"Creation around which we have always placed an aura of mystery consists in forming the mind forward. Few of us have ever learned the art of thinking forward, because education and experience have always emphasized thinking backward. Strange to say, in most of our educational processes, we deal rather consistently with the past, but without much definite understanding as to how it fits the future."

—Robert P. Crawford
5.0 INTRODUCTION

5.1 BASIC ELEMENTS OF RESEARCH METHOD

5.1.1 Variables therein
5.1.2 Hypothesis Built
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5.1.4 Sample Selected

5.2 STATISTICAL TECHNIQUES : EXPERIMENTAL DESIGN

5.2.1 Types of Design
  5.2.1.1 Single Group Design
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5.2.2 ANOVA : A Factorial Experiment

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5.3.1 Familiarisation with PTPG
  5.3.1.1 Instruction
  5.3.1.2 Time Schedule
  5.3.1.3 Format of the Programme

5.3.2 Experimental Work Done

5.3.3 Response Analysis

5.3.4 Observations

5.4 RESUME
5.0 INTRODUCTION

Research design is a strategy on paper like an architect's plan. Certain fundamental steps of research design must be given due importance when proposed to be used. The operation of the design, that is planning must be carried out with patience and accuracy.

The first phase of the study, i.e. development of divergent thinking programme in Geography have been described in the foregoing chapter. This chapter deals with the description of the second phase of the study, i.e. implementation of productive thinking programme in Geography and to study its effect on the creativity of school children.
For validational study, the following design was contemplated with the research tools and sampling procedure.

5.1 BASIC ELEMENTS OF RESEARCH METHOD

As described in chapter IV, this caption deals with the 'Put in practice' the four basic requirements in research method, viz. Variables, Hypothesis, Research tools and sample selection.

5.1.1 Variables Therein

Although the research studies have, in general, supported the effectiveness of special programmes of creativity viz. Purdue Creative Thinking Programme, Productive Thinking Programme, for the creativity of the school children. But very few attempts have been done in enhancing the creativity of pupils through thinking programmes based on the academic subject taught usually in school. Even then there are several major unsolved problems containing their utilisation and effects on the creativity of the students; B.K. Passi in his talk in 'All India seminar on Creativity' held at Regional College of Education, Bhopal (1982), had stated the need of such programmes and its way of implementation to look after the creativity of the students. So generalisation has decided to take the treatment as one of
the independent variable. As described in the review chapter III, IQ is seemed to be an effective variable in nurturing and audiencing the creativity levels of the students. To study the effect of these productive thinking programme on Geography, the investigator has kept in view the pre-acquired creativity level of the students. So the pre-acquired creativity ability is also considered in the independent variable for this study.

The three variables and the levels of which they operate in the present study are shown in the following table.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Variable</th>
<th>Nature of the variable</th>
<th>No. of Levels</th>
<th>Name of Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Treatment PTPG</td>
<td>Independent</td>
<td>3</td>
<td>i) PTPG Discussion along Textbook</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ii) PTPG alongwith Textbook</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>iii) No programme</td>
</tr>
<tr>
<td>2</td>
<td>Intelligence</td>
<td>Independent</td>
<td>2</td>
<td>i) High Level</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ii) Low Level</td>
</tr>
<tr>
<td>3</td>
<td>Preacquired Creativity</td>
<td>Independent</td>
<td>2</td>
<td>i) High</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ii) Low</td>
</tr>
<tr>
<td>4</td>
<td>Creativity</td>
<td>Dependent</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The three levels treatment viz. execution of PTPG programmes and discussion on the basis of the test of
Geography std. IX, execution of PTPG programmes alongwith teaching Geography, and only teaching of Geography contents in the textbook (IX), are taken in account because PTPG discussion thenafter may effect on the creativity level, preacquired by the students.

The variables as per the description above incorporated in the study paved way to the formation of the hypotheses that were really to be tested after the data collection.

5.1.2 Hypotheses Built

The hypotheses formulated for this present study are mentioned below:

$H_{01}$ There is a significant effect of productive thinking programme on the creativity of the students.

$H_{02}$ There is no significant difference in creativity of the students when productive thinking programmes are executed in two ways: Books with discussion and only books.

$H_{03}$ There is no significant difference in creativity of the students possessing two different IQ levels after the PTPG was implemented.

$H_{04}$ There is no significant different in creativity of the students possessing two different creativity
levels after the PTPG was implicated.

$H_{05}$ There is no first order interaction effect of treatment (PTPG) and IQ on the creativity of the students.

$H_{06}$ There is no first order interaction effect of treatment (PTPG) and preacquired creative ability on the creativity level of the students after the treatments were given.

$H_{07}$ There is no first order interaction effect of IQ and preacquired creativity ability on the creativity of the students after the treatment was over.

