CHAPTER III

Methodology
### CHAPTER III
### METHODOLOGY

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00</td>
<td>INTRODUCTION</td>
<td>97</td>
</tr>
<tr>
<td>3.01</td>
<td>METHOD ADOPTED</td>
<td>97</td>
</tr>
<tr>
<td>3.02</td>
<td>AREA OF THE STUDY</td>
<td>97</td>
</tr>
<tr>
<td>3.03</td>
<td>POPULATIONS FOR THE STUDY</td>
<td>98</td>
</tr>
<tr>
<td>3.04</td>
<td>SAMPLES SELECTED FOR THE STUDY</td>
<td>99</td>
</tr>
<tr>
<td>3.04.1</td>
<td>SIZE OF THE SAMPLE</td>
<td>99</td>
</tr>
<tr>
<td>3.04.2</td>
<td>SAMPLING TECHNIQUE</td>
<td>100</td>
</tr>
<tr>
<td>3.04.3</td>
<td>ANALYSIS OF THE SAMPLE</td>
<td>101</td>
</tr>
<tr>
<td>3.05</td>
<td>VARIABLES OF THE STUDY</td>
<td>103</td>
</tr>
<tr>
<td>3.06</td>
<td>TOOLS USED FOR DATA COLLECTION</td>
<td>103</td>
</tr>
<tr>
<td>3.06.1</td>
<td>SELF-CONCEPT SCALE</td>
<td>103</td>
</tr>
<tr>
<td>3.06.2</td>
<td>EMOTIONAL COMPETENCE SCALE</td>
<td>105</td>
</tr>
<tr>
<td>3.06.3</td>
<td>LEARNING ENVIRONMENT SCALE</td>
<td>107</td>
</tr>
<tr>
<td>3.06.4</td>
<td>ACHIEVEMENT TEST IN TEACHING OF MATHEMATICS</td>
<td>112</td>
</tr>
<tr>
<td>3.06.5</td>
<td>PERSONAL DATA SHEET</td>
<td>116</td>
</tr>
<tr>
<td>3.07</td>
<td>DATA COLLECTION</td>
<td>116</td>
</tr>
<tr>
<td>3.08</td>
<td>SCORING AND CONSOLIDATION OF DATA</td>
<td>117</td>
</tr>
<tr>
<td>3.09</td>
<td>STATISTICAL TECHNIQUES USED</td>
<td>117</td>
</tr>
<tr>
<td>3.10</td>
<td>CONCLUSION</td>
<td>122</td>
</tr>
</tbody>
</table>
CHAPTER III
METHODOLOGY

3.00 INTRODUCTION

In this chapter, the procedure and methodology of the study are described. The research study is aimed at examining the relationship of achievement in Teaching of Mathematics with Self-Concept, Emotional Competence and Learning Environment of primary teacher trainees. The details of Method adopted, Variables selected, Tools used for data collection, Sample selected, Procedure for collection of data, Scoring and consolidation of data, and Statistical techniques used for analysis of data are described in detail under suitable heads as given below.

3.01 METHOD ADOPTED

The selection of a method and the specific design within that method appropriate to the research problem will depend upon the nature of the problem and upon the kind of data. Based on the topic and objectives of the study the investigator has adopted normative survey method. The word ‘survey’ indicates the gathering of data regarding the present conditions. It attempts to describe and interpret what exists at present in the form of conditions, practices, processes, trends, etc. The word ‘normative’ is used because surveys are frequently made for the purpose of ascertaining which the normal or typical condition is or practice at the present time. Thus, the normative survey method attempts to find out the normal or typical condition or practice existing currently.

3.02 AREA OF THE STUDY

The area of the study consists of two Southern revenue districts of Tamil Nadu namely, Tirunelveli and Thoothukudi. The map spotting these areas of study is attached. (Appendix-XII)
3.03 POPULATION FOR THE STUDY

The target population of the study comprised of all those teacher trainees who were enrolled in all the Teacher Training Institutes, including DIETs in Tirunelveli and Thoothukudi districts of Tamil Nadu during the academic year 2012-2013.

The details of Teacher Training Institutes situated in the two southern districts of Tamil Nadu are as follows:

**TABLE NO: 3.1**

**Details of TTIs in Tirunelveli and Thoothukudi districts**

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>DIET</th>
<th>GOVT.TTI</th>
<th>AIDED TTIs</th>
<th>SELF-FINANCED TTIs</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tirunelveli</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Thoothukudi</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>37</td>
<td>46</td>
</tr>
</tbody>
</table>

The population of the present study comprises all primary teacher trainees studying in these two districts. 46 Teacher Training Institutions were functional during the academic year 2012-2013. The details of the population of teacher trainees in these districts are as follows:

**TABLE NO: 3.2**

**Details of teacher trainees enrolled in all the TTIs during the year 2012-13.**

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>NO. OF TEACHER TRAINEES</th>
<th>I YEAR</th>
<th>II YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tirunelveli</td>
<td>1242</td>
<td>1377</td>
<td></td>
</tr>
<tr>
<td>Thoothukudi</td>
<td>469</td>
<td>885</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1711</td>
<td>2262</td>
<td></td>
</tr>
</tbody>
</table>

