CHAPTER 3

METHODOLOGY

In order to fulfill the objectives mentioned in chapter-1, scientific methods and procedure were followed. This chapter contains relevant information pertaining to materials and techniques used and other methodological aspects of study. The methodological aspects of the study are:

1. Research Design
2. Sample
3. Tools used
4. Treatment Employed
5. Identification of variables
6. Experimental Controls Used
7. Procedure of Experimentation
8. Data collection
9. Statistical Analysis

3.1.0 Research Design
In order to study the effectiveness of training module in provocative operation on lateral thinking of student teachers, Nesting-cum-Crossing design was followed. It was nested in the sense that two different groups were taken i.e. the experimental group and the control group. The treatments were assigned to these groups randomly. Further, in each of the sections, student-teachers belonging to three levels of intelligence viz., high, middle and low, were present. In this way, different levels of intelligence were nested in different treatments. All these categories of the student-teachers were different from each other which is the characteristics of the nesting design. The design was crossing because all the groups of the student-teachers were pre-tested as well as post tested for the dependent variable (lateral thinking). Here the same student-teachers were pre-tested and post tested, which is one of the characteristic of crossing design. In this way, the experimental design was nesting-cum-crossing (as per Lewis, 1968).
The experiment resembled three-way factorial (2X3X2) nesting-cum-crossing design. Here two groups, one experimental and one control group were involved and three levels of intelligence were included. There were two occasions of testing viz. pre-test and post-test for the dependent variable (lateral thinking). There were, thus, 2X3X2=12 (twelve) combinations. The notations for the treatment combinations are illustrated in table 3.1.

**Table 3.1**

**Notations for (2X3X2) factorial Nesting-cum-Crossing design**

M₁I₁O₁  M₂I₁O₁  
M₁I₂O₁  M₂I₂O₁  
M₁I₃O₁  M₂I₃O₁  
M₁I₁O₂  M₂I₁O₂  
M₁I₂O₂  M₂I₂O₂  
M₁I₃O₂  M₂I₃O₂  
M₁ – Experimental Group  
M₂ – Control Group  
I₁ – High intelligence  
I₂ – Middle intelligence  
I₃ – Low intelligence  
O₁ – Pre-test  
O₂ – Post-test
Figure 3.1

SCHEMATIC PRESENTATION OF DESIGN WITH NESTING-CUM-CROSSING (2X3X2)

Total Students 102

M₁

51 Students

M₂

51 Students

I₁

17 Students

I₂

17 Students

I₃

17 Students

O₁

17 Students

O₂

17 Students

O₁

17 Students

O₂

17 Students

O₁

17 Students

O₂

17 Students

O₁

17 Students

O₂

17 Students
In order to study the effect of treatment on dependent variable (lateral thinking), a three way factorial (2X3X5) design of trend analysis was followed. There were two parallel groups which were exposed to two different methods of teaching, modular and conventional. In this way each student-teacher of each treatment group was tested five times. The difference in the pre-test and post-test scores of each student-teacher was termed as ‘Gain Scores’. The objective was to study the improvement in the scores from one occasion to another after the treatment.

As already has been specified, each treatment group was exposed to two different teaching methods and in case of each treatment, there were three groups of intelligence viz. high, middle and low intelligent. Further each student-teacher was having five gain scores. In this way, the design resembled 3-way factorial (2x3x5) trend analysis. The variation because of different factors was:

1) The treatment varied in two ways (conventional and training by module)
2) Intelligence varied in three ways (high, middle and low),
3) Occasions varied in five ways (occasion 1, occasion 2, occasion 3, occasion 4, occasion 5).

