Chapter IV

Method and Procedure of the Study
CHAPTER - IV
METHOD AND PROCEDURE OF THE STUDY

The present study “Effectiveness of competency-based approach in developing exit competencies among prospective mathematics teachers in relation to achievement motivation and teaching aptitude” was experimental in nature. Utilizing the experiment method, researcher strived to assess the effectiveness of application of competency-based approach for training prospective mathematics teachers in developing Mathematical Exit Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies and Mathematics Teaching Competency in relation to Achievement Motivation and Teaching Aptitude.

In this chapter the design of the study, structure of sample, tools and techniques used for the collection of data have been described. The statistical techniques used for attaching meaning to raw scores and thus attaining objectives of the study are also mentioned herewith. Experimental research describes what will be and when certain variables; are carefully controlled or manipulated. Variables are the conditions that the experimenter manipulates, controls or observes. In it the effect of manipulations in independent variables is examined.

To take care of contamination of results due to extraneous variables, steps taken to control these variables are also mentioned in this chapter.

4.1 VARIABLES OF THE STUDY

4.1.1 Independent Variables:

In the present study

i. The teacher Training Strategy was independent or treatment variable.

Treatment variable was manipulated in two ways:

➢ Training through competency-based strategy i.e. Mathematics Competency Based Training Strategy (MCBTS) developed by the investigator.

➢ Training through Traditional Training Strategy (TTS).

ii. Achievement Motivation and Teaching Aptitude were used as classifying variables.
4.1.2 Dependent Variables:

Following four Mathematical Competencies were dependent variables:

- Mathematics Content Competencies
- Mathematics Process Competencies
- Mathematical Pedagogical Competencies
- Mathematics Teaching Competency

These competencies were identified and defined by investigator.

4.2 DESIGN OF THE STUDY

To study the main effects and interaction effects of the independent variables of Training Strategies, Achievement Motivation and Teaching Aptitude on the dependent variables of Mathematical Exit Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies; and Mathematics Teaching Competency, of prospective mathematics teachers, statistical technique of analysis of variance was employed. The efforts here were directed to the question, “In what way and to what extent the Training Strategies, Achievement Motivation and Teaching Aptitude with the cross-classification interact in affecting the development of Mathematical Competencies among prospective mathematics teachers”? The answer to this question would have been sought through the factorial design of 2X2X2 analysis of variance. Since, it was an experimental study and nature of the study did not permit to have large sample, it was not feasible to study second order interaction by including both the classifying variables, namely Achievement Motivation and Teaching Aptitude in one design. Therefore, these two variables were taken one by one. Finally 2X2 factorial design was used twice in the present study.

The variable of Training Strategy was given code A and the two Training Strategies: Mathematics Competency Based Training Strategy (MCBTS) and Traditional Training Strategy (TTS) as A1 and A2 respectively. The variable of Achievement Motivation was given code B and its two levels; low and high as B1 and B2 respectively. The variable Teaching Aptitude was given code C and its two levels; low and high as C1 and C2 respectively. The top 27% cases formed high group and the bottom 27% cases formed the low group.

A layout of factorial design used in the study for variables of Training Strategy and Achievement Motivation is presented in figure 4.1 and for the variables of Training Strategy and Teaching Aptitude is presented in figure 4.2.
Figure 4.1
Shows layout of factorial design for the variables of Training Strategies and Achievement Motivation

A

A1

B1

A1B1

B1

A1B1

B2

A1B2

B2

A1B2

A2

B1

A2B1

B1

A2B1

B2

A2B2

B2

A2B2

Total numbers of combinations were $2 \times 2 = 4$.

This design was replicated for each of the four Mathematical Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies and Mathematics Teaching Competency.

Figure 4.2
Shows layout of factorial design for the variables of Training Strategies and Teaching Aptitude

A

A1

C1

A1C1

C1

A1C1

C2

A1C2

C2

A1C2

A2

C1

A2C1

C1

A2C1

C2

A2C2

C2

A2C2

Total numbers of combinations were $2 \times 2 = 4$. 