Note: Teacher trainees studying in II year alone were selected for the sample
3.04 SAMPLE SELECTED FOR THE STUDY

Selection of sample is an integral part of any research. A good sample of a population is one, which will reproduce the characteristics of the population with great accuracy. “Sample is a small group selected from a large population; the sample is intended to reflect the population closely, so that findings made from the sample will be applicable to the population” (Charles, 1995). According to Best and Kahn (1999) “A sample is a small proportion of a population selected for observation and analysis. By observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is drawn”. “The validity of the results obtained with any psychological tests will depend in part upon the adequacy and representativeness of standardization sample” (Freeman 1960).

The population of the present study was primary teacher trainees studying in various Teacher Training Institutes in Tirunelveli and Thoothukudi districts of TamilNadu. The study was confined to the second year teacher trainees only. Treating this as the reference population, the investigator had to take decisions regarding the size of the sample, techniques of sampling, and factors to be represented in the sample. The details are given below:

3.04.1 Size of the sample

In fixing the size of the sample, the investigator took into consideration the following factors:

i) The major consideration in deciding the size of the sample was the type of statistical procedures used in the study

ii) The size of the sample should be small enough to permit a close study. As there are a series of tests to be administered together with other forms of information about them, it was estimated that nearly three hours of testing time will be required for
completing the administration of the tests. Hence the size will have to be small enough to be effectively covered.

The above considerations suggest a sample size of around 600 primary teacher trainees from various teacher training institutions.

3.04.2 Sampling Technique

Of the various techniques, stratified random sampling technique is found to be the best suited technique for the present study. Stratified random sampling is ‘a technique designed to ensure representativeness and to avoid bias. This technique is applicable when the population is composed of sub groups or strata of different sizes, so that the representative sample must contain individuals drawn from each category or stratum in accordance with the size of the sub groups” (Garrett, 1973). The stratified random sampling technique is widely accepted as the best procedure when heterogeneous sample have to be brought under study, as in the present case.

At the first stage, stratification was done on the basis of revenue districts. First of all, the lists of all Teacher Training Institutions functioning in the two districts were obtained from the DIETs of the respective districts. At second stage, ten Teacher Training Institutions from each revenue district were randomly selected. The selected TTIs were divided into three strata viz. Government, Aided and Self-Financed TTIs. At the third stage the respondents were selected at random from the selected institutions. Since majority of the institutions were meant for women only, co-educational institutions were selected compulsorily. The respondents were divided into two strata viz. Men and women. The TTIs selected are given Appendix VII and VIII.
### TABLE NO: 3.3
Region wise distribution of the sample

<table>
<thead>
<tr>
<th>Region</th>
<th>Population</th>
<th>Sample drawn</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tirunelveli</td>
<td>1377</td>
<td>300</td>
<td>21.79%</td>
</tr>
<tr>
<td>Thoothukudi</td>
<td>885</td>
<td>300</td>
<td>33.90%</td>
</tr>
<tr>
<td>Total</td>
<td>2262</td>
<td>600</td>
<td>26.53%</td>
</tr>
</tbody>
</table>

### 3.04.3 ANALYSIS OF THE SAMPLE

### TABLE NO: 3.4
Distribution of sample with reference to background variables

<table>
<thead>
<tr>
<th>S. No</th>
<th>Variables</th>
<th>Category</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>Men</td>
<td>156</td>
<td>26.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Women</td>
<td>444</td>
<td>74.00</td>
</tr>
<tr>
<td>2</td>
<td>Marital Status</td>
<td>Married</td>
<td>65</td>
<td>10.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unmarried</td>
<td>535</td>
<td>89.17</td>
</tr>
<tr>
<td>3</td>
<td>Residence</td>
<td>Hosteller</td>
<td>345</td>
<td>57.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day-scholar</td>
<td>255</td>
<td>42.50</td>
</tr>
<tr>
<td>4</td>
<td>Group at 12\textsuperscript{th} standard</td>
<td>Arts</td>
<td>190</td>
<td>31.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science</td>
<td>259</td>
<td>43.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vocational</td>
<td>151</td>
<td>25.16</td>
</tr>
<tr>
<td>5</td>
<td>Marks in 12\textsuperscript{th} standard</td>
<td>&lt; 700</td>
<td>81</td>
<td>13.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>700 - 1000</td>
<td>449</td>
<td>74.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 1000</td>
<td>70</td>
<td>11.67</td>
</tr>
<tr>
<td>6</td>
<td>Type of Institution</td>
<td>Govt.</td>
<td>180</td>
<td>30.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aided</td>
<td>190</td>
<td>31.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-Financed</td>
<td>230</td>
<td>38.33</td>
</tr>
</tbody>
</table>
The above table reveals that 26% of the respondents are men and 74% of the respondents are women teacher trainees. 10.83% of the student teachers are married and 81.17% are unmarried. 57.5% of the total sample is residing in the hostel attached to the institution and 42.5% are coming to the institution daily from their home. Half of the sample is from Tirunelveli region and the remaining half is from the Thoothukudi region. 31.67% of the sample have chosen Arts group; 43.17% of the sample have chosen Science group and 25.16% of the sample have chosen Vocational group at their 12th standard level. 13.5% of the sample has secured less than 700 marks in the 12th standard examination; 74.83% of the sample has secured marks between 700 and 1000 and only 11.67% of the sample has secured more than 1000 marks out of 1200 in the 12th standard examination. 30% of the sample is from Government Institution; 31.67% from Aided institution and 38.33% from self-financed institution.
3.05 VARIABLES OF THE STUDY