Here it may be argued that this design could not be nesting-cum-crossing because gain scores were taken and each gain score carried the effect of previous treatment except the first gain score. Above all, here the objective was to see the trend of improvement, so the design was comparable to trend analysis. The analysis of the trend was seen separately for each of the treatment groups. There were, thus, 2X3X5=30 (thirty) combinations. The notations for the treatment combinations are illustrated in Table 3.2
TABLE 3.2

Notations for 2X3X5 Factorial of Trend Analysis

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In order to see the effectiveness of the module, data was analyzed qualitatively. The willingness of the student-teachers for the module and their reactions towards it were analyzed qualitatively. Case study approach was followed to know the process that goes on in the mind of the student-teachers during the experimentation. For this purpose six student-teachers were selected. To study the effect of the module two student-teachers who scored highest and two student-teachers who scored lowest on lateral thinking test were interviewed. Besides two student-teachers who gained maximum (the student-teachers who had the largest difference in their pre test and post test scores) after the exposure of thinking exercises were selected. Interviews of these three high scorer and two low scorer student-teachers were also recorded. The interview helped in face to
face, verbal interaction with them to know the reactions of the student-teachers towards the training module.
Figure 3.2

SCHEMATIC PRESENTATION OF FACTORIAL DESIGN OF TREND ANALYSIS

Total Students 102

M₁
51 Students
I₁
17 Students
O₁

M₂
51 Students
I₂
17 Students

I₃
17 Students

I₁
17 Students

I₃
17 Students

I₂
17 Students

I₃
17 Students
3.2.0 Sample

The sample in the present experimental study was selected with three considerations. Firstly the student-teachers matched with each other in their qualifications, college environment, general home environment, physical conditions, sex etc. Secondly, the student-teachers who formed the particular group in the experiment should belong to different levels of independent variables. Thirdly, the extraneous variables which were concomitant to the dependent variable and correlated with that, may not introduce systematic bias in the results. Such variables could be those the specifications of which might not have entered purview of the experiment.

Keeping these conditions in view, only one college of education was selected from the urban area of Sonepat District. There were 200 female student-teachers in the college studying in four different sections. So, there were 50 student-teachers in each section. Out of these, 40 student-teachers were selected randomly from each section making for 160 student-teachers in all. The student-teachers were matched on socio-economic status test and the scores proposed that majority of student-teachers belonged to the same i.e. average socio-economic status. Now the sample student-teachers were administered the Raven’s Progressive matrices. On the basis of mean and standard deviation, student-teachers were divided in three parallel groups; high intelligent, middle and low intelligent. Now 40 student-teachers were selected from each category of intelligence randomly, making for 120 student-teachers in total. These student-teachers were further divided into two groups randomly in such a way that there were 20 student-teachers of each intelligence level in all the categories. As the number of student-teachers relating to three different intelligence levels were same in both the groups, so the groups were homogeneous with respect to intelligence. The student-teachers who were non-serious or unable to be present throughout the experiment and could not take all the tests were labeled under sample death. Initially the number of student-teachers was kept 120 for the fear of sample death; only 102 were retained for data analysis. Therefore, for the analysis there were 17 student-teachers in each category. The number of student-teachers belonging to different categories has been shown in Figure 3.3

Figure 3.3

SCHEMATIC PRESENTATION OF DISTRIBUTION OF STUDENTS IN DIFFERENT GROUPS
3.3.0 Tools used

In the present study two types of tools were used, instructional tools and measuring tools.

3.3.1 Instructional Tools

These were the tools used to impart training in Provocative Operation method to develop Lateral Thinking in the student-teachers. For the same a training module was developed by the investigator.

**TRAINING MODULE**

The module was provided in form of a booklet consisting of five activities relating to the method and a worksheet. The module booklet consisted of seven parts. The first part presented
the general information about the module which included its name and contents. The second part presented the instructions to be given to the student-teachers. In this part the student-teachers were instructed how to read the content, how to respond etc. The third part deals with the rationale of the module. In this part, the introduction to the concept was also imparted. The fourth part informed the learners about the objectives in the behavioral terms; the changes expected in the learners once they go through the booklet. The fifth part was divided into six parts according to six activities. Each activity was presented in the form of a frame. Each frame was followed by the exercise questions and their answers to provide immediate feedback. For the same a response sheet was provided along with each activity as well as the exercise sheet. These response sheets were presented separately so that the training module becomes reusable. Sixth part consisted of the exercise sheet while the seventh part was in form of an answer sheet that included answers for exercise questions of the exercise sheet. The construction, standardization and other details of the module are given in chapter 5