129
This design was replicated for each of the four Mathematical Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies; and Mathematics Teaching Competency.

4.3 SAMPLE FOR THE STUDY

The prospective mathematics teachers admitted in various self-financed colleges affiliated to Punjabi University, Patiala during the academic session 2008-2009 constituted the population of the study.

The study included providing training to experiment group through Mathematics Competency Based Training Strategy (MCBTS) and to control group through Traditional Training Strategy (TTS) in developing Mathematical Exit Competencies among prospective mathematics teachers. Therefore intact sample was chosen as required by nature of study through non-probability sampling technique.

A sample of 126 prospective mathematics teachers was taken. The prospective mathematics teachers were from Mohali district of Punjab. The district was chosen according to geographical advantage; as the investigator is working in an institution located at district Mohali. Hence the sampling was purposive and convenient. The names of the institutions from which sample was chosen are:-

1. Rayat and Bahra College of Education, Sahauran
2. Doaba College of Education, Ghataur
3. Chandigarh College of Education, Landran
4. Guru Nanak Dev College of Education, Majatri
5. Shivalik Institute of Education and Research, Mohali
6. Ambika College of Education, Badala

Out of these six colleges, three colleges, namely, Rayat and Bahra College of Education, Sahauran; Doaba College of Education, Ghataur and Ambika College of Education, Badala were randomly selected and from these three colleges 63 prospective mathematics teachers were randomly selected and were put in group I. Out of the remaining three colleges, namely, Chandigarh College of Education, Landran; Shivalik Institute of Education and Research, Mohali and Guru Nanak Dev College of Education, Majatri, 63 prospective mathematics teachers were randomly selected and put in group II. One of these two groups was randomly assigned as experiment group (A1) and other as control group (A2). The prospective mathematics

Experimental group was exposed to training through Mathematics Competency Based Training Strategy (MCBTS) and control group was exposed to training through Traditional Training Strategy (TTS).

The justification behind selection of sample and generalization of results to entire population was that since students enrolled in the B.Ed course are on the basis of Entrance Test and also the environmental setup and infrastructural facilities of these self-financed colleges are almost similar. Accordingly, the investigator assumed that the results of above sample will be true for the entire population.

The college wise breakup of the sample is given in table 4.1.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the College</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Boys</td>
</tr>
<tr>
<td>1</td>
<td>Rayat and Bahra college of Education, Sahauran</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Doaba college of Education, Ghataur</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Chandigarh College of Education, Landran</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Guru Nanak Dev College of Education, Majatri</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Shivalik Institute of Education and Research, Mohali</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Ambika College of Education, Badala</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
</tr>
</tbody>
</table>

In population also, the ratio between boys and girls was approximately same.
4.4 TOOLS USED IN THE STUDY

The tools used in the present study are listed below:

1. Observation schedules for ascertaining the acquisition of ten Mathematical Exit Sub-Competencies, identified and selected by investigator; according to the set 80/80 criterion level.

2. Rating scales developed by investigator to measure
   - Mathematics Content Competencies
   - Mathematics Process Competencies
   - Mathematical Pedagogical Competencies

3. Mathematics Teaching Competency Assessment Scale (MTCAS) developed by the investigator, was used to assess the Mathematics Teaching Competency of prospective mathematics teachers.


4.5 DESCRIPTION OF EACH TOOL

4.5.1 Observation Schedules

Observation schedules were developed by investigator for ascertaining the acquisition of three Mathematical Exit Competencies identified and selected by investigator; according to the set 80/80 criterion level. They were prepared in correspondence to the key factors associated to the desired performance of a mathematics teacher.

In the strategy developed by the investigator, i.e. Mathematics Competency Based Training Strategy (MCBTS) three Mathematical Exit Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies and Mathematical Pedagogical Competencies, were identified and selected. In all ten Mathematical Exit Sub-Competencies, falling in different Mathematical Exit Competencies were taken in the strategy (MCBTS). Ten observation schedules for the Mathematical Exit Sub-Competencies were developed to ascertain the acquisition of
each Mathematical Exit Sub-Competency up to the set criterion level of 80/80. Details have been given in chapter III.