$H_{08}$ There is no second order interaction of treatment, IQ and pre-acquired creative ability on the post-acquired creativity of the students.

5.1.3 Tools Used

The following were the main tools which were used to observe the data for this study.

1. Creative Ability Test (CAT)
   Developed by J. Z. Patel

2. Productive Thinking Programme in Geography (PTPG)
   Developed by the Investigator

3. Group Intelligence Test
   Developed by K.G. Desai and C.L. Bhat
This test is in Gujarati language as shown in Appendix 4,5. It can be used in group or individual.

(A) The CAT is classified in three sections as below:

- Section-1 : Verbal Creativity Test
- Section-2 : Figural Creativity Test
- Section-3 : Numerical Creative Test

The question of every section is followed by the instruction given with illustrations.

In verbal creativity test, there are two sub-parts, (a) Instances (b) Uses. Each sub-part consists two questions. In Figural creativity test there are two sub-parts, (a) Line meaning (b) pattern meaning. These two sub parts also consist two figures in each. In numerical creativity test there are two subparts. (a) Numerical (b) Operations. These two subparts consist only one question in each. Thus the whole test consists of 10 questions.

**Description of CAT**

The CAT is classified as above. For each test, five minutes time limit is given for each question, so fifty minutes time is required for the completion of CAT. The test reliability was found by test-retest and split-half method. The sub test scores vary from 0.73 to 93 and 0.77 to 90 respectively and factor scores vary from 0.86 to 0.94 and 0.82 to 0.90 respectively. The concurrent validity of
CAT with different criteria measures varies from 0.66 to 0.77.

(B) Productive Thinking Programme (PTPG)

Productive Thinking Programme is an instrument to enhance the creativity of pupils.

The (PTPG) series has essentially a geography-operation. However its physical part is also related very closely to the school curricula.

The outline for PTPG series follows the theme.

Physical Geography includes destructive and constructive work of geographic inheritance. Some incidences like earthquake and volcano astonishes or gives botheration to human beings. But all these activities are around human activities. Some incidents bless and some are like curses due to the changes of land forms and new land forms e.g. our mother river gives innumerable advantages to human beings. Man has controlled all these physical devices through his ultimated activities and has succeeded in it. Man himself indicates the winner of physical devices. Moreover in getting control on heat, cold and rain, he never fails.

Through this study the students of secondary school may think thoroughly on physical devices. The main objective of this study is to make them think between the relation of physical devices and human activities, that are
interesting and novel. The children are expected to become more proficient in doing activities as the series of the programme progresses. The copies of all eight programmes in details are shown in Appendix 1.

The PTPG series outline is as follows:

1) Earthquake
2) Volcano
3) Land Forms (Mountains)
4) Land Forms (Plateau)
5) Land Forms (Plains)
6) Rivers
7) Climate (Temperature)
8) Climate (Rainfalls)

The series of PTPG is constructed into eight in numbers i.e. PTPG1, PTPG 2, PTPG 3, respectively.

Each programme is followed by its activities PTA- 1, 2, 3, 4, 5. There are five activities (PTA) in each Programme, which may take about 40 minutes including suggestions. The investigator puts initiated limited content in the starting in each and every programme. The first, third and fifth activities are quite easy but the second and the fourth are quite difficult because it is on divergent thinking type. In each programme activities are given equal importance. Some are more complex and more closely related to our life and observation. Considerable effort has been made to
Scoring of CAT

As there is no right or wrong responses for the test much can be exercised at the time of scoring. The scorer has to acquaint himself fully with the method of scoring and the use of scoring sheet. The following points had been kept in mind while scoring the test.

Each test item is to be scored for Fluency, Flexibility and originality score. The total of these component scores become the creativity score for each item. Then the total of all the items scores become the total creativity score of the testee.

In score for fluency the investigator has gone through the responses to item in question carefully and struck off those which were irrelevant and/or has been responded. Then he counted the remaining number of responses and entered that number as a fluency score, for the item in the appropriate box on the answersheet.

In scoring for flexibility, the investigator first acquainted himself with the categories of responses given for each item in the scoring guide. For the shake of convenience, he noted bracket against each response. The alphabetic serial of the category to which it belongs, whenever he
came across a response which has not been mentioned in scoring guide, he had determined the category to which it would seem to belong. When the response belongs to an entirely new category not considered in the scoring guide, he had given it a new alphabetic serial and noted in the bracket against the response in question. After he had gone through all the responses to a given item, he counted the number of different categories used by the testee. This could be easily determined on the basis of the number of different alphabet serials used. Then he counted the total number of different alphabet serial used, and entered that number as the Flexibility score for the item in the appropriate box on the answersheet.