“Variables are the conditions or characteristics that the experimenter manipulates, controls, or observes” (Best & Khan, 2007, p.162). The present study is an attempt to find the relationship of self-concept, emotional competence, and learning environment with achievement in teaching of mathematics. Hence, teaching of mathematics is taken as the dependent variable. Self-concept, emotional competence, and learning environment are taken as independent variables in this study. Gender, marital status, residence, region, group studied at 12th std., marks obtained in 12th std., and type of institution are taken as the background variables. The independent variables are also sub categorized as low, medium, and high groups.

3.06 TOOLS USED FOR DATA COLLECTION

Tools are the instruments which are employed as the means to gather new facts or to explore new fields. Without a powerful data gathering instrument, no reliable data can be collected. According to J.W.Best (1983), “Like the tools in a carpenter box each research tool is appropriate in a given situation to accomplish a particular purpose. Appropriateness of the tools decides the effectiveness of the method of research. The tools employed in the present study are enumerated below.

1. Self-concept scale developed by Dr. Mukta Rani Rastogi
2. Emotional Competence Scale developed by R.Bhardwaj and H.C.Sharma
3. Learning Environment Scale developed by the investigator
4. Achievement Test developed by the investigator

3.06.1. SELF-CONCEPT SCALE (SCS)

The self-concept scale constructed and standardized by Dr.(Miss) Mukta Rani Rastogi was used to assess the self-concept of the subjects. This scale consisted of ten constructs covering three dimensions of self-concept i.e., perceptual, conceptual and the
Attitudinal dimensions. The ten constructs are—Health, Abilities, Self-Confidence, Self-Acceptance, Worthiness, Present Past Future, and Belief in Convictions, Shame & Guilt, Sociability and Emotional Maturity. It consisted of 51 statements and these statements were given in a jumbled order and they included both positive and negative statements.

The positive statements are 1, 2, 4, 6, 7, 8, 9, 18, 20, 22, 25, 27, 34, 36, 37, 40, 42, 43, 44, 46, 47, 48, 49 and the negative statements are 3, 5, 10, 11, 12, 13, 14, 15, 16, 17, 19, 21, 23, 24, 26, 28, 29, 30, 31, 32, 33, 35, 38, 39, 41, 45, 50, 51. Each statement has five responses namely ‘Strongly agree’, ‘Agree’, ‘Undecided’, ‘Disagree’, ‘Strongly Disagree’. The subject had to put a tick mark (√) for any of the five responses that fits them best. Reliability was computed by using test and retest method. The reliability obtained was 0.85.

**Method of Scoring**

For the positive statements, the five responses were given a weight age of 5,4,3,2,1 respectively for the ‘Strongly agree’, ‘Agree’, ‘Undecided’, ’Disagree’, ‘Strongly Disagree’. For the negative statement, the reverse order was followed and it is given in the following table.

**TABLE NO: 3.5**

Scoring procedure for SCS

<table>
<thead>
<tr>
<th>Response</th>
<th>Scoring Key (Value)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive Statement</td>
<td>Negative Statement</td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Undecided</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

104
PILOT STUDY

In order to establish the reliability of the self-concept scale, the test - retest method was used. Tamil translated version of the questionnaire was pilot tested on 50 teacher trainees studying in different TTIs. The selected teacher trainees from the selected TTIs were asked to fill in the Tamil version of the Self-concept Scale. After a period of fifteen days, the same questionnaire was administered on the same set of teacher trainees. Their responses were scored. The correlation co-efficient was obtained for the two sets of scores and was found to be 0.86. Thus the reliability of the tool was established. Hence, the tool in its original form was made use of in this study. A copy of the tool is given in appendix II.

3.06.2 EMOTIONAL COMPETENCE SCALE (ECS)

The Emotional Competence was assessed by the EC-scale developed by Bharadwaj and Sharma (1995). This scale consists of 30 statements divided into five components viz., adequate depth of feeling, adequate expression and control of emotions, ability to function with emotions, ability to cope with problem emotions and encouragement of positive emotions. The five components of emotional competence are discussed below.