A copy of each of these observation schedules has been given in appendix ix to xviii.

4.5.2 Rating Scales

Three Mathematical Exit Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies and Mathematical Pedagogical Competencies were identified and selected in the strategy (MCBTS) developed by the investigator. Three rating scales were developed for assessment of prospective mathematics teacher’s acquisition of Mathematical Exit Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies and Mathematical Pedagogical Competencies. Details have been given in Development of Training Strategy and Tools, chapter III. A copy of each of these rating scales has been given in appendix vi to viii.

The statements used in the stem of seven point observation schedules and rating scales were in one-to-one correspondence with key factors associated with the desired performance. Inter-observer reliability was calculated. The inter-observer reliability coefficients of correlations for observation schedules and rating scales ranged from 0.85 to 0.91 and were found to be significant at 0.01 level of significance. Hence the results may be considered as reliable.

The observation schedules and rating scales has content validity since at every stage of their development; various Mathematical Exit Competencies, Mathematical Exit Sub-Competencies and their corresponding desired performances / behavioural indicators were discussed with experts, mathematics teachers and mathematics teacher educators.

4.5.3 Mathematics Teaching Competency Assessment Scale (MTCAS)

The scale was developed by the investigator after methodical review of available mathematical literature, research studies and views of experts in the field and her personal teaching experience as teacher educator. The scale was used to gather data related to the Mathematics Teaching Competency of prospective mathematics teachers at the pre-test and post-test levels.
The details of the scale are given in chapter III. A copy of the scale has been given in appendix v.

4.5.4 Achievement Motive Test (ACMT)

The test has been constructed and standardized by Bhargava (1994). The test is available in Hindi and English version. However, in the present study the English version of the test was used. The test is intended to measure the N Ach score of the person and contains Sentence Completion type test items. The test consists of 50 items of incomplete sentences/items which are to be completed by the subjects by putting a checkmark on any one of the three alternative responses given against each item. The subjects are instructed about what they have to do and are required to check the item by choosing one of the alternative responses which indicate his true feelings with respect to the point asked through a particular item. It is expected and believed that the subject while engaged in the process of checking the item would consider all the possible aspects which may be thought of about the item at that time. Thus, his check on the alternative responses (which he chooses so) would indicate his true feelings. In this way all the items are to be checked indicating his responses on the whole test. Another special feature of the test is that items are repeated more than once in order to know the level of consistency with which the subject is answering the test. Similar responses on similar test items indicate the consistency in responding to the test. This has been done so as to avoid the time interval gap effect which is usually present where test retest is done allowing a time gap. Care has been taken to cover as many aspects as are conveniently permissible and possible from administration point of view.

4.5.4.1 Reliability of the test

For Hindi Test: - Test retest reliability after an interval of one month was 0.87. By comparing the responses on similar items, it was 0.79. Considering the responses if they indicate to measure the same aspects for which they were intended to measure, it was found that they did so, the index of reliability being 0.78.

For English Test: - the values of reliability were 0.91 and 0.78.
4.5.4.2 Validity of the test

The test was tried for having the agreement with the criterion test of N Ach, and with educational achievement in various faculties. It was found that the test scores on this test with Educational Achievement Test (General) it had an agreement of 0.75.

For English version the values of validity indices were 0.85 with Educational Achievement Test (General).

The reliability and validity of the test was also found by the investigator.

Investigator used the test-retest method to find the reliability coefficient of the scale. Investigator took the sample of 60 prospective mathematics teachers and administered the test with an interval of three weeks and obtained reliability coefficient of 0.85, which was significant at 0.01 level of significance.

The validity of scale was determined by the administration of present scale and Achievement Motivation Scale by Deo and Mohan (1985) to a group of 60 prospective mathematics teachers. The validity coefficient was found to be 0.80 which was significant at 0.01 level of significance.