In scoring for originality, the investigator had strictly followed the scoring guide. Every original responses such as mentioned in the scoring guide with underline were given one score of originality to each. When he came across such responses which are not mentioned in the scoring guide, he had briefly noted down them on the backside of the answersheet, and after all the test scripts had been scored, he had decided on the basis of statistical scheme which of those was unique response and
which was not, and categories for such new responses were also determined at the time of scoring, and then added those scores by putting a plus (+) sign in the appropriate box where he had already noted the originality score based on the responses given in the scoring guide.

(C) Group IQ Test

It is prepared by K.G. Desai and Champaben Bhatt, to measure mental ability of the students. It was found useful to the investigator to equate experimental and control group for 3x2x2 factorial design using IQ level of the groups studying in std. IX.

It is the test of general ability to measure intelligence meant for Gujarati speaking children. It does not require reasoning arithmatic or any other form of school achievement.

This test of intelligence was a revision of Desai's Group Test of intelligence for grade VII to XI. It was originally standardized by K.G. Desai.

The test battery included ten sub tests, viz. following directions, oppositions, disarranged sentences, classification, meaning of proverbs, number sequence, analysis, differentiation, arithmetical reasoning and verbal reasoning.
Extreme Group method was used for the item analysis. Items with the poor discrimination power were discussed. From the remaining items, ten best items for each of the test comprised 100 items of which forty five items were retained and modified from the original Desai's Group Test of Intelligence and the remaining ones were altogether new.

Then the test was administered finally to a sample of 1160 boys and 897 girls from grade VIII to IX from the schools selected by stratific sampling method. The time limit for the completion of the test was fixed at forty minutes. By giving a score of one to every correct responses raw scores were obtained which were used directly for fixing the norms and calculation of the reliability and validity co-efficients.

Age norms for boys and girls of eleven to seventeen years were established. Reliability was determined by split half and test-retest methods, and co-efficients were found to be 0.86 and 0.84 respectively. The concurrent validity of the test was established by co-relating the IQ's on the present test with IQ's on three other tests viz. (i) The Desai Group Test of Intelligence (ii) The Bhatt's Group Test of Intelligence and (iii) The Bhavsar's Non-verbal Group Test of Intelligence. The validity co-efficients with these tests were 0.77, 0.65 and 0.69 respectively.
5.1.4 Sample Selection

It is very difficult to work on the total population for any research, as the factor like time, energy, finance are limited, (sometimes experimental design also puts restriction on the sample selection). Owing to these limitations, it was decided to work on a sample for the present study. Sampling is a process of selection of subjects. The purpose of sampling is to study a small group i.e. assumed to be representative of the large group-population from which it is drawn. According to Borg:

"The factor that must often differentiate between good and poor research is not the fund available the size of the sample or the sophistication of the statistics it is cure and thought that goes into research plan."

Now it is worth to fix the size of sample before selecting the sample for the study. Edward De Bono opine

"There is no ideal size. Twelve people are a convenient number but a brainstorming session can work very well with as many as fifteen or as six." This study concludes experiment method. It is the most exacting and difficult to all methods and also important from the scientific point of view


But the experimental method restricts the sample size as the programme are to be on Avil to study its effect.

Sampling procedures may be of various types among which the following classification is specific and useful too.

1. Random sampling
2. Stratified sampling
3. Quota sampling
4. Multi Stage sampling
5. Systematic sampling
6. Cluster sampling
7. Purposive sampling

Of these types, the investigator had to select such a sample, which would satisfy the following characteristics:

(a) In general, IQ and creativity of students should normally be distributed.

(b) Socio-economically the students should be from affluent group.

(c) The school should be known to the experimenter for easy approach and full co-operation of the students as well as the staff.

(d) The school should have co-educational system.

(e) The school should have at least three classes of std. IX to compare three treatments to be implemented.
Looking to the above requirements, the investigator selected the purposive sampling technique for this study. In most general sense, it means selection according to some purposive principles. Claims have been made that this method gives "More representative sample than objective methods. Garrett³ says "A purposive sample may be expressly chosen, because in the light of available evidence, it mirrors some larger group with reference to given clarification.

A school satisfying all the requisite conditions named 'NAVDEEP VIDYALAYA', Nava Vadaj, Ahmedabad was selected for the purpose. There were three classes of std. IX. As per the predetermined purpose of the selection of sample the classes were formed according to the variability of IQ and creativity of the students. Total 126 students of std. IX had participated. The composition of the sample was found as shown below in table.

<table>
<thead>
<tr>
<th>TABLE 5.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPOSITION OF SAMPLE UNDER STUDY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASSES</th>
<th>IX.A</th>
<th>IX.B</th>
<th>IX.C</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOYS</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td>49</td>
</tr>
<tr>
<td>GIRLS</td>
<td>25</td>
<td>25</td>
<td>27</td>
<td>77</td>
</tr>
</tbody>
</table>

| | 42 | 41 | 43 | 126 |

Out of these three groups A, B, C, two groups were selected as an experimental group and the rest as a control one. See Fig. 7.