Adequate Depth of Feeling (ADF)

Feeling in its broadest sense is any kind of process or experiencing (English and English, 1958) characterized by predominance of ‘affect’ and accessible emotions which lead to some kind of involvement to a great degree of the individual. A feeling of being confident or capable with all reality assumptions may be termed as adequate depth of feeling specifically associated with effective judgment and personality integration, which ensures vigorous participation in living.
**Adequate Expression and Control of Emotions (AEC)**

Emotional competence requires both an adequate expression and control which may be regarded as natural dynamic stability of an individual to express and control emotions spontaneously as demanded by the situation. Adequate expression and control of emotions refer to a tendency marked by adequate emotional expressiveness based on some expression and control of emotions. Any form of inadequacy in either expression or control of emotions may lead to uncontrolled and disorganized emotionality.

**Ability to Function with Emotions (AFE)**

It is sometimes difficult to carry out even routine work when one finds himself face to face with a highly emotional situation. Emotional competence requires that the individual should develop a characteristic pattern of emotional reactivity which should not let him be influenced in his adequate mode of functioning that helps him in performing actions of daily routine properly.

**Ability to Cope with Problem Emotions (ACPE)**

Certain problem emotions play a destructive role and pose a potential damage to the life orientations of the individual’s course of life. Therefore, emotional competence requires an understanding of the role of sensitivity and the detrimental effects of such emotions in the beginning and also a development of the ability to resist their harmful effects thereafter.

**Encouragement of Positive Emotions (EPE)**

The congenial growth of personality requires predominance of positive emotions that show a constructive influence in the dynamics of behaviour. The growing vitality and feeling of wholeness with a continuous capacity for intellectual and spiritual growth are associated with an experience of positive emotions. The encouragement of positive
emotions refers to the ability of the person to develop a predominance of positive emotions in the personality make-up to ensure a meaningful and fairly well integrated life.

It is a five-point Likert scale having five alternatives to each item. Scoring of these five alternatives follows a system of 1, 2, 3, 4 and 5 from upper to lower end. Each component consists of 6 items and score of each component ranges from 6 to 30. The total emotional competence score ranges from 30-150. The sum of the item scores obtained is taken as the raw score. The Emotional Competence Scale is given in Appendix III.

PILOT STUDY

In order to establish the reliability of the emotional competence scale, the test-retest method was used. Tamil translated version of the questionnaire was pilot tested on 50 teacher trainees studying in different TTIs. The selected teacher trainees from the selected TTIs were asked to fill in the Tamil version of the emotional competence scale. After a period of fifteen days, the same questionnaire was administered on the same set of teacher trainees. Their responses were scored. The correlation co-efficient was obtained for the two sets of scores and was found to be 0.74. Thus the reliability of the tool was established. Hence, the tool in its original form was made use of in this study. A copy of the tool is given in appendix III.

3.06.3 LEARNING ENVIRONMENT SCALE (LES)

This scale was developed and standardized by the investigator with the help of the research supervisor and in consultation with experts in the field. The details of the procedure involved in the development of the scale are given below.

Preparation of the draft tool

The investigator reviewed books, periodicals and other descriptive materials to procure the requirements to construct the items for the learning environment scale. Experts in the field were also consulted and their suggestions were taken into consideration. The
investigator decided to include eight dimensions of learning environment. The eight dimensions were order and organization, physical facilities, teaching resources, activities, peer relations, teacher support, involvement, and task orientation. Initially, one hundred fifty items were prepared. These items were presented to a group of three judges and according to the opinion of the judges, the complex and vague items were discarded. Ultimately one hundred and thirty eight statements were included in the draft form of the learning environment scale. The scale was developed following the Likert method.

Pre-try-out

After a thorough screening and editing of the items, the scale was tried out on twenty five teacher trainees in order to find out the accuracy and relevance of each statement. After this preliminary administration, minor changes were made in the language and sentence construction in some of the statements. It was also ascertained that the vocabulary used in the items was appropriate for the trainee students.

Try-out

After pre-try-out, the test was administered on a sample of one hundred teacher trainees under study. The test papers were evaluated and were arranged in descending order of scores i.e. from highest scores to the lowest scores. The sum of the scores of all the items constituted the total score of the scale. The highest 27% and lowest 27% of the response sheets were separated. These were the criterion group in terms of which to evaluate individual statements.

Item Analysis

a) Item Discrimination

Item discrimination was calculated by using the following formula.

\[
\text{Item discrimination} = \frac{D_{\text{observed}} \times (\text{High group} - \text{Low group})}{D_{\text{maximum}} \times (\text{High group} - \text{Low group})}
\]

[Illustration:
\( D_{\text{observed}} \) for High group

Suppose for statement no. 1 (positive statement), 8 respondents put tick mark against SA; 5 respondents put tick mark against A; 5 respondents put tick mark against U; 4 respondents put tick mark against D and 3 respondents put tick mark against SD.

Then, High group score = \((8 \times 5) + (5 \times 4) + (5 \times 3) + (4 \times 2) + (3 \times 1) = 86\)

For Low group,

Suppose 3 respondents put tick mark against SA; 2 respondents put tick mark against A; 5 respondents put tick mark against U; 9 respondents put tick mark against D and 6 respondents put tick mark against SD;

Then, Low group score = \( (3 \times 5) + (2 \times 4) + (5 \times 3) + (9 \times 2) + (6 \times 1) = 62\)

\( D_{\text{maximum}} \)

High group score = \(27 \times 5 = 135\)

Low group score = \(27 \times 1 = 27\)

Therefore, Item discrimination = \(\frac{86 - 62}{135 - 27}\)

\[ = \frac{24}{108} = 0.222... \]

**Item Difficulty**

‘Item–whole’ correlation (Pearson’s) determines the item difficulty of the scale.