These results indicate that the scale was reliable and valid. A copy of the test has been given in appendix i.

4.5.4.3 Administration of the test

The usual time which is needed for administering the test is 30 minutes including the time needed for giving the instructions to the subjects. It is desirable that the test administrator while giving the test to the subjects should get them seated in such a way that they may not talk to each other or consult each other about the responses which they should check. This is sufficient to check the faking of responses which is usually happening when the test is being administered in group situation. The author feels that language variable influences and the social desirability or approval influences cannot possibly be reduced. It may always be present.

4.5.4.4 Scoring of the test

The procedure for scoring is very simple. It can be done with the help of a scoring key. Each item indicating Achievement Motivation (N Ach) is given a score
of 1 and the total score earned on all the items is the N Ach score. A copy of scoring key has been given in appendix ii.

4.5.5 Teaching Aptitude Scale (TAS)

The test is designed and developed by PSY-COM Services. TAS is meant to measure teaching aptitude. The scale has 119 items measuring 8 psychological traits namely; Communication skills (cs), General intelligence (gi), Maturity (ma), Perceptive (pc), Persistence (ps), Receptive (rc), Social warmth (sw) and Teaching interest (ti). The psychological description of the 8 dimensions (traits) measured by this test is as following:

1. Communication Skills (Cs):

   High scorer on Cs tends to be a good listener and an effective communicator. Such individuals display patience and are intellectually able and verbally fluent. Low scorer on factor Cs tends to be a poor listener, and is slow and generally confused. Such people have narrow and very few interests. They are generally distrustful in personal and social outlook.

2. General Intelligence (Gi):

   High scorer on Gi tends to be insightful, has a mental capacity to do things, inclination to have more intellectual interests and show better judgement. However, low scorer tends to be a dull, with low mental capacity to abstract problems and apt to be less organized. They are concrete thinkers and show poor judgement.

3. Maturity (Ma):

   High scorer on Ma tends to be seen as emotionally mature, calm and stable person. They do not let emotional needs obscure realities of a situation, and adjust to facts very easily. He has stable interests and attitudes. Whereas, low scorer on Ma, tends to be affected by feelings, emotionally less stable and evasive of responsibilities. Such people get easily disturbed and their attitudes and interests are readily changeable.

4. Perceptive (Pc):

   High scorer on Pc tends to be polished, sophisticated and socially aware. They have an exact calculating mind and are insightful towards self and others. However, low scorer tends to be unpretentious and socially clumsy. They have a vague and judicious mind. They are not skilled in analyzing motives and lack self insight.
5. Persistence (Ps):

High scorer on Ps tends to be seen as planful, responsible and thorough. Such individuals are quite reliable and dependable. Low scorers on the other hand are quitting and fickle minded. They get influenced by personal biases and dogmatism. They are generally uncontrolled and impulsive.

6. Receptive (Rc):

High scorer on Rc tends to be loyal, trusting, generous and devoted. They tend to be considerate of others in an organizational setup. Low scorers on Rc may turn out to be disloyal and inconsiderate of others ideas. They are generally not open to new ideas and tend to get fixated to established patterns.

7. Social Warmth (Sw):

Individuals who score high on Sw tend to be warm hearted, easy going and adaptable. They have readiness to cooperate and like to participate in group activities. Low scorers on Sw tend to be reserved, aloof and critical. They prefer to stand by their own ideas. They are rigid, cold and prone to sulk.

8. Teaching Interest (Ti):

High scorers on Ti are highly motivated to take teaching as a profession. They are also actively involved in co-curricular activities. They want to see their students grow physically, mentally, culturally, socially and in other aspects of life. Low scorer on Ti displays little or no interest in teaching; not motivated to take up teaching as a profession.

