CHAPTER V
EXPERIMENTAL DESIGN
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REFERENCES
The first phase of study, i.e., establishment of Brain Storming Technique Programme developed have been described in the foregoing chapter. This chapter deals with descriptions of the second phase of the study, i.e., implementation of Brain Storming Technique Programme for the secondary school children.

For validational study, the following design was contemplated with the research tools and sampling procedure.

5.1 **TOOLS USED FOR THE PRESENT STUDY**

The following were the main tools of the study.
The major data-gathering tools to be used are mentioned below:

1) Creative Ability Test (Prepared by J.Z. Patel).

2) Brain Storming Technique Programme
   (prepared by Investigator)

3) Group IQ Test (prepared by K.W. Desai and Bhatt)
5.1.1 **Creative Ability Test**

It is prepared by J.Z. Patel. It consists of a test of battery of six. Six tests are classified as follows:

1) Unusual uses test of verbal task,
2) Unusual uses test of figural task, and
3) Unusual uses test of numerical task.

Above tests (CT) were selected for the study to measure the creative talent namely fluency, flexibility and originality of the children of class IX, for pre-test and post test.

A copy of it is shown in the Appendix-

5.1.2 **Brain Storming Technique Programme**

It is prepared by the investigator. It is an instrument to enhance the creativity of the secondary school children who were studying in class IX. It consists of sixteen problems for brain storming. It was prepared with the intention to nurture and to develop creative talents of the subjects under study. Its detail description is given in the foregoing chapter IV. A copy of BSTP is shown in Appendix-

5.1.3 **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 investigator to equate experimental and control group for 2x2 functional design using IQ level of the groups studying in standard 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 XI 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, row scores were obtained which were used directly for fixing the norms and calculation of 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 coefficients 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 IQs 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 coefficients with these tests were 0.77, 0.65 and 0.69 respectively.

5.2 SAMPLING

Sampling is a process of selection of subjects. It is impossible and unnecessary to obtain data from the entire population. The purpose of sampling is to study a small group i.e. assumed to be representative of the large group 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 the research plan".

Now it is worth to fix the size of sample before selecting the sample for the study. According to Edward de Bono \(^1\) "There is no ideal size. Twelve people is a convenient number but a brain storming session can work very well with as many as fifteen or as six. Less than six usually becomes an argument and with more than fifteen each person does not get enough opportunity to contribute. If there is a larger group than it can be broken into smaller groups and notes can be compared at the end". Alex Osborn \(^2\) said that the question as to what should be size of a brain storm panel has been subject to a wide degree of experiments.

Therefore investigator decided to have 16 subjects in each of two groups (Experimental and controlled).

Experimental method is the most exacting and difficult to all methods and also most important from the scientific point of view. There are various types of experimental designs. They are broadly classified as under \(^3\):

1) Pre-experimental designs,
2) True-experimental designs,
3) Factorial designs,
4) Quasi-experimental designs, and
5) Time-Series designs.
A factorial design enables the experimenter to evaluate two or more variables simultaneously in order to study the effects of number of independent factors singly as well as the effects due to interaction with one another. Factorial designs vary according to the degree of complexity depending upon the nature and purpose of the experiment. They include two or more independent variables, and each one is manipulated in two or more ways to assess both their separate main and their interaction effects.

For the present study the investigator has taken advantages of simple factorial design 2x2 as mentioned below:

1. The differences in the effect of different levels or categories of more than one variable (IQ and BSTP) can be studied with factorial designs simultaneously.

2. While studying the significance of the differences in the dependent variables under the effect of the levels of any of the factor, the groups become alike with respect to the different levels of the other factors and thus the groups get controlled as far as the levels of the other factors are concerned.

3. Besides studying the significance of the differences in the levels of the factors, the factorial designs provide an opportunity to study interactions between the factors.
In the word of Edward, "If the interaction involving a given factor are not significant, then we obviously have a broader basis for generalizing about the main effect of the factor, because it has been tested in conjunction with variations of other factors rather than holding the other factors constant at arbitrarily levels. If, on the hand, we have a two-factor interaction, examination of the nature of the interaction may provide us with additional insight how each factor operates."

At the present study, the investigator has taken into consideration the following limitations:

1. It is very difficult to control or manipulate too many factors simultaneously, the experiment and statistical analysis of the data sometimes become unmanageable.

2. Moreover, the combinations of variables also become artificial.

5.3 METHODOLOGY

Selection of the appropriate method and technique of research for a particular problem is most important aspect of research that every investigator workers faced. For this, it is necessary to consider characteristics and nature of the problem carefully. It is also important
that the method selected must be helpful on all the steps of studying the particular problem. Mainly, methods of educational research could be considered and classified into four types as under:

1) The Historical method,
2) The Normative survey method,
3) The Casual Comparative method, and
4) The experimental method.