3.3.2 Measuring Tools

The measuring tools included the lateral thinking test, Raven’s Progressive Matrices, the socio-economic status scale, willingness scale and general reaction scale, Interview

(a) The Lateral Thinking Test

Lateral thinking test was developed by the investigator herself to measure the lateral thinking of the student-teachers. There are twenty four items in all. All the items are verbal in nature and can be administered in a group or individually. The questions are followed by the most obvious alternatives (three in most of the cases). But the student-teachers were given the freedom to express their own answers. No idea or answer in the test was assumed wrong. This test is concerned with measuring the capability of an individual to think laterally. Therefore the scoring in the test mainly centered on thinking differently. More than the obvious idea, the idea that is different or outrageous is given due weightage. With no previous studies to make a lead, the researchers centered the scoring on these four elements.

1. Vertical Thinking- In the present study the vertical thinking term was used for the way of thinking where a person tends to think logically and if the logical answers are already given as optional choices, he tends to select the best suited answer according to his thinking out of these given answers. Therefore, the most obvious answers selected by the student-teachers out of the given three choices were marked under vertical thinking score.
2. **Escape** - The right brain is mostly overpowered by left brain in most of the people. That is why most of people think by logic, reasoning and details. Our previous information, knowledge and experiences leave some impression in our brain giving birth to traps and patterns. So the first element for lateral thinking is escape from the usual i.e. the ability to avoid the obvious ideas that our logics and reasoning mostly points towards. To test the same investigator presents three most obvious answers to choose from. Marks for escape is given only if someone avoids these answers and gives some other answer.

3. **Novelty** - Or originality of the thoughts is also given the weightage as in the creativity tests. Just like creativity in this test also novelty is calculated by selecting the answers that were given by less than 5% of population. Such answers were marked the novel answers. But the scores for the answers selected as original were fixed.

4. **Outrageousness** - To move from the routine track to provocation and then on side track is called movement by De Bono. The movement is different from judgment. The logical thinking forces us to pass the judgment immediately. So withholding the judgment and accepting the unusual is the third element. It includes provocation / outrageousness of idea. The ideas that are totally different or are in opposite direction to the conventional thought process, are considered as outrageous ideas. An extra score is given for such an idea.

So the maximum score a question can earn is four. Accordingly a scoring key was prepared to make scoring easier. The total score of all the test items is considered as the score on lateral thinking test. The test-retest reliability of the test was 0.74. The test was also found to be valid.

The construction, standardization and other details of the test are given in chapter-5.

**(b) The Raven’s Progressive Matrices:**

In order to measure the intelligence of the student teachers, Raven’s progressive matrices were used. This test was selected in comparison due to the following reasons:

1) It is a standardized non-verbal test that can be administered with ease on subjects of any language.

2) The problems are so interesting and absorbing that that these provide necessary motivation to student-teachers.

3) It does not require separate instructions and time for sub-tests or sub-groups.

4) The test does not require any elaborate arrangements be made and can be administered under normal classroom conditions. The instructions are simple and easy.
5) It is a powerful test aimed at testing ability rather than efficiency.

This last factor of the Progressive Matrices test is that it minimizes the possibility of any extraneous error of omission or commission due to anxiety about any time limit. Speed test imposes on the student-teachers a certain amount of stress and strain of having to work under time limitations. This test permits the subjects to proceed at their own pace which increases the reliability of the test.

This test consisted of sixty problems divided into five sets (A, B, C, D and E) of twelve each. Every problem in the test is readily the source of thought for the next. The problem which follows, becomes progressively more difficult, hence the name “Progressive Matrices”. The order of the test provides standard training in the method of doing work. The five sets provided five opportunities for grasping the method and five progressive assessments of person’s capacity for intellectual activity.

