure 15

Mean scores for Different Groups 'A' 'R' & 'U' on Ikonic Mode Questions on Test 1.

Maximum scores = 42
Figure 16

Mean scores for Different Groups 'A', 'R' & 'U' on Symbolic Mode Questions on Test 1.

Maximum scores = 42
Figure 17

Mean scores for Different Methods 'E', 'I' & 'S' for Different Groups on Test 2 as a whole

Maximum scores = 56
Figure 18

Mean scores for the Different Groups 'A' 'R' & 'U' for Different Methods on Test 2 as a whole

Maximum scores=56
Figure 19

Mean scores for Different Methods 'E' 'I' & 'S' for Adivasi Groups on Test 2.

Maximum scores = 56
Figure 20

Mean scores for Different Methods 'E' 'I' & 'S' for Rural Groups on Test 2.

Maximum scores = 56
Figure 21

Mean scores for Different Methods 'E', 'I' & 'S'
for Urban Groups on Test 2.

Maximum scores = 56
Figure 22
Mean scores for the Different Groups 'A' 'R' & 'U' for Enactive Method on Test 2.
Maximum scores = 56
Figure 23
Mean scores for the Different Groups 'A', 'R' & 'U' for
Ikonic Method on Test 2.

Maximum scores = 56
Figure 24

Mean scores for the Different Groups 'A' 'R' & 'U' for Symbolic Method on Test 2.

Maximum scores = 56
5.2.5. General observations regarding field trials:

Though the experiment was time consuming, especially in case of enactive and iconic mode programmes but activity involved. The students were interested and highly motivated in the whole learning process. Especially in case of enactive part which involved action on the part of the students they were deeply absorbed in the learning process.
### Table No. 5.17

Comprehensive table of the field trial.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Different Points</th>
<th>Urban Area</th>
<th>Rural Area</th>
<th>Adivasi Area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N. M. V.</td>
<td>Ethel Garden High School</td>
<td>Bopgaon High School</td>
<td>Hivare School</td>
</tr>
<tr>
<td>1</td>
<td>Total No. of Lessons</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Total No. of Students</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>180</td>
</tr>
<tr>
<td>3</td>
<td>Total No. of working hours for administration of Pre-test</td>
<td>40 Mts.</td>
<td>40 Mts.</td>
<td>40 Mts.</td>
<td>40 Mts.</td>
</tr>
<tr>
<td>4</td>
<td>Total No. of working hours for administration of programmes</td>
<td>20 Hrs.</td>
<td>20 Hrs.</td>
<td>20 Hrs.</td>
<td>20 Hrs.</td>
</tr>
<tr>
<td>5</td>
<td>Total No. of working hours for administration of post-test</td>
<td>6 Hrs.</td>
<td>6 Hrs.</td>
<td>6 Hrs.</td>
<td>6 Hrs.</td>
</tr>
<tr>
<td></td>
<td>Total time required for the field trial</td>
<td>Nearly 2 Weeks</td>
<td>Nearly 2 Weeks</td>
<td>Nearly 2 Weeks</td>
<td>Nearly 2 Weeks</td>
</tr>
</tbody>
</table>

Field trials were conducted during October 1987 to January 1988.