4.5.5.1 Reliability of the test

The reliability of the test was calculated by Split Half Method using Guttman and Spearman Brown Prophecy formulas which yielded the coefficient of correlations as +0.82 to +0.89 and +0.89 to +0.91, respectively on a sample of 100 cases. The Test Retest Method on a group of 50 teachers yielded a correlation of +0.87 to +0.94 for various factors. All these coefficients are very high and therefore the test has a good reliability.

The test also has a high degree of internal consistency and all the eight traits measure independently their respective qualities irrespective of a moderate overlapping among four traits. The inter-element correlations between the eight
components mostly centered around +0.50. Hardly any one of them is less than +0.50 and none more than +0.547.

4.5.5.2 Validity of the test

The validity of the test was secured by computing a coefficient of correlation between scores on the test and the assessment marks obtained in the final examinations of over 1000 pupil teachers under training in eleven government teacher training institutes spread in all over India. The coefficient of correlation between the total marks of theory, practice teaching and craft, and the score on the scale of 200 pupil teachers, was between +0.60 to +0.85 for eight factors measured by this scale. The obtained validity coefficient is quite satisfactory.

Reliability and validity of the test was also established by the investigator.

Investigator used the test-retest method to find the reliability coefficient of the scale. Investigator took the sample of 60 prospective mathematics teachers and administered the scale with an interval of three weeks and obtained the reliability coefficient 0.86 which was found to be significant at 0.01 level of significance.

The validity of the scale was determined by administration of the present scale and Teaching Aptitude Test by Jaiprakash and Srivastava (1973) to a group of 60 prospective mathematics teachers. The validity coefficient was found to be 0.81 which was significant at 0.01 level of significance.

These results indicate that the scale was reliable and valid. A copy of the test has been given in appendix iii.

4.5.5.3 Administration of the test

The test has a Reusable Test Booklet of 8 pages and Answer sheet for recording the answers. The first page contains the instructions for answering the questions, with a few examples. Examinees must be told in the very beginning that they have to mark their answers in the answer sheets; therefore they should not make any mark on the Booklets. This test is untimed but almost all examinees normally finish the test in 25-30 minutes. It can be given both individually or in group situations.

The present scale has been designed for self administering with little supervision required. Subjects can understand the instructions on the first page and work out the practice problems themselves. No further instructions are required. In
group testing or individual testing normally the subjects are simply asked to read the instructions on the first page of the booklet.

4.5.5.4 Scoring of the test

The scoring procedure of the scale is quite objective and simple. Transparent stencil scoring key is available for this purpose. The subject should not skip more than ten questions, or else the test is invalid. Every question should have only one answer. The scoring key can be placed on answer sheet and each answer is to be marked either 2 or 1 as indicated by the numbers printed over the boxes, only exception being the ‘Ga’ dimension where the answers are to be scored either 2 or 0. The scores are added horizontally for each dimension and written at the right hand corner of the answer sheet in the space provided for that dimension. Total score is obtained by adding the scores obtained on various dimensions.

A copy of scoring key has been given in appendix iv.

4.6 PROCEDURE OF THE STUDY

A sample of 126 prospective mathematics teachers of the academic session 2008-09 was taken from six self-financed colleges of education affiliated to Punjabi University, Patiala. The sample was divided into two groups as has been already explained while describing the sample. The present study was conducted in three phases:-

4.6.1 PHASE I: (PRE-TESTING)

In this phase, the initial scores were obtained pertaining to Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies and Mathematics Teaching Competency of prospective mathematics teachers in B.Ed through respective rating scales for Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies; and Mathematics Teaching Competency Assessment Scale (MTCAS) for Mathematics Teaching Competency.

Each prospective mathematics teacher included in the sample delivered four macro lessons of 30 minutes to school students. First lesson of each student was observed on rating scale for Mathematics Content Competencies; second lesson was observed on Mathematics Process Competencies; third lesson was observed on rating scale for Mathematical Pedagogical Competencies and fourth lesson was observed on
Mathematics Teaching Competency Assessment Scale (MTCAS) developed by the investigator.