The figures in each problem are boldly printed, accurately drawn and as far as possible pleasing to look at, to ensure interest and freedom from fatigue. This test is useful for the persons of all ages from 8 to 65 years. The scale has a test-retest reliability varying with age from 0.83 to 0.86 with “Terman Merrill Scale of Intelligence”. A copy of answer sheet and scoring key of this test is given in Appendices.

(c) Willingness Scale

In order to study the willingness of the student teachers towards the thinking module to develop lateral thinking by PO method, a willingness scale was constructed by the investigator. The student-teachers of the experimental group, who were given the training module, were provided the willingness scale at the end of the experiment. The scale consisted of 14 items out of which 11 items were in form of statements for which the trainee teachers were required to select the answers from the given options – SA (strongly agree), A (agree), U (undecided), D (disagree) and SD (strongly disagree). Scoring was done in the usual manner where all the positive statements (showing willingness to favour the module) got the score 5 if answered SA, 4 if answered A, 3 if answered, 2 if answered D and 1 if answered SD. Accordingly negative statements (1, 2, 3, 4, 6, 8, 9) got 5 marks for SD, 4 for D and so on. The last three items were open ended. The test-retest reliability of the scale is 0.81.

(d) General reaction scale

A general reaction scale comprising 19 items was prepared by the investigator to check the general reactions of the student teachers towards the module. The student-teachers of the
experimental group, who were given the training module, were provided this scale at the end of the experiment. The scale consisted of 19 items in form of statements for which the trainee teachers were required to select the answers from the given options – SA (strongly agree), A (agree), U (undecided), D (disagree) and SD (strongly disagree). Scoring was done in the usual manner where all the positive statements (showing willingness to favour the module) got the score 5 if answered SA, 4 if answered A, 3 if answered, 2 if answered D and 1 if answered SD. Accordingly negative statements (5,6,7,9,10,11,12) got 5 marks for SD, 4 for D and so on. The test-retest reliability of the scale is 0.89.

Details and construction of Willingness scale and reaction scale are given in chapter-5

(e) Socio-economic status scale

A socio economic status scale developed and standardized by Meenakshi (2004) was used to check the socio economic status of the student-teachers. The scale was selected due to the following reasons.

i. The scale was very comprehensive and did not differentiate between rural or urban and male or female.

ii. The test was a standardized verbal test which can be administered in group with ease.

iii. The test was divided in seven parts. The first part deals with education and the second part with the profession. The third part deals with monthly income whereas fourth part deals with total wealth in cash or debts. Fifth part consisted of questions relating to property. Sixth part deals with surrounding locality and seventh with social status.

iv. The scores could be further categorized in five categories ranging from poor (49 or below) to high (105 and above).

v. The test has high test-retest reliability (0.82) and was found to be sufficiently valid.

(f) Scheduled Interviews

As already mentioned, to study the effect of the module, qualitative analysis of data was done by conducting the interviews of two student-teachers who scored highest and two student-teachers who scored lowest along with two student-teachers who gained maximum on lateral thinking test after the exposure with the module. The interview helped in face to face, verbal interaction with them to know the reactions of the student teachers. Before the interview personal information about the candidates were collected through reliable sources like official records, class-mates and teachers. The interview was started with a general introduction of the candidate. This information given by the candidate was matched with the information collected
from other sources to check the seriousness of the candidate. The general introduction round was followed by a set of fifteen questions presented in a framed manner. Same questions were repeated twice at different intervals so as to check the reliability of the answers. Ultimately a case study of each candidate was prepared keeping in view not only the change in lateral thinking scores but considering the behavioural changes observed in them after the exposure of training module.

3.4.0 Treatment employed

There were two groups of student-teachers in the study, who were given two different types of treatments that lasted for two months. One of the groups was given training in PO method with the help of training module and its exercises. This group was designated as A₁ i.e. experimental group. The second group was designed as A₂ i.e. control group and was taught through expositional method.