Items with correlation coefficient, more than 0.40 were selected for the final tool.

The investigator selected the items with difficulty level 40 to 80 and discrimination index above 0.20. Thus 77 items were selected for the final tool. The final tool is given in the appendix III. Item discrimination and item difficulty of Learning Environment Scale and the items selected for the final tool are given in Appendix IV:
TABLE NO: 3.6
Description of the LES

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Dimension</th>
<th>No. Of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Order and Organization</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Physical Facilities</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Teaching Resources</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Activities</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Peer Relations</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Teacher Support</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>Involvement</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>Task Orientation</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>77</strong></td>
</tr>
</tbody>
</table>

SCORING PROCEDURE

The positive statements are 1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 47, 48, 49, 50, 51, 52, 54, 55, 56, 58, 59, 60, 61, 64, 65, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77 and the negative statements are 6, 8, 20, 24, 45, 46, 53, 57, 62, 63 and 66. Each statement has five responses namely ‘Strongly agree’, ‘Agree’, ‘Undecided’, ‘Disagree’, ‘Strongly Disagree’. The subject had to put a tick mark (√) for any of the five responses that fits them best.

For the positive statements, the five responses were given a weight age of 5, 4, 3, 2, 1 respectively for the ‘Strongly agree’, ‘Agree’, ‘Undecided’, ‘Disagree’, ‘Strongly Disagree’. For the negative statement, the reverse order was followed and it is given below:
**TABLE NO: 3.7**  
Scoring Procedure for LES

<table>
<thead>
<tr>
<th>Category</th>
<th>Scoring Key (Value)</th>
<th>Positive Statement</th>
<th>Negative Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Undecided</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**RELIABILITY**

In order to establish the reliability of the learning environment scale, the test-retest method was used. Tamil version of the questionnaire was administered on a set of 50 teacher trainees studying in different TTIs. The selected teacher trainees from the selected TTIs were asked to fill in the learning environment scale. After a period of fifteen days, the same questionnaire was administered on the same set of teacher trainees. Their responses were scored. The correlation co-efficient was obtained for the two sets of scores and was found to be 0.82. Thus the reliability of the tool was established.

**VALIDITY**

The content validity of the scale was censured by subjecting the items prepared for the initial try-out before a panel of three experts for scrutiny. The items which were accepted by the panel of experts were selected and included in the final tool. A copy of the final tool in English and its Tamil version is given in Appendix IV.
3.06.4 ACHIEVEMENT TEST IN TEACHING OF MATHEMATICS

Achievement test in Teaching of Mathematics was constructed by the investigator. This test consisted of 50 objective type questions from the D.El.Ed., second year Text book. The tool was developed following the steps described below.

i) Selection of content


The investigator, being the teacher educator for more than a decade, feels that the trainees’ mastery in the subject could be understood by testing their mastery in eighty percent of the portion. The informal discussion with the colleagues also supports his ideas. Thus the part of the portion prescribed for the second year D.El.Ed. Course is selected as the content for the academic achievement in Teaching of Mathematics in this study. The portion included Applications of Mathematics in Everyday Life, Algebra, Statistics, Practical Geometry, Strategy Instructions, and Problem Based Learning in Mathematics, Word Problems, and Preparation of Further Activities for Learning Mathematics.

ii) Development of the test

After studying the related literature and other tools, the investigator started preparing the test. Before such preparation, proper guidance of experts, Lecturers and Senior Lecturers of the DIET were taken into consideration. The achievement test was subjected to criticism and suggestion. After completing the above procedure, the investigator finalized the achievement test items in consultation with the subject experts.
and the research guide. This test consists of questions set on the specification of objectives knowledge, understanding, application and skills. At first, blue print was prepared for the achievement test. The objective type questions are distributed as follows.

**Blue Print**

The blue print is a document that gives a complete picture of the test. It shows the distribution of questions and marks assigned for different objectives. It helps the test constructor to prepare appropriate questions to suit the purpose of test construction. Thus the blue print was prepared showing the distribution of questions and scores for different objectives namely knowledge, understanding, application and skill.