5.2 **STATISTICAL TECHNIQUES : EXPERIMENTAL DESIGN**

Experimental design and statistical techniques to be adopted for the testing of the hypothesis. Main design and tools techniques are enlisted are discussed here in brief, out of which the investigator has made use of the techniques keeping in view the needs of the method adopted. Research and explanation for making solution of these techniques are vividly set out under this caption.

5.2.1 **Types of Design**

Different types of experimental designs can be divided into groups as follows:

(i) Single Group Design

(ii) Separate Control Group Design

5.2.1.1 **Single Group Designs**

Single group experiments do not involve a separate control or comparison group. These designs are further classified in the following manner:
Fig. 7 Flowchart

Creative Ability Test (CAT) Pretest

Experimental Group Total: 83

Programme with Feed-back IX A: 42

Programme without Feed-back IX B: 41

Productive Thinking Programme in Geography

CAT Post Test

Data
(a) One Shot Case Study

In this technique a single group or person is exposed to some experimental treatment. The one shot case study is so named, because it is often used in case studies. It might also be appropriately called a single group after experiment to point out that observations are made after the introduction of the experimental variable.

(b) The One-group Pre-test, Post-test Design

It is one form of repeated measurement design, since there are two measurements for each S, there may be systematic differences in how Ss respond to treatment-1 and treatment-2 that reflect differences.

(c) The Time Series Experiment

This is a type of longitudinal research, where Ss undergo repeated measurements both before and after the introduction of the experimental variable.

(d) The Equivalent Time-Sampling Design

One way to control history in some designs is to randomly vary the presentation of X so that at times it is present and at times it is absent. An alternative possibility is to compare X1 and X2. In this way experimenter can compare the relative effects of two experimental treatments rather than of one treatment and a control. This method
eliminated the effects of history, because X is presented more than once but it introduces a few other problems.

(e) The Equivalent Material Design

In single group repeated measurements designs, the introduction of X may carry over from one occasion to another. This design is exactly the same as the above (d) design except that different materials are introduced throughout the course of experiment.

5.2.1.2 Separate Control Group Designs

Such experiments required at least one comparison. Comparison may be between two or more experimental treatments or between groups exposed to X and groups not exposed. Some well-known techniques are like these:

(a) Static Group Comparison

When applied to the static group comparison the term "Pre experimental" is unusually descriptive, because this type of design leaves many factors uncontrolled. The difficulty with the design is that the investigator has no way of knowing if the groups were equivalent before the introduction of X. Another difficulty with this design is mortality but there could be no experimental mortality, if groups remained unchanged throughout the entire experiment.

(b) The Pre-test, Post-test Control Group Design with Randomisation.
This is the first "true experimental" design, because major controls are provided for internal validity and for at least some sources of external validity. The effects of history can be disregarded because anything that effects the $O_1 - O_2$ difference is also likely to effect differences between $O_3$ and $O_4$ assuming of course that experimental and control groups are tested together and at the same time.

(c) The Solomon Four Group Design

In an effort to eliminate some of the difficulties in generalising with above (b) design, Solomon proposed using four groups. In this technique the last two groups receive no pre-test and all the groups are initially equivalent through randomisation. Hence the investigator can determine the effect of pre-test $O_1$ and $O_2$. Most of the major variables are controlled here in this design, so Campbell and Stenly consider it to be a true experimental design.

(d) The post-test only Control Group Design

In this technique only the last two groups in the Solomon four group design are employed, providing an experimental and a control group, but no pre-testing. This is the third and last of the true experimental designs.

(e) The Non-equivalents Control Group Design

This quasi-experimental design makes use of infact
### Major Advantages and Disadvantages of Different Experimental Designs

<table>
<thead>
<tr>
<th>Design Type</th>
<th>History</th>
<th>Maturation</th>
<th>Testing</th>
<th>Instrumentation</th>
<th>Regression</th>
<th>Selection</th>
<th>Mortality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SINGLE-GROUP DESIGNS:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. One-shot case study</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>Does not allow for comparison of changes; no premeasures.</td>
</tr>
<tr>
<td>2. One-group pretest-posttest design</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>A type of repeated measurement design but with a single group.</td>
</tr>
<tr>
<td>3. Time-series</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Leads to a complex statistical analysis.</td>
</tr>
<tr>
<td>4. Equivalent time samples</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Generalization is only to other groups which are repeatedly tested.</td>
</tr>
<tr>
<td>5. Equivalent materials design</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Generalization again restricted to groups tested repeatedly.</td>
</tr>
<tr>
<td><strong>SEPARATE CONTROL GROUP DESIGNS:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Static-group</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>Along with designs 1 and 2, this is a pre-experimental design.</td>
</tr>
<tr>
<td>7. Pretest-posttest control group design with randomization</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
<td>A true experimental design; generalization restricted to other pretested groups.</td>
</tr>
<tr>
<td>8. Solomon four-group design</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Another true experimental design; requires use of multiple groups.</td>
</tr>
<tr>
<td>9. Posttest-only control group design</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>A third true experimental design.</td>
</tr>
</tbody>
</table>
groups of classrooms which are formed on the basis of some natural grouping. Thus, experimental and control groups are not formed by randomly assigning Ss although they could be matched. A minimum requirement for this technique is that pre-test scores for the experimental and control groups should be as similar as possibly.