As the objective of the study was to see the effectiveness of module in PO method for developing lateral thinking, the experimental group student-teachers were given training in PO method with the help of a training module. Following are the details of the treatment given to the experimental group:

3.4.1 Treatment-1

The experimental group was given a self-instructional training module which consisted of six activities. All the activities consisted of frames of varying sizes according to the length and difficulty level of the teaching points. The frames made generous use of illustrations and examples from daily life to bring more clarity in the concepts. The activities were followed by exercise questions based on the activity. The answers to these questions were also given so as to provide immediate feedback to the student-teachers.

1. Activity one: The first activity in the module discussed in general, the concept of thinking and importance of lateral thinking. This activity being the introductory activity, was kept as small and simple as possible.

2. Activity two: The second activity discussed in a simplified manner, the concept of PO i.e. provocative operation. The names of different strategies of PO method were also introduced in this activity.
3. Activity three: The third activity discussed in brief, PO-1 i.e. intermediate impossible. In this activity, generating new ideas using PO-1 and ways to use this method in class-room to provoke students so as to convert the absurd ideas also into useful ones, was discussed.

4. Activity four: The fourth activity was about PO-2 i.e. random juxtaposition and making use of it to generate new ideas.

5. Activity five: The fifth activity centered around PO-3 i.e. challenge for change, and how to challenge the established facts to generate a new thinking.

6. Activity six: In the sixth activity, general uses of PO along with its techniques were elaborated. Activity six was followed by a practice sheet.

The lateral thinking test was given to the students of this group five times, one before beginning the treatment i.e. pre-test, one after activity-3, one after activity-4, one after activity -5, and one in the end after presentation of complete module and the practice sheet.

3.4.2 Treatment-2

The second group A_2 was taught through a conventional method called as expositional method. In this method also the student-teachers were taught about lateral thinking. However, the treatment-2 differed to treatment-1 in two aspects.

1) In treatment-2, the teaching points were presented by the teacher in regular class-room in a conventional manner, through expositional method unlike the modular method used in treatment-1.

2) The content of teaching was also different in treatment-1 and treatment-2. Whereas the training module focused only on a single method i.e. PO method to develop lateral thinking in student-teachers, treatment-2 i.e. expositional method explained lateral thinking and various tools and techniques to develop lateral thinking in general.

The exercise given in the end of the treatment was same in both of the groups. Following is the detailed description of the treatment given to the control group.

Phase 1: In the first phase of the treatment, all the pros and cons of the topic lateral thinking were detailed out. Various tools and techniques to develop lateral thinking were discussed in brief.

Phase-2: In the second phase, the major points about the content related to lateral thinking were written on the chalk-board.
Phase-3: In this phase, the student-teachers noted down the teaching points in their note-book on their own.

Lateral thinking test was given for five times to the student-teachers of this group also. One before the treatment started i.e. pre-test, one after phase 1, one after phase-2, one after phase-3 and last one after giving the exercise sheet. In between the three phases, achievement tests were also conducted to evaluate the student-teachers.

3.5.0 Identification of variables

In the present study, three variables were worked upon. These variables were independent variables, dependent variables and intervening variables. Different variables in each of these categories have been detailed out.

3.5.1 Independent Variables

There were the variables which were manipulated in order to see their effect on the thinking outcome of the student-teachers. These variables were independent variables. These included (1) Two methods of Teaching (2) Three level of intelligence (high, medium and low) and (3) Two testing occasions (pre-test and post-test)

Methods of teaching: - Method of teaching was an independent variable wherein the student-teachers were classified into two treatment groups. One group was taught about lateral thinking in a conventional manner and was termed as the control group. The other group was provided training in lateral thinking by modular approach. This group was termed as the experimental group.

Levels of Intelligence: - Intelligence of the student-teachers was an independent variable where in student-teachers were classified as per high, medium and low on the basis of their intelligence scores. The variable existed in the student-teachers prior to the conduct of the experiment and did not come in the course of its manipulation.

Testing Occasions: - The effect of treatment was assessed on two different occasions. One was before giving treatment called pre-test and the other was after giving treatment called post-test.