**TABLE NO: 3.8**

**Blue Print- Teaching of Mathematics – Second Year (D.El.Ed.)**

**Time–1 Hours Maximum Mark–50**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Objectives</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Skill</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Applications of Mathematics in Everyday Life</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>Algebra</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>12%</td>
</tr>
<tr>
<td>3</td>
<td>Statistics</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>6%</td>
</tr>
<tr>
<td>4</td>
<td>Practical geometry</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>5</td>
<td>Strategy Instructions</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>18%</td>
</tr>
<tr>
<td>6</td>
<td>Problem Based Learning in Mathematics</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>7</td>
<td>14%</td>
</tr>
<tr>
<td>7</td>
<td>Word Problems</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>18%</td>
</tr>
<tr>
<td>8</td>
<td>Preparation of Further Activities for Learning Mathematics</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>9</td>
<td>Total</td>
<td>13</td>
<td>22</td>
<td>10</td>
<td>5</td>
<td>50</td>
<td>100%</td>
</tr>
<tr>
<td>10</td>
<td>Percentage</td>
<td>26%</td>
<td>44%</td>
<td>20%</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
iii) Standardization of the Test

After the development of the achievement test the validity of the test and the reliability of the test were established by item analysis and test–re test method respectively.

Validity

In order to find the goodness of each item in the achievement test, item analysis was followed by the investigator. The responses of each test item were scored simply as ‘1’ for right answer ‘O’ for wrong answer responses. The achievement test was administered on a small group of 50 primary teacher trainees. The investigator was with the subjects at the time of administering the test. The doubts raised by the subjects were clarified and the items concerned were noted down, the items found ambiguous were also corrected. From the responses, the total number of “Right answer” and total number of “wrong answer” were calculated. After careful analysis, 50 items were selected.

Item Validity

The pilot study was conducted to establish the item validity of the research tool. The tool was administered to fifty second year teacher trainees randomly selected. The investigator tried to refine the tool by finding out the most suitable items to be included in the final tool. The item analysis was carried out to find out the item difficulty index and item discriminating power of each item. The scores were arranged in the descending order. The upper 27 percent of the scores and lower 27 percent of the scores were selected.

Item Difficulty Level

The item difficulty of an item is the percentage of students who answer the items correctly in a tool. It is calculated using the formula.

\[
\text{Difficulty Index} = \frac{R}{T} \times 100
\]

R - The number of examiners who get the item correctly.
T - The total number of examiners who tried the item.

**Item Discriminating Power**

The discriminating power of a test item is a measure of an item ability to discriminate best those who scored high on the total test and those who scored low. It is calculated using the formula.

\[ \text{Discriminating Power} = \frac{RU + RL}{\frac{1}{2}T} \]

RU - The number of examiners in the Upper group who get the item right

RL - The number of examiners in the Lower group who got the item right

T - Total number of examiners included in the item analysis.

**Selection Criteria**

Items with difficulty level 40% to 80% and items with discrimination index 0.2 and more were selected for the final tool. The final tool is given in the appendix V. Item discrimination and item difficulty of achievement test and the items selected for the final tool are given in appendix V.

The questions were also shown to senior faculty members of the DIET and two professors of Mathematics in college of education. All the suggestions and corrections proposed by the experts were incorporated and the tool is thus found to be valid.

**Reliability**

Before arriving at a final form of the achievement test (Questionnaire) a pilot study was conducted on a set of 50 teacher trainees. The investigator had administered the tool with 50 teacher trainees and the responses were collected. After a period of 15 days same questions were administered with the same students. Again the responses were observed. The correlation coefficient between these two responses was found as 0.71. Thus the reliability of the tool was established.
Administration of the Test

After careful planning, the tool was administered personally by the investigator on the teacher trainees in their respective places. For this purpose, permission was sought from the respective heads of Teacher training Institutes. After getting the permission from the heads of the institutions, instructions were carefully read out and explained to the trainees. The teacher trainees were instructed to respond by marking a tick (√) mark in the appropriate boxes for 50 questions.

Quantification of the Test

The achievement test designed by the investigator is objective type. This test is used to find the achievement level of primary teacher trainees in the subject—Teaching of Mathematics. This test consists of 50 objective type questions. The achievement test, so prepared after getting the responses from the teacher trainees is quantified as follows.

**TABLE NO: 3.9**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Right Answer</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Wrong Answer</td>
<td>0</td>
</tr>
</tbody>
</table>

The maximum marks in this test is ‘fifty’ and minimum ‘Zero’. For convenience, the scores obtained by the subjects were converted to ‘One Hundred’

3.06 5 PERSONAL DATA SHEET

A Personal data sheet was prepared by the researcher. It is given in Appendix I.

3.07 DATA COLLECTION

First of all, permission was obtained from all the heads of the selected TTIs for administration of the research instruments. Venue and time of data collection was also confirmed from the heads of the selected institution. The data were collected by the
researcher himself. Before administering the questionnaires, trainees were briefed about the procedure “How to respond to the questionnaire”. The trainees were assured that their responses would not affect their regular classroom evaluation. Information given by them would be used for research purpose only.

3.08 SCORING AND CONSOLIDATIONS OF DATA

Scoring of the responses was done in accordance with the scoring scheme of each test. The scores on different tools were tabulated on a consolidated data sheet. The total sample was classified on the basis of gender, marital status, residence, region, group studied at 12th standard, marks obtained in 12th standard and type of institution. Each subject was assigned a number and the whole data corresponding to that subject were coded in different columns headed with suitable codes to identify each, against the number.