Achievement Motive Test (ACMT) by Bhargava (1994) was administered to get the scores on the Achievement Motivation of prospective mathematics teachers of both the groups.

Teaching Aptitude Scale (TAS) by PSY-COM Services (1996) was administered to get the scores on the Teaching Aptitude of prospective mathematics teachers of both groups.

4.6.2 PHASE II: - (EXPERIMENTAL PHASE)

4.6.2.1 Treatment to group A1: - (Experimental Group)

The prospective mathematics teachers of group A1 were given orientation regarding the Mathematics Competency Based Training Strategy (MCBTS) prepared by the investigator. Model lessons were delivered by investigator and discussed. The peers acted as pupils during the training period.

The investigator identified three Mathematical Exit Competencies, namely, Mathematics Content Competencies, Mathematics Process Competencies and Mathematical Pedagogical Competencies.

Firstly, the first Mathematical Exit Competency, ‘Mathematics Content Competencies’ was taken. Under this Mathematical Exit Competency, four Mathematical Exit Sub-Competencies were identified and selected for the study. The first Mathematical Exit Sub-Competency, ‘Mathematics Content Knowledge’ from this domain was taken. Mathematics prospective teachers practiced the competency till the criterion of 80/80 was met. It was followed by the practice of next Mathematical Exit Sub-Competency ‘Illustrating with Examples’ of the Mathematical Exit Competency ‘Mathematics Content Competencies’. It was again practiced till the set criterion of 80/80 was met. The next Mathematical Exit Sub-Competency ‘Selection and Organization of Mathematics Content’ was practiced till the set criterion of 80/80 was met. Further the next Mathematical Exit Sub-Competency ‘Mathematical Connections’ of the Mathematical Exit Competency ‘Mathematics Content Competencies’ was practiced till the mathematics prospective teachers met the criterion of 80/80.
After the practice in all the four Mathematical Exit Sub-Competencies of the first Mathematical Exit Competency ‘Mathematics Content Competencies’, practice was given in the second Mathematical Exit Competency ‘Mathematics Process Competencies’. The investigator identified and selected four Mathematical Exit Sub-Competencies of Mathematical Exit Competency ‘Mathematics Process Competencies’. The prospective mathematics teachers practiced the first Mathematical Exit Sub-Competency ‘Mathematical Communication’ of this Mathematical Exit Competency. After the set criterion of 80/80 was met, the prospective mathematics teachers started with the practice of next Mathematical Exit Sub-Competency ‘Questioning and Response Management’ of the Mathematical Exit Competency ‘Mathematics Process Competencies’. The practice continued till the set criterion of 80/80 was met. Then the next Mathematical Exit Sub-Competency ‘Mathematical Problem Solving’ was taken and practiced by the prospective mathematics teachers of the experimental group, till the set criterion was met. Further the next Mathematical Exit Sub-Competency ‘Evaluation’ of ‘Mathematics Process Competencies’ was practiced by the prospective mathematics teachers, till the set criterion of 80/80 was met.

Same procedure was repeated with the remaining two Mathematical Exit Sub-Competencies namely, ‘Black Board Writing’ and ‘Multiple Instructional Strategies’, of the third Mathematical Exit Competency ‘Mathematical Pedagogical competencies’. Mathematical Exit Sub-Competencies were practiced in the same way till the acquisition of the set criterion of 80/80.

The training was given in a simulation situation. The investigator herself demonstrated planned model lessons. Relevant observation schedules prepared by the investigator were used and feedback was given to the prospective mathematics teachers after every practice lesson. The peers who acted as pupils also provided feedback.

4.6.2.2 Treatment to group A2:- (Control Group)

The prospective mathematics teachers of group A2 were given orientation regarding the Traditional Training Strategy (TTS). Model lessons on five micro teaching skills, namely, Black Board Writing, Introduction of Topic, Illustration with
Examples, Questioning, and Explanation; were delivered by investigator one by one and discussed with prospective mathematics teachers of control group.