3.5.2 Dependent Variables

These were the variables which acted as a criterion to the test the effect of different independent variables. The change in the level of these variables was attributed to the effect of independent variables. In the present study scores on lateral thinking test, and the scores on different factors
of lateral thinking i.e. vertical thinking, escape, originality and outrageousness were the dependent variables. These have been enumerated as follows:

1) Scores of student-teachers on lateral thinking test: - In order to see the effect of the treatment (treatment I i.e. module in PO method), the main factor which was taken into consideration was the scores of the student on lateral thinking test. These were measured on two occasions as follow- (a) before the experiment started, the student-teachers were administered Lateral thinking test; the scores on this test were termed as pre-test scores. (b) Lateral thinking test was again administered after the treatment; the scores on this test were termed as post-test scores.

2) Scores of student-teachers on different factors of lateral thinking: - In order to see the effect of treatment (i.e. module in PO method), different factors of lateral thinking were considered the dependent variable. For the same, the scores for all these four factors were measured on two occasions as follow- (a) before the experiment started, the scores of student teachers on lateral thinking test conducted on them i.e. pre-test scores, out of which scores for each factor were calculated separately and were marked as pre-test scores for that factor. (b) Lateral thinking test was again administered after the treatment; the scores on each factor of this test were termed as post-test scores for that factor.

3.5.3 Intervening Variables

There is another category of variables which cannot be measured directly but may have an effect on the outcome of the treatment. This category of variables is called intervening variables. In the experimental study like this, there are many intervening variables that can be considered e.g., socio-economic status, grade level, existing abilities, teacher behavior, other pupil variables, school variable, physical environment of the classroom, contamination effect, study effect etc. All these variables were either controlled experimentally, statistically or equalized by the ways of controlling them. The steps taken to control the effect of these variables have been given below:

3.6.0 Steps taken to control Intervening Variables

Before conducting the experiment, it was considered necessary to identify as well as control all these variables that can affect the dependent variables. The intervening variables and the controls employed on them have been discussed in the proceeding paragraphs:
Socio-economic status: It is one of the important variables that affect the activities of the learners, especially the thinking. The same caution was kept in view and attempt was made to control this. The socio-economic status scale was assessed by administering the socio-economic status scale to the sample subjects. The SES scale was developed by Meenakshi. The mean of SES of total sample student-teachers was computed. On the basis of mean most of the student-teachers belonged to middle level on SES.

i. Sex of the student-teachers: It was held constant as the sample in this study was all females.

ii. Qualification: As all the samples of study included B.Ed. trainees so all the student-teachers were at least graduates, so we can take this variable also as constant.

iii. Existing Abilities: The results may be affected by already existing abilities of student-teachers. If some student-teachers with high or low mental abilities enter into the sample of the study, the treatment may project falsifying effects. In order to control the variable, all the sample subjects were pre-tested and post-tested for all the criterion variables. While analyzing the data, pre-test and post-test scores were taken in to consideration.

iv. Teacher Behavior: Inter-teacher variations were eliminated because the experiment was controlled by the investigator herself. All the treatment groups were exposed to thinking exercises by the investigator. So, the teacher was same for all the treatment variations. Further, the administration of various tests was also done by investigator. In this way, there was similar familiarity with all the treatments for all the groups of student-teachers. Therefore, the possibility of variation due to teacher-competence could be assumed to be negligible. Again the investigator tried to keep the level of motivation, mental and physical alertness same throughout the experiment. In this way, by performing the experimental herself, the researcher tried to control the effect due to teacher variation.

v. Other Pupil Variable: There could be many other pupil variables which could interfere with the treatment effect, like pupil caste, home environment etc. This was controlled by randomization. The groups were randomly selected and treatment was randomly assigned to the various groups.

vi. College Variable: The colleges selected for experimentation were self financed training colleges. These colleges were having more or less same physical environment. Thus the student-teachers environment taken as an intervening variable, was also controlled.

vii. Physical Environment of all Class: The investigator was able to complete the experiment in the same room during the stay in college. The experiment was conducted in the months of January and February. The primary variation due to seasonal conditions, physical
environment of the classroom, ventilation, and light arrangement etc. was more or less same in the college.