3.09 STATISTICAL TECHNIQUES USED

The major statistical techniques used are

1) Finding of Levels

After calculating mean and standard deviation, the scores were grouped in to three
Low Level = Scores below ‘Mean – Standard deviation’
Average Level = Scores between ‘Mean ± Standard deviation’
High level = Scores above ‘Mean + Standard deviation’

2) Two tailed test of significance of the difference between means for large independent groups

The significance of difference in mean scores for the dependent variable and independent variables for the sub samples based on gender, marital status, and residence was determined by testing the significance of difference between means of these paired groups, i.e. Men-Women, Married-Unmarried, and Hostellers-Day scholars.
The significance of difference in mean scores for the dependent variable was further analyzed with more sub-groups. The whole sample was categorized into three groups viz. Low, Medium and High based on the score of each of the three independent variables studied. Significance of difference in the mean scores of dependent variable for the sub samples based on gender, marital status, residence, region and group studied at 12th standard, marks in 12th standard and type of institution in each of the three categories (Low, Medium and High) of the sample for the three independent variables was estimated separately.

The procedure to work out the t-values (critical ratio) for estimating the significance of difference between means is given by the formula

\[ t = \frac{M_1 - M_2}{SE(M_1-M_2)} \]  

(Garrett, 1981)

Where,

- \( M_1 \) = Mean score of the first group
- \( M_2 \) = Mean score of the second group

and \( SE(M_1-M_2) \) = standard error of difference between means \( M_1 \) and \( M_2 \)

\( SE(M_1-M_2) \) was estimated by using the formula,

\[ SE(M_1-M_2) = \sqrt{SE^2 m1 + SE^2 m2} \]

where,

\( SE^2 m1 \) and \( SE^2 m2 \) are the standard errors of the mean scores \( M_1 \) and \( M_2 \) respectively,

If \( N_1 \) and \( N_2 \) are the size of the samples under comparison and \( \sigma_1 \) and \( \sigma_2 \) are their respective standard deviations

Then, \( SE M1 = \frac{\sigma_1}{\sqrt{N_1}} \) and \( SE M2 = \frac{\sigma_1}{\sqrt{N_2}} \)

The t-value (critical ratio) obtained is treated as belonging to a normal distribution. If the obtained falls between +1.96 and -1.96 the difference between means is considered as
not being significant at 0.05 levels. If the t-value exceeds ±1.96, then the difference in means was considered as significant at 0.05 levels. If the estimated t-value falls between -2.58 and +2.58, then the difference between means was not being treated as significant at 0.01 levels and if it falls outside the range ±2.58, then it was considered as significant at 0.01 level.

3) Analysis of Variance

The analysis of variance (ANOVA) is an effective way to determine whether means of more than two samples are too different to attribute to sampling error. The one-way analysis of variance consists of these operations;

1) The variance of the scores for the groups is combined into one composite group, known as total group’s variance ($V_t$).
2) The mean value of the variances of each of the groups, computed separately, known as within groups variance ($V_w$).
3) The difference between total groups variance and within groups variance in known as the between-groups variance ($V_t - V_w = V_b$).
4) The F ratio is computed as

$$F = \frac{V_b}{V_w} = \frac{\text{Between group variance}}{\text{Within group variance}}$$

The SPSS package was used to calculate the F-value. If the calculated F-value is found to be significant, then the Tukey HSD post hoc multiple comparison procedure would be applied to know the pairwise comparisons.

4) Pearson’s product-moment coefficient of correlation ‘r’ (Best and Khan, 1995)

For estimating the extent of relationship between dependent and independent variable, the technique of Pearson’s Product-Moment coefficient of correlation method
was used. The Statistical Package for Social Sciences (SPSS) was used for finding the extent of relationship between the dependent and independent variables.

The Pearson’s Product-Moment coefficient of correlation formula for calculating ‘r’ is

\[ r = \frac{N\sum{XY} - (\sum{X})(\sum{Y})}{\sqrt{N\sum{X^2} - (\sum{X})^2}\sqrt{N\sum{Y^2} - (\sum{Y})^2}} \]

Where, \( r \) = Pearson’s Product – Moment coefficient of correlation

- \( \sum{X} \) = sum of the X scores
- \( \sum{Y} \) = sum of the Y scores
- \( \sum{X^2} \) = sum of the squared X scores
- \( \sum{Y^2} \) = sum of the squared Y scores
- \( \sum{XY} \) = sum of the product of paired X and Y scores
- \( N \) = Number of paired scores

5) Partial correlation

Partial correlation is used to remove the effect of one variable on the correlation between two or other variables. It is calculated using the formula

\[ R_{12,3} = \frac{r_{12} - (r_{13})(r_{23})}{\sqrt{1-r_{12}^2}(1-r_{23}^2)} \]

6) The coefficient of multiple correlations ‘R’

The multiple correlation co-efficient ‘R’ of the variable \( X_1 \) and variables \( X_2, X_3, \) and \( X_4 \) is given by

\[ R_{1(234)} = \sqrt{1 - \frac{\sigma_{1234}^2}{\sigma_{12}^2}} \]

variable \( X_1 \) when the effect of the variables \( X_2, X_3, \) and \( X_4 \) are held constant.