Firstly, the investigator delivered a model micro lesson on the first micro skill, namely ‘Black board Writing’. Discussions were held in the class. The prospective mathematics teachers of control group prepared and delivered the micro lesson plan on this particular skill. Peers acted as students of the class. Observation schedule was filled by all the peers. The lesson delivered by the prospective mathematics teacher of the control group was followed by feedback from the peer group. Satisfactory performance led the prospective mathematics teacher of control group to move on to the next skill, whereas the unsatisfactory performance was followed by a re-teach session. The cycle was carried on till the satisfactory performance of the prospective mathematics teacher of the control group.

Then the investigator moved on to the next micro teaching skill, namely, ‘Introduction of topic’. The same procedure was followed as explained above.

Same procedure was followed with remaining three micro teaching skills, namely, Illustration with Examples, Questioning and Explanation.

Model lesson on one full topic was given by the investigator. The demonstration was followed by group discussion.

The training to both the groups continued throughout the session. The duration of training was about sixty days and on an average two hours daily for both the groups.

4.6.3 PHASE III: - POST-TESTING

In this phase, the final scores were obtained pertaining to Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies of prospective mathematics teachers through respective rating scales and Mathematics Teaching Competency of prospective mathematics teachers through Mathematics Teaching Competency Assessment Scale (MTCAS).

In this phase, the acquisition of Mathematical Exit Competencies by the prospective mathematics teachers was assessed. Each prospective mathematics teacher delivered four macro lessons of 30 minutes to school students. First lesson of each student was observed on rating scale for Mathematics Content Competencies developed by the investigator; second lesson was observed on rating scale for
Mathematics Process Competencies developed by the investigator; third lesson was observed on rating scale for Mathematical Pedagogical Competencies developed by the investigator and fourth lesson was observed on Mathematics Teaching Competency Assessment Scale (MTCAS) developed by the investigator. The post test scores were then obtained.

The layout of the procedure is given in the table 4.2.

**Table 4.2**

<table>
<thead>
<tr>
<th>PHASE</th>
<th>GROUP A1</th>
<th>GROUP A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHASE I</td>
<td>1. Rating Scale to measure 'Mathematics Content Competencies'</td>
<td>1. Rating Scale to measure 'Mathematics Content Competencies'</td>
</tr>
<tr>
<td>PRE-TEST</td>
<td>2. Rating Scale to measure 'Mathematics Process Competencies'</td>
<td>2. Rating Scale to measure 'Mathematics Process Competencies'</td>
</tr>
<tr>
<td></td>
<td>3. Rating Scale to measure 'Mathematical Pedagogical Competencies'</td>
<td>3. Rating Scale to measure 'Mathematical Pedagogical Competencies'</td>
</tr>
<tr>
<td></td>
<td>4. Mathematics Teaching Competency Assessment Scale (MTCAS) to measure Mathematics Teaching Competency</td>
<td>4. Mathematics Teaching Competency Assessment Scale (MTCAS) to measure Mathematics Teaching Competency</td>
</tr>
<tr>
<td></td>
<td>5. Achievement Motive Test (ACMT) by Bhargava (1994) to obtain scores on Achievement Motivation of prospective mathematics teachers</td>
<td>5. Achievement Motive Test (ACMT) by Bhargava (1994) to obtain scores on Achievement Motivation of prospective mathematics teachers</td>
</tr>
<tr>
<td></td>
<td>6. Teaching Aptitude Scale (TAS) by PSYCOM Services (1996) to obtain scores on Teaching Aptitude of prospective mathematics teachers</td>
<td>6. Teaching Aptitude Scale (TAS) by PSYCOM Services (1996) to obtain scores on Teaching Aptitude of prospective mathematics teachers</td>
</tr>
<tr>
<td>PHASE II</td>
<td>Training through Mathematics Competency Based Training Strategy (MCBTS)</td>
<td>Training through Traditional Training Strategy (TTS)</td>
</tr>
<tr>
<td>(Experimental)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE III</td>
<td>1. Rating Scale to measure 'Mathematics Content Competencies'</td>
<td>1. Rating Scale to measure Mathematics Content Competencies'</td>
</tr>
<tr>
<td>POST-TEST</td>
<td>2. Rating Scale to measure 'Mathematics Process Competencies'</td>
<td>2. Rating Scale to measure 'Mathematics Process Competencies'</td>
</tr>
<tr>
<td></td>
<td>3. Rating Scale to measure 'Mathematical Pedagogical Competencies'</td>
<td>3. Rating Scale to measure 'Mathematical Pedagogical Competencies'</td>
</tr>
<tr>
<td></td>
<td>4. Mathematics Teaching Competency Assessment Scale (MTCAS) to measure Mathematics Teaching Competency</td>
<td>4. Mathematics Teaching Competency Assessment Scale (MTCAS) to measure Mathematics Teaching Competency</td>
</tr>
</tbody>
</table>
4.7 DATA COLLECTION