viii. Contamination Effect: This effect occurs due to exchange of ideas by the student-teachers in the different treatment groups about the content learnt. The other reason for the contamination effect may be due to receiving tuition beyond instructions in the classroom. It occurs if the pupils of the treatment group exchange ideas about the content learnt and the manner in which the content was presented. An attempt was made to control this effect. The student-teachers were asked not to talk to their fellow-student-teachers or exchange their class notes. The student-teachers did follow these instructions.

ix. Study Habits: Another variable closely connected with the thinking is the study habits of the student-teachers. The hours of study put in by a student may bring a change in the ability level of the student. This factor was controlled by requesting the student-teachers not to go for extra study hours on the topics related to thinking.

### 3.7.0 Experimental Control Used

Every possible attempt was made to control those factors, which could create bias. Firstly, the investigator herself provided treatment to all the groups. It was generally believed that the competence and attitude of the investigator may alter the treatment effects. In order to control the inter-group variation in different treatment groups, the researcher herself provided treatment to all the groups. Secondly, the investigator tried to maintain the sympathetic and encouraging attitude towards all the groups in order to have a constant socio-cultural climate during the experimentation. Thirdly, every effort was made to maintain the experimental conditions similar in all experimental groups. Fourthly, the experimental process was controlled by keeping experimental situation, classroom environment, duration of experiment and mode of testing same for all the treatment groups. Fifthly, the student-teachers of all the treatment groups were requested to maintain a good attendance for experimental period. The student-teachers who were irregular or non-serious in any of the teaching groups were kept out of sample.

### 3.8.0 Procedure of Experimentation

The procedure of this study involves selection of student-teachers for treatment groups and experimentation.

#### 3.8.1 Selection of Student-teachers for Treatment groups
Initially out of 200 student-teachers of a self financed B.Ed college, 160 student-teachers were selected randomly.

i. **Administration of intelligence test:** All the student-teachers of the college were administered Raven’s Standard Progressive Matrices. On the basis of the common mean and SD, three different groups were identified as high intelligence, medium intelligence and low intelligence groups.

ii. **Administration of SES scale:** All the student-teachers were also administered SES scale developed by Dr. Meenakshi. The mean of SES scale of the total sample student-teachers was computed but as all the student-teachers belonged to nearly the same socio-economic status, so the categorization on the basis of SES was dropped by the researcher.

iii. **Formation of the groups:** From the three categories formed on the basis of results of Raven’s Standard Matrices 40 student-teachers were selected randomly in each category. The number of student-teachers selected from each category was kept 40 taking into consideration the sample death during experimentation. So during experimentation only 34 student-teachers were retained in the end for analysis of data. Now these student-teachers were further divided randomly into two groups one named as control group and the other as experimental group. So the student-teachers from each category in both the groups are illustrated below in table number 3.3
### Table 3.3

**Distributions of student-teachers in different groups**

<table>
<thead>
<tr>
<th></th>
<th>Total Student-teachers (102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High intelligent (HI)</td>
<td>34</td>
</tr>
<tr>
<td>Middle intelligent (MI)</td>
<td>34</td>
</tr>
<tr>
<td>Low intelligent (LI)</td>
<td>34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group</th>
<th>Experimental</th>
<th>Control</th>
<th>Experimental</th>
<th>Control</th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