(f) Separate Sample Pre-test Post-test Design

At times experimenter may have to work with large but separate samples of groups of Ss which cannot be selected at the same time. This technique allows the investigator to make a comparison between groups receiving X and those not exposed to X.

To get the comparative idea about all the described techniques, table 5.3 is given on the next page. It gives major advantages and disadvantages of the experimental design.

Looking to the above, one can infer that separate control group design (i.e. Technique from type ii) is the applicable type for the study undertaken. Moreover (b) technique i.e. the pre-test post-test control group design with randomisation is the most suitable to be adopted for the research. Justification of the adopted technique could be given as:
(1) Selection is eliminated here because SS have been assigned at random to experimental and control groups.

(2) Instrumentation can also be controlled by having the same observers participating with both groups.

(3) Because there is a control group comprised of the same type of SS as are in the experimental group regression can be ruled out.

(4) The experimental and control groups are tested together and at the same time.

(5) The effects of experimental mortality can also be checked by examining the pre-test scores of those who failed to show up for the post-test comparison.

5.2.2 ANOVA: A Factorial Experiment

In some experiments, there are two or more independent variables, each of which is varied in two or more ways, called levels. If experimenter takes all possible combinations of variables with levels and incorporate each combination as a separate experimental condition, the arrangement made, is known as Factorial Design. In a factorial experiment, the effect of number of different factors is investigated simultaneously, particularly with an aim to study not
only the main effect of the factors involved but also inter-
action effects which are best studied with factorial design.

Allen L. Edwards defines the three models according
to the levels of factors as below:

"When the levels of factors are not randomly
selected, the ANOVA model is referred to as a
fixed model, when the levels of each factor
have been randomly selected from the large
population, the ANOVA model is referred to
as a random effect model. If the levels of
some factors have been randomly selected and
those of others have not, the ANOVA model is
referred to as a mixed model."

In this study there are three groups: Two experi-
mental Groups and One control group, where two groups would
get training through PTPG and the other would not. Out of
these two experiment groups, one group would get a chance
of discussion on programme content along with the textbook
of geography while second group would not get a chance of
discussion but allow to use the textbook. Other two indepen-
dent variables, as discussed ahead, are intelligence and
preacquired creative ability of the sample under study. The
investigator has decided to take two levels of each by
considering above median and below median scores. Therefore,

4. Allen L. Edwards: Experimental Design in Psycho-
logical Research. (New York: Holt, Rinehart and
ANOVA model of this study is a mixed model and hence it involves both fixed effects and random effects.

To study the effect of treatment (PTPG), intelligence and the preacquired creative ability, on the creativity of the students, 3x2x2 factorial experiment with a randomized group design has been employed as a statistical tool.

5.2.3 Statistical Technique in ANOVA

In this ANOVA technique, the Treatment, Intelligence and Preacquired creative ability are the independent variables while the creative ability is the dependent variable. The 3x2x2 factorial design has been developed in the given tabular form.

<table>
<thead>
<tr>
<th>TABLE 5.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3x2x2 FACTORIAL DESIGN FOR DATA ANALYSIS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>TREATMENT A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A₁  A₂  A₃  Total</td>
</tr>
</tbody>
</table>
| IQ | PCA | PTPG  PTPG  No Prog-
| | | (Discu-
| | | ssion)+ |
| | | (T.B.)(T.B.) |
| B₁ | N  M | X² | |
| C₁ | M  M | X² | X |
| B₂ | M  M | X² | X |
| C₂ | M  M | X² | X |
| C₁ | N  N | X² | X |
Before proceeding for F-test, it would be proper to look into the assumptions underlying the ANOVA technique. They are parametric assumptions, viz:

1) An equal unit scale is assumed for the measurement of the dependent variable.
2) Homogeneity of variance is the basic assumption that is, the samples of the group coming from the same population have equal variance.

For the test of homogeneity, the $F_{\text{max}}$ test can be used. The formula for $F_{\text{max}}$ (Allen L. Edward) is given below:

$$F_{\text{max}} = \frac{\text{Maximum variance}}{\text{Minimum variance}}$$

If the $F_{\text{max}}$ value is not significant, the basic assumption (2) is found to be satisfied.