The data were collected following strictly as per the design and procedure of the study. The data consisted of:

1. Pre-test scores and Post test scores on Rating scale of ‘Mathematics Content Competencies’.

2. Pre-test scores and Post test scores on Rating scale of ‘Mathematics Process Competencies’.

3. Pre-test scores and Post test scores on Rating scale of ‘Mathematical Pedagogical Competencies’.

4. Pre-test scores and Post test scores on Mathematics Teaching Competency Assessment Scale (MTCAS).

5. Scores on Achievement Motive Test.

6. Scores on Teaching Aptitude Scale.

4.8 STATISTICAL ANALYSIS OF DATA

1. Descriptive statistics such as mean, median, standard deviation, skewness and kurtosis were worked out to ascertain the nature of distribution of scores on the variable of three Mathematical Exit Competencies namely, Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies; and Mathematics Teaching Competency; Achievement Motivation and Teaching Aptitude.

2. 2x2 analysis of variance was used to study the main effects and interaction effects.

3. For further investigation, t-test was employed wherever F-ratio was found to be significant.

4. Inter observer reliability was calculated for rating scales pertaining to three Mathematical Exit Competencies namely ‘Mathematics Content
Competencies’, ‘Mathematics Process Competencies’ and ‘Mathematical Pedagogical Competencies’; and Mathematics Teaching Competency.

4.9 STEPS TAKEN TO CONTROL EXTRANEOUS VARIABLES

The following steps were taken to control the extraneous variables.

- **Matching of Groups:** Matching of groups was one of the controls where in all the relevant variables were controlled. Matching of groups was done on the variables of age, gender and teaching experience. In both the groups, prospective mathematics teachers were in the age group 23 to 28 years. Also in both the groups the number of boys and girls were almost same. These prospective mathematics teachers had no earlier teaching experience.

- **Randomization:** The procedure of randomization adopted at various stages, ensured that the groups were matched to as many variables as possible.

- **Matching of groups on Mathematical Exit Competencies and classifying variables:** Experiment group and control group were matched on the variables of Mathematical Exit Competencies and classifying variables, namely, Achievement Motivation and Teaching Aptitude, by using t-test. t-ratios were calculated between experimental group and control group on pre-test scores on Mathematics Content Competencies, Mathematics Process Competencies, Mathematical Pedagogical Competencies and Mathematics Teaching Competency; and scores on Achievement Motivation and Teaching Aptitude.

- **Holding situational variables constant:** Equal number of subjects were taken in both the groups, both the groups were trained by the investigator herself at the same time of the day and in the same environmental conditions such as temperature, presence or absence of distracting noise and like.

- **Analysis on gain scores:** The analysis was conducted on the gain scores to eliminate the difference, if any, between experiment group and control group on the variable of Mathematical Exit Competencies before the treatment.
- **Self financed colleges**: Colleges of education selected for the study were self financed and affiliated to Punjabi University, Patiala. The colleges of education had more or less same physical environment. The infrastructural facilities available in these self financed colleges were almost similar.