### 3.8.2 Experimentation

The experimentation was conducted under three phases. In the first phase the student-teachers of each of experimental and control group were administered the Lateral Thinking test. After the administration of the test, the student-teachers were provided orientation and instructions about the treatment to be given to them. These instruction and orientation programming took three days. The purpose for giving such an orientation program was to get over the anxiety and curiosity of the student-teachers which may create hindrance to the final outcome of the results. For eg. the student-teachers of experimental group were given a trial of the method and module so that they may be able to follow what they have to do in a particular strategy. It was thought that such an orientation will help in normalization of the student-teachers. The student-teachers were also made familiar with the objectives etc., so that they may not feel total novelty in the experimental set up. In the second phase of the experiment, each of the treatment group was taught with one particular method of teaching. In the experimental group training module in PO method was administered. All the student-teachers of the experimental group were mentally prepared by giving preliminary briefing. They were asked to read the module thoroughly and answer the exercise questions. The module was given to the student-teachers in such a way that...
one activity was provided to them at one time, giving them ample time to read the module and use their mental abilities to solve the exercises. There were six activities followed by thinking exercises. In experimental group, after each activity and exercise student-teachers were given lateral thinking test. But the activity and lateral thinking test were administered not in one sitting but at an interval of one day, so as to avoid boredom and fatigue. In case of control group, the student-teachers were taught about lateral thinking in expositional method. The teaching in this manner was also continued for two months because here also after regular intervals, the lateral thinking test was administered. Here also, the teaching and lateral thinking test were administered not in one sitting but at an interval of one day, so as to avoid boredom and fatigue. The third phase was the evaluative phase. In this phase, student-teachers were evaluated for the achievement in the treatment. In case of experimental group, the exercise questions were given at the end of each activity in the module itself. For control group separate written tests were conducted at regular intervals relating to the understanding of the lateral thinking.

3.9.0 Data collection

In this study, the data was collected keeping in view the objectives of the study. The data to study the effectiveness of the module was collected on two occasions. One was pre-test (before the treatment) called as occasion I and the other after the treatment was called occasion II. Willingness scale, Reaction scale and Scheduled Interview technique was used to know the process that goes on in the mind of children during thinking.

Occasion I: - The first occasion was the pre-test stage. Before the experiment was conducted, the student-teachers of each of the treatment groups were administered the test of lateral thinking. The scores of these tests were termed as pre-test scores.

Occasion II: - Immediately after the treatment the student-teachers were administered the same test of lateral thinking. The scores were treated as post-test scores.

Willingness scale: To access the willingness of the student-teachers towards the module, the student-teachers were given a willingness scale in form of a checklist after completion of the module.

Reaction scale: To access the reaction of the student-teachers towards the module, the student-teachers were given a reaction scale in form of a checklist after completion of the module.

Scheduled Interviews: - To study the effect of the module, the interviews of two student-teachers who scored highest and two student-teachers who scored lowest on lateral thinking test
along with two student-teachers who gained maximum (the student-teachers who had the largest difference in their pre-test and post-test scores) were interviewed. A brief case study of these student-teachers was prepared. The purpose for conducting these interviews was to know the process that goes on in mind of student-teachers during the exposure to the training module in PO method to develop lateral thinking.
To study the trend i.e. effect of different activities of module on the lateral thinking of the student-teachers of experimental group, the lateral thinking test was conducted on five occasions. One as pre test, one after activity 2, one after activity 3, one after activity 4 and lastly one after complete module i.e. on the last day as discussed earlier also. The lateral thinking test was conducted for five times on the student-teachers of control group also as discussed earlier.

### 3.10 Statistical Techniques Used
Keeping in view the objectives and design of the study, the following statistical techniques were employed to analyze the data. The techniques and the rationale for using these are given below:

1) The measures of central tendency and the measures of dispersion such as mean and standard deviations were worked out to know the nature of the data.

2) Multivariate analyses were used to assess the data in order to find out the effect of different groups (i.e. experimental and control), levels of intelligence and testing occasions on lateral thinking. The lateral thinking tests were employed and three way analysis of variance (2X3X2) factorial design was used.

3) Multivariate analyses were used to assess the data in order to find out the effect of different groups (i.e. experimental and control), levels of intelligence and testing occasions on different components of lateral thinking i.e. vertical thinking, escape, outrageousness and originality.

4) A paired t-test was conducted to compare the effect of training module on lateral thinking and vertical thinking.

5) (2X3X5) three way analyses of variance were used for the trend analysis.

6) The percentages were calculated for qualitative analyses.

Whenever F-ratio was significant, it was interpreted through mean scores and t-test.