Hence, ANOVA summary has been given to test whether the group means differ or not, in the following form.
TABLE 5.5
ANOVA SUMMARY SHOWING BETWEEN GROUPS AND WITHIN GROUPS

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean SS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The level of significance at 0.05 level and 0.01 level of confidence has been accepted in education research.

Next the summary of the complete ANOVA to test whether there exist the main effect of independent variables or not and whether there exist any order of interactive effect of variables on the dependent variable, say creativity, would be of the form shown below:

TABLE 5.6
SUMMARY OF THREE WAY (TREATMENT, IQ & ACA) ANOVA

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_1 x B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_2 x B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_1 x C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_2 x C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B x C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_1 x B x C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A_2 x B x C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The values of $F$ are obtained by dividing each of the mean sum of squares (MSS) by error variance, i.e. within groups mean square. The level of significance at .05 and .01 levels of confidence has been accepted to study the main effect and interactive effect on the creativity. Thus the hypothesis could be tested for acceptance or rejection.

5.3 EXECUTION OF PTPG

The resultant work derived from the use of foregoing tools, techniques etc. is elaborately discussed in this caption under four heads.

(i) Familiarisation with Programme
(ii) Experimental work
(iii) Response analysis
(iv) Observations during work.

5.3.1 Familiarisation with PTPG

Before implementation of productive thinking programme (PTPG) the person incharge should be familiarised with the programme and its execution as shown in the programme booklet; this caption includes in specific aspects of pre-experiments namely, viz.: Introductions, Time schedule and the programme format.
5.3.1.1 Instructions

Stressing the importance of the directions given in the test manual. Thorndike\(^5\) states:

"It is very important that the instructions be clear and adequately detailed. When the test is of familiar form and the procedures are simple, a brief paragraph of instructions will suffice."

As this type of programme seems to be new one, the instructions needful and the details such as method of reading the informative paragraphs, explanations regarding the types of activities and importance of such work. The direction for the administering the PTPG, they prepared minutely as shown in appendix-

5.3.1.2 Time Schedule

The PTPG includes eight programmes, which is to be spread over six weeks duration as determined in chapter IV. Flow chart will give the idea of a study at a glance. Nine points problem items and the testing required one period of 40 minutes. In the beginning the implementation started with creative ability test CAT as a pre-testing. It was given to all the three groups of students under study. All the three groups were so formed that they found homogeneous on

the achievement test.

By the next week of the pre-testing, two groups were selected randomly for experimentation, and third group was treated as a control group, i.e. no such programme is to be given to the students of control group. One of the experimental group received the feedback through discussion while the other experimental group did not receive. Both the groups required eight period for training to think differently in the academic subject, say Geography. In the beginning one period per week was necessary. For the first four programmes and remaining four, two periods per week were kept. So that the training periods lasted for six weeks. The duration of each period was 40 minutes in the school time table. After completion of the programme the creative ability test was given to all the three groups to study the effect of programme. Thus the experimental work required eight weeks duration to train the students to think, to measure the creative ability of the students.

5.3.1.3 Format of the Programme

The format of the programme was discussed in detail in chapter IV. The activities (PTA) 1 and 3 in each programme pertain to conversion thinking where the programmer had not to be more familiar with such activities. 2 and 4 pertain to divergent thinking. These activities need where the programmer is required to be more familiar with such.
activities.

Moreover, he had to respond to the stimulus in different ways. The last activity is of evaluating type where the students have to think most logically.

The whole programme (eight) consisted of 40 items. So the time required for training was eight periods, one period per week upto four weeks and two periods per week upto remaining four was necessary. So that training lasted for 6 weeks i.e. 1\frac{1}{2} months.

Implementation started with CAT as pre-test. It was given to all three classes of IX grade at a time in separate classes. Three teachers of the school complex assisted the investigator during the testing.

5.3.2 Experimental Work Done

On the first day of training the students were supplied a small note book as an answerbook for CAT. On the front page of answer booklet, they were requested to give their required personal data at the back of the booklet. A small form of data collected is shown in Appendix- 4.

Also the students were supplied with the programme booklets containing five items PTA for giving answers. The investigator put ample space below each item of PTA properly. They were requested to give their personal data on the front
page of the programme. The investigator suggested to read
the matter of front page which create the curiosity of the
students. The investigator established the rapport with
some introductory remarks.

"Today we are going to do some work in a typical
way. You will be supplied a problem. You will have to think
about the problem and give the answer. On second page of
each programme are given few important hints. For the prog-
gramme-content read carefully and you will have to think
about the problem and give the answer in the same booklet in
the given space. One thing you should bear in mind that man
correct answers are given for each problem. So you should
not think that a particular answer is right and others are
wrong. You are asked to think from different angles. This
is not a test or an examination, but a training. We shall
work together for 2 months. So please be honest in your
work. Do not try to cheat or copy but write as many answers
as you can for each item in your programme book."