Creativity test was administered both of the groups and data gathered. Data arranged in the respective categories to compute mean creativity score for each of the four groups. The means scores are recorded in the appropriate cells in chapter VI. ANCOVA (Analysis of co-variance) was applied to study the effect of BSTP on creativity of the subjects under present experiment.

5.4 ANALYSIS OF VARIANCE AND ANALYSIS OF COVARIANCE

Investigator used ANOVA and ANCOVA to overcome the difficulty of interaction effect on other variables in the present study which is 2x2 factorial design consisted of two independent variables. Investigator wanted to find out the effect of BSTP on creativity of the subjects in this study.
The analysis of covariance is such a method which may be used to "control" or "adjust" for the effects of one or more uncontrolled variables and it permits, thereby a valid evaluation of the outcome of the experiment.

According to Ferguson, "In psychology and education primary interest in the analysis of covariance rests in its use as a procedure for the statistical control of an uncontrolled variable. It may, however, serve other purposes, such as testing the homogeneity of a set of regression coefficients and related hypotheses. In application of the analysis of covariance the influence of the uncontrolled variable, sometimes called the covariate or the concomitant variable, is usually removed by a simple regression method, and the residual sums of squares are used to provide variance estimates which in turn are used to make tests of significance.

Allen E. Adward, had used the direct method as "a procedure for the statistical control for Analysis of variance, to "control" or "adjust for " the effects of one or more uncontrolled concomitant variables, and permit, thereby, a valid evaluation of the outcome of the experiment which are attributed within limits of error to the treatment variable and to no other casual circumstances."

Investigator applied ANOVA and ANCOVA to overcome the difficulties for statistical control as discussed above. Investigator prepared matrix of sample for ANOVA
and ANCOVA as shown in Fig. 5.1.

**Figure 5.1**

**MATRIX OF SAMPLE FOR ANOVA AND ANCOVA**

<table>
<thead>
<tr>
<th>Methods</th>
<th>Treatment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ Levels</td>
<td>BSTP $(a_1)$, Control $(a_2)$</td>
<td></td>
</tr>
<tr>
<td>High IQ $(b_1)$</td>
<td>$8(a_1b_1)$, $8(a_2b_1)$</td>
<td>$16(a_1b_1) + (a_2b_1)$</td>
</tr>
<tr>
<td>Low IQ $(b_2)$</td>
<td>$8(a_1b_2)$, $8(a_2b_2)$</td>
<td>$16(a_1b_2) + (a_2b_2)$</td>
</tr>
<tr>
<td>Total</td>
<td>$16(a_1b_1) + (a_1b_2)$, $16(a_2b_1) + (a_2b_2)$</td>
<td>$32(a + b)$</td>
</tr>
</tbody>
</table>

This ANOVA and ANCOVA sketch was used to check the following hypotheses.

### 5.5 Hypotheses:

The hypotheses formulated for the present study are mentioned below:

- $H_{01}$ There is significant impact of Brain Storming Technique Programme on the creativity levels of the pupils.
- $H_{02}$ There is no significant difference in creativity score of the pupils having high and low IQs.
- $H_{03}$ There is no significant interaction effect of treatment and IQs of the pupils.
The same hypotheses formed as above are also tested for the dependent variables as follows:

1. Creativity as Dependent variable,
2. Verbal and Figural creativity as Dependent variable, and
3. Fluency and Flexibility as Dependent variable.

Investigator determined the main effects of two main independent variables and interaction effect of creative achievement scores and intelligence level, with the levels of means.

5.6 IMPLEMENTATION OF BST PROGRAMME

In order to meet the need of the present study, investigator kept in mind the following points:

(i) A test to the groups for measuring the creativity was administered and the means of the pre-test scores for experimental and control group were found out.

(ii) IQ levels for the groups were kept identical except for exposing the experimental subjects with the problems of BSTP and the control group subjects with usual work in the class.

(iii) A test to the groups for measuring the creativity was administered and found out the mean of post-test score
(iv) The mean difference between pre-test and post-test for both groups were found out.

(v) ANCOVA procedure was applied to ascertain whether the difference in the scores sufficiently great to be real difference, or whether it was only a chance occurrence.

Result work derived from the use of the developing tools, techniques and the other is elaborately discussed.

For the implementation of BSTP, instructions are important. Hence instructions were prepared by the investigator for BSTP execution as shown in Appendix-B.