The coefficient of multiple correlations indicates the strength of the relationship between one variable and two or more others combined with optimal weights.

The significance of multiple ‘R’ is interpreted in the same way as the simple correlation coefficient ‘r’.
7) Multiple Regression Equation (Garrett, 1981)

Multiple regression equations were derived to predict the mean scores of achievement in Teaching of Mathematics of primary teacher trainees by using the three influencing independent variables. The influence of each independent variable on achievement in Teaching of Mathematics also can be found out. The regression which expresses the relationship between $X_1$ (the criterion variable – the variable to be predicted) and the three independent variables $X_2, X_3$ and $X_4$ given in the score form is

$$(X_1 - M_1) = b_{12,34}(X_2 - M_2) + b_{13,24}(X_3 - M_3) + b_{14,23}(X_4 - M_4)$$

or transposing and collecting terms, the above equation is

$$X_1 = b_{12,34}X_2 + b_{13,24}X_3 + b_{14,23}X_4 + k \text{ (a constant)}$$

Where, $b_{1234}, b_{1324}$ and $b_{1423}$ are the regression coefficients $M_1, M_2, M_3$ and $M_4$ are the mean scores of the variables $X_1, X_2, X_3$ and $X_4$ respectively

The regression coefficients are given by the formula

$$b_{12,34} = \frac{r_{12,34}}{\frac{\sigma_{1,234}}{\sigma_{2,134}}}$$
$$b_{13,24} = \frac{r_{13,24}}{\frac{\sigma_{1,324}}{\sigma_{3,124}}}$$
$$b_{14,23} = \frac{r_{14,23}}{\frac{\sigma_{1,423}}{\sigma_{4,123}}}$$

In these

$$r_{12,34} = \frac{r_{12,3} - r_{14,3} \cdot r_{24,3}}{\sqrt{1 - r^2_{12,3}} \cdot \sqrt{1 - r^2_{24,3}}}$$
$$r_{13,24} = \frac{r_{13,2} - r_{14,2} \cdot r_{34,2}}{\sqrt{1 - r^2_{13,2}} \cdot \sqrt{1 - r^2_{34,2}}}$$
$$r_{14,23} = \frac{r_{14,2} - r_{13,2} \cdot r_{41,2}}{\sqrt{1 - r^2_{14,2}} \cdot \sqrt{1 - r^2_{41,2}}}$$

$$\sigma_{1,234} = \sigma_1 \sqrt{1 - r^2_{12}} \cdot \sqrt{1 - r^2_{13,2}} \cdot \sqrt{1 - r^2_{14,23}}$$
$$\sigma_{2,134} = \sigma_1 \sqrt{1 - r^2_{21}} \cdot \sqrt{1 - r^2_{23,1}} \cdot \sqrt{1 - r^2_{24,13}}$$
\[ \sigma_{1,324} = \sigma_1 \sqrt{1 - r_{12}^2} \sqrt{1 - r_{13}^2} \sqrt{1 - r_{14}^2} \]
\[ \sigma_{3,124} = \sigma_1 \sqrt{1 - r_{12}^2} \sqrt{1 - r_{32}^2} \sqrt{1 - r_{34}^2} \]
\[ \sigma_{1,423} = \sigma_1 \sqrt{1 - r_{14}^2} \sqrt{1 - r_{12}^2} \sqrt{1 - r_{13}^2} \]
\[ \sigma_{4,123} = \sigma_1 \sqrt{1 - r_{41}^2} \sqrt{1 - r_{12}^2} \sqrt{1 - r_{13}^2} \]

Beta (\( \beta \)) coefficients or ‘beta weights’ may be calculated from b’s

Thus

\[ B_{1234} = b_{1234} \times \frac{\sigma^2}{\sigma_1} \]
\[ B_{1324} = b_{1324} \times \frac{\sigma^3}{\sigma_1} \]
\[ B_{1423} = b_{1234} \times \frac{\sigma^4}{\sigma_1} \]

The ‘beta weights’ give the relative weight by which each independent variable contributes to the dependent variable, independently of the other factors. \( R^2 \) of the multiple regression equation may be expressed in terms of beta coefficients and the zero order r’s.

Thus,

\[ R^2_{(1234)} = \beta_{12,34} \times r_{12} + \beta_{13,24} \times r_{13} + \beta_{14,23} \times r_{14} \]

\( R^2 \) of the multiple regressions gives the proportion of variance of dependent variable attributable to the joint action of independent variables. From the \( R^2 \) values obtained percentage of variance of dependent variance attributable to the joint action of independent variables also can be calculated. Similarly, \( \beta_{12,34} \times r_{12}, \beta_{13,24} \times r_{13}, \beta_{14,23} \times r_{14} \) each give percentage of variance of dependent variable attributed to the action of that particular independent variables.

3.10 CONCLUSION

In this chapter, the investigator discussed the method adopted for the study, population and samples selected for the study, tools used for the study and statistical techniques used. The next chapter deals with the analyses of data.