The time schedule for the execution of whole prog-
ramme is shown in the table 5.7 to follow.
### TABLE 5.7

PROGRAMME WISE PERIOD DISTRIBUTION (WEEKLY)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Programme</th>
<th>Content</th>
<th>Period</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 (Oral)</td>
<td>Preliminary items</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Earthquake</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Volcano</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Mountains</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Plateaus</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Plains</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Rivers</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Climate (Temp.)</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Climate (Rainfall)</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

(Six Weeks)

The execution of the programme was carried on as discussed below.

**ZERO Period**

Before the implementation of PTPG the investigator had kept zero period to establish the rapport with the experimental group subjects during the zero period. The subject under experimental condition were made aware of different types of thinking namely, viz. Convergent thinking, Diverse
thinking and evaluating thinking which are the primary base for the productive thinking. The investigator had clarified these three terms with appropriate situational problem in Geography as mentioned below:

(1) Convergent Thinking

- How would you differentiate stars and planets in the space?

(2) Divergent Thinking

- The earth rotates around the sun. If it stops to move what consequences would be observed?

(3) Evaluating thinking

- From the rocket the earth seems to be as shining globe. Justify the statement.

The investigator had collected all the responses and put before the class for discussion to find out very uncommon responses and for the divergent thinking and logical thinking, while justifying the statements which are mentioned below:

Divergent Thinking

1) the people of half of the world live in darkness.

2) the people of half of the world cannot breathe fresh air.
3) there would be no rain.
4) half part would be too hot and the other half part would be too cold.

Evaluating Thinking

1) The earth is a planet of the sun.
2) All planets shine due to the reflection of the sun-rays.
3) The earth also shines due to the reflection of the sun rays.

Thus the students were familiar with the three types of thinking and the best rapport was established between the teacher and the taught, so much so that the students could participate wholeheartedly throughout the experimentation of the PTPG.

According to the time schedule of the programme implementation the investigator had treated both the experimental groups on the same day every week.

FIRST Period

The first programme with activity from the booklet was distributed to each of the subjects to the experimental group. To give the gestalt view of the first programme based on earthquake, it was read by the investigator, attracting the students' attention towards the paragraphs. Hence
the students could read the same paragraph silently for 3 minutes. Students were asked to concentrate on productive thinking activity PTA 1.1 given on page 1.2 appendix.

Students were then asked to write down explanation of the terms in brief against the space and the responses given were checked by themselves, when the investigator explained each term. The time duration of this activity based on divergent thinking was kept 6 minutes, the students were asked to apply their imagination to the given situational problem. In the activity uncommon responses were collected and shown on the black board. They are as under:

(A) The world is full of sins.
(B) Nag Shakes his head on which the earth rests.
(C) The people from the other planet rush to the earth.
(D) The great war broke out.

Thus, this activity was found to be difficult but after providing the stimulation the students could apply the imaginative power to the given situation with great interest.

PTA 1.3

This activity required the higher level of knowledge, to think logically on the basis of past learning experience. The students were asked to give the causes on the basis of immediate learning. PTA 1.3 on page 1.3 appendix.
PTA 1.4

The students were asked to draw the constructive and destructive effects on the earth by thinking divergently. Incubation period of 2 minutes was provided to think on PTA 1.4, the very uncommon responses were put before the whole groups. PTA 1.4 on page No. 1.3, appendix-

PTA 1.5

This activity required evaluating thinking by justifying the given situations rationally and applying the imaginative power in various modes. It was found that this item required great help from the teacher, for evaluating the given situations in figure but the second part was found interesting. The total time required to complete the programme was found nearly 52-55 minutes which was more than pre-determined time duration. At the end of the period, the programme booklets were collected from the students with thanks.

SECOND Period

In this period, the work was continued on the same line as programme one. The second programme on Volcano is closely related to the first programme in all ways. Activity first was finished within 5 minutes as they were familiar with such work ahead. Immediately students started next item 2.2, which required the divergent ways of thinking.
Students gave different ideas on Volcano figure and the uncommon responses were collected and put before the group (See appendix-1). Item 2.3 based on cause-effect, students gave correct responses and some of them required more clarification. Item 2.4 on multi-response, responses were more original and imaginative. Item 2.5 'A' was imaginative and evaluating, so the students took more time, while responding to 'B' item it was found to be very interesting but difficult too. Investigator observed the students to take more time to solve the problem in activity 2.5, programme booklets were collected at the end of the period.