Keeping in view the full details, such as method of reading the problems, explanation regarding the types of work and the importance of such work to meet the instructions need, the directions for administering the BSTP were prepared minutely as shown in Appendix-B. The following flow chart will give the idea of the study at a glance.

Flow Chart ...

The whole BSTP consists of sixteen problems. Four hours per week were necessary to complete two problems of BSTP, so for the present study, the investigator has adopted pre-test control group design.

Investigator was interested in comparing the effectiveness of Brain Storming Technique Programmed
INTELLIGENCE TEST

EXPERIMENTAL GROUP ← Formation of Groups → CONTROL GROUP

← CREATIVITY TEST

BSTP TRAINING PROBLEM NO. 1 to 16

EXECUTION

WARM UP SESSION

INDIVIDUAL SESSION

BRAIN STORMING SESSION

EVALUATION SESSION

POST BS SESSION

CREATIVITY TEST

DATA ANALYSIS AND INTERPRETATION

FIGURE 5.2: FLOW CHART OF BSTP EXECUTION
to all the subjects under study. By the next week of the IQ test, sixteen students were selected for the experiment. The other sixteen students were termed as a control group, i.e., no training programme was to be given to them.

Next week creativity test was given to all subjects as a pre-test. During third week, training to leader, note-takers and participants was given in advance before the starting of BSTP.

Experimental work was started on third week with first problem of the BSTP. The actual procedure carried out in implementing the whole programme was briefed as under.

5.6.1 Experimental Work Done

Before starting the BSTP, the investigator established rapport with the group which is shown in Appendix II. Experimental work for BSTP done as follows:

Investigator employed four-session technique for each problem:

1. Warm up session,
2. Individual Ideation Brain Storming Session,
3. Group Ideation Brain Storming Session, and
4. Evaluation Session.

Post Brain Session (BS) was also employed.
5.6.1.1 **Warm-up Session (B₁):**

The panel leader was trained in advance for his function. He set up sessions to warm-up the subjects.

These sessions were employed before all the problems. For the first six problems, time duration was found essentially more than the rest of the problems.

To orient the subjects towards the problems was an important task for the investigator. For this purpose, importance of BSTP was given by following persons under:

1. Experts and Investigator for 15 minutes.
2. Teachers for 5 minutes.
3. Leader for 5 minutes.
4. Five Talented subjects for 10 minutes.

Investigator provided the following literature along with the invitation letters to all the participants:

1. Understanding of the creativity.
2. Importance of creativity.
3. Blocks to creative thinking. (Given step by step within first five problems).
4. Overcoming the blocks to nurture and to develop creative talents (given step by step within first five problems).

Above literature was provided along with the invitation letters as their enclosures, which is shown in Appendix-B.
5.6.1.2 Individual Ideation Brain Storming Session (B₂)

In advance sixteen BSTP Problems were given to each individual before group brain storming session. These were provided step-by-step. No training, orally was given to generate individual ideas. But treatment was given in each problems to warm up and for orientation work. Subjects worked to generate individual ideation by using solo thinking. To some extent, they were free to discuss the problems given to them and to generate ideas. Main aim of these sessions was incubation. For this the place was not fixed up.

5.6.1.3 Group Ideation Brain Storming Session (B₃)

B₃ type of sessions were organised during the school interval time. Time was fixed up for 35 minutes. After the completion of B₁ and B₂, B₃ were arranged. The purpose of B₃ was to generate creative ideas, and to develop imagination of the subjects under study.

5.6.1.4 Evaluation Session (B₄)

Investigator organized sixteen evaluation session (B₄) to come to verdict from ideas produced during B₁, B₂ and B₃ sessions. Each B₄ was conducted during the time period of interval as mentioned in B₃ type session. Participants voted to some important ideas raising fingers, and thus they enjoy and were become ready for next session.
5.6.1.5 Post Brain Storming Session:

Subjects were free to generate and suggest more ideas for each problem. No time limit was adopted. At the end of the BSTP these ideas were collected.

Two problems were completed within a week. But the total duration of BSTP was 18 weeks. Eight weeks for BSTP sessions, six weeks for try out and observation; and last one week to keep contact with participants and supporters to collect remained ideas of the some participants. Also three weeks were required to administer IQ test, creativity test (pre-test and post-test), and to train the participants.

5.6.2 Post Testing

After the completion of the whole BST Programmes (1 to 16), the creativity test was administered to all the subjects under study. The creativity score was considered as a dependent variable to study the effectiveness of the BST Programmes.

Thus, the data obtained were at hand to analyse and to verify the formulated hypotheses.
REFERENCES