THIRD Period

The same procedure as above was applied while implementing PTA.3. Students observed minutely the figure given in PTA 3.1 on page 3.2 (Appendix-1), and they recognised mountains and described each of them in brief. It was found that the students took the help of an informative paragraph in activity PTA 3.2, students were able to find out changes occurred by the drift valley but those responses were same as seen in earthquake and volcano activity. In activity 3.3 students had imagined about the difficulties they came across in climbing the hills. Students enumerated a good number of usefulness of the mountain in human development and also the hurdles there. In activity 3.5 students were found to infer the effects of mountain Himalaya on the climate of India. So
the students were asked to take the help of the textbook to see the effects.

FOURTH Period

After reading the paragraph about land form and plateaus, the students were asked to explain the four term in PTA 4.4, Appendix-\(\text{\textsuperscript{1}}\). In activity 4.2 students applied their mind to find out the causes of caves in southern plateaus. The investigator discussed about causes in a group. The students found the cause and effect relationship between two facts given in activity 4.3. In activity PTA 4.4 the three types of plateaus were shown with appropriate regions on the world. Students were asked to find out their effect of human life but students were found unable to give good number of responses. So the teacher discussed same points and asked to infer a good number of points showing the effects on human life. (See appendix-\(\text{\textsuperscript{3}}\), responses). In PTA 4.5 the students finished evaluating Geographical situation on the basis of the common experiences. The teacher had to suggest situations so that students should give the correct responses.

FIFTH Period

After exposing informative paragraphs regarding the points, students clarified the four terms given in PTA 5.1. PTA 5.2 provides complete freedom to students to observe while passing by the river side. Students gave number of
responses (see appendix-3). PTA 5.3 deals with a comparative study of plateaus and plains in relation to the population and development of nature. In 5.4, students applied the imaginative powers and gave good number of responses on destruction caused by the flood. (see appendix-3). The students could not justify the statements properly given in the activity PTA 5.5 the teacher had to prompt same ideas for justifying the statement.

SIXTH Period

This programme deals with the Geographical content Rivers. Students clarified details given in PTA 6.1, on the basis of past learning. Students thought about the rivers in this modern time in various ways. (i) Pollution absorber, (ii) No water in the river (iii) River without water. Students narrated their observations regarding the river coming down the hills and passing through the plains. The students took great interest in responding the Geographical situation given in this programme. It also required forty minutes to complete the programme.

SEVENTH Period

Programme No. 7 was implemented in the last week of the execution of this programme. The impact of one to the six programmes was found positively effective in responding temperature. In PTA 7.3 activity No. 7.5 'B' was found really
evaluating the two factors regarding temperature of any place in India. It was found very interesting due to map on page 7.5 (Appendix-7).

EIGHTH Period

Programme No. 8 deals with the rains. This programme was similar to that of the programme No. 7 dealing with the temperature. So the students were stimulated to respond in a better way. They responded in different modes for the situation aroused. As for example, if Himalaya is not on the north border of India. The PTA 8.5 deals with the situation of the five cities in India in the content of rain fall, which students have evaluated.

This was the last period and teacher thanked the students for co-operation.

After the completion of the PTPG, the CAT was administered to all the students under study.

5.3.3 Response Analysis

The programme was not to be standardized at this level. So the response analysis should not be based on statistical calculation like reliability, validity or norms establishment. This programme is meant for the creativity development. Due to this reason it was necessary to analyse the
responses according to the level of creativity. As per suggestions of B.K. Passi the responses less than 10% were to be considered as highly creative and the responses having percentage between 11% to 28% were called normally creative or common responses. Considering this suggestion as a guideline the responses of all the items were classified into three categories as under:

(i) 0 to 10% responses highly creative
(ii) 11 to 28% responses creative
(iii) Above 28% responses non creative.

The responses of the last i.e. (iii) category were neglected for all the 3 types of programmes and the responses of the 1st and 2nd categories were listed as shown in Appendix III.

5.3.4 Observation

The following important observations were made from the implementation of the programme.

As the atmosphere was kept free for the treatment of group students, some so-called naughty or mischievous students gave unexpectedly very good responses during the training programme. Moreover, some students, who were found idle in the beginning of the time limit, proved quite creative and outstanding in their responses at the end.

Some female students participated in the discussion during the training imparted in the interval between two writing time limits which mislead the investigator into impression that they were less creative. The completion of some items, however, were very good. Rapport was established with the researcher and various responses were obtained from them.

The programme proved to be very interesting and creative too in respect of all the students of IX grade.

The programme was found to be a little tough and confusing to many students and they developed a kind of aversion to this type of programmes. Some really brilliant students, however, could give creative responses. (See Appendix-3).
In this chapter the plan was designed with the help of selected tools, samples and hypotheses which are narrated to present their importance and due weightage. Separate control group design is accepted and the selection of the statistical technique ANOVA was found fit on the basis of its multiple advantages. The organization and implementation procedures were carried out with due care.

In the next chapter, the data obtained on CAT were put to statistical analysis to study the hypotheses put forth.