CHAPTER-III

METHODOLOGY

This chapter deals with the methodology adopted in the present study. It describes the method used in the study, variables involved, sample of the study, the tools used for the collection of data, procedure of data collection and the statistical techniques used for the analysis of data.

3.1 METHOD OF THE STUDY

The present study aimed at ascertaining the relationship of learning outcomes of adolescents with other variables viz. emotional intelligence, metacognition and personality traits; finding out the significance of difference in gender, locale, school and stream with regard to different variables of the study and to find out the interaction among them. To achieve these objectives of the study, normative survey method was found to be the best suited because survey studies are conducted to collect detailed descriptions of existing phenomena with the intent of employing data to justify current conditions and practices or to make more intelligent plans for improving them. Their objective is not only to analyse, interpret and report the status of an institution, group or area in order to guide practice in the immediate future but also to determine the adequacy of status by comparing it with established standards. The present investigation endeavours to use the steps and characteristics essential for the normative survey method of research.

3.2 VARIABLES INVOLVED

The present study involved the following variables:

**Independent Variable:** The independent variable or stimulus variable is that factor which is measured, manipulated or selected by the researcher to determine its relationship to an observed phenomenon. In the present study, Emotional Intelligence, Metacognition and Personality Traits of adolescents are independent variables.

**Dependent Variable:** The dependent variable or response variable is that factor which is observed and measured to determine the effect of the independent variable. It is considered
dependent because its value depends upon the value of the independent variable. In the present study, learning outcomes of the adolescents is a dependent variable.

**Moderator Variable:** The moderator variable is the factor which is measured, manipulated or selected by the researcher to discover whether it modifies the relationship between the independent variable and the dependent variable. It is a kind of independent variable or a secondary independent variable. It is a factor which affects the relationship between the primary independent variable and the dependent variable. In the present study, gender, locale, type of school and subject stream are considered as moderator variables.

**Control Variable:** Some factors are neutralized to make sure that they will not have a differential or moderating effect on the relationship between independent and dependent variables. These factors are called control variables. In the present study, other factors such as grade and age were controlled by using an appropriate sampling device. To reduce the influence of these factors to minimum possible degree, the sample comprised of only XII class adolescents who were of almost equal age range of 14-17 years.

### 3.3 SAMPLE OF THE STUDY

It is not possible for an investigator to conduct a study on the entire population when the size of the population is large. Therefore, the sample, representative of the population has to be selected. The sample of the present study consists of 1000 adolescents studying in class XII and is raised from three districts in Punjab, viz. Ludhiana, Jalandhar and Moga. The total sample is divided equally on the basis of their gender, locale, type of school and subject streams as depicted in the figure 3.1:
Collection of data from three districts of Punjab
3.4 DESCRIPTION OF THE TOOLS USED

The following tools are employed in the study:

(i) Mangal Emotional Intelligence Inventory by Dr. S. K. Mangal and Mrs. Shubra Mangal.

(ii) Metacognition Inventory by Dr. Punita Govil.

(iii) Dimensional Personality Inventory by Dr. Mahesh Bhargava.

(iv) The variable learning outcomes is divided into two parts for the study:

   Academic Achievement and Non Academic Achievement.

   (a) Academic achievement is studied by taking percentage of the marks obtained by students in the previous class.

   (b) Non academic achievement scale is constructed by the investigator.
Details about the construction and standardization of these tests are given below:

(I) **Mangal Emotional Intelligence Inventory (MEII)**

Emotional intelligence inventory has been designed for use with Hindi and English knowing 16+ years age of school, college and university students for the measurement of their emotional intelligence (total as well as separately) in respect of four areas of emotional intelligence namely, Intra-personal Awareness, Inter-personal Awareness, Intra-personal Management and Inter-personal Management respectively. It has 100 items, 25 each from the four areas to be answered in Yes or No.

**Item Analysis**

Item analysis was carried out by computing biserial correlation of each item (i) with the total scores on the inventory and (ii) with the area total scores. The significance of a biserial at 0.01 level was fixed as the criterion for retaining an item.

**Standardisation**

The final test of 100 items was administered on a large sample of 2200 (1050 males and 1150 females) students of 16+ years age. The distributions of the scores of the subjects of both sexes in respect to the total inventory as also of the four separate areas of the inventory were tested for the normality by applying chi square test. The test upheld that the distributions were not departing significantly from normality.

**Reliability**

Reliability of the inventory was examined through three different methods, namely

(i) Split half method using Spearman-Brown prophecy formula
(ii) K-R formula (20)
(iii) Test-retest method (after a period of 4 weeks)

The reliability coefficients derived through these tests are given in the table 3.1.

<table>
<thead>
<tr>
<th>Method used</th>
<th>N</th>
<th>Reliability coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Split half</td>
<td>600</td>
<td>0.89</td>
</tr>
<tr>
<td>(ii) K-R (20)</td>
<td>600</td>
<td>0.90</td>
</tr>
<tr>
<td>(iii) Test-retest</td>
<td>200</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Table 3.1 Reliability coefficients of MEII
Validity

The validity for the inventory has been established by adopting two different approaches, namely factor and criterion related approach.

Factorial Approach

For adopting factorial approach inter-correlations among the four areas of the inventory were calculated. The derived correlation matrix is presented in the table 3.2.

<table>
<thead>
<tr>
<th>Intra PA</th>
<th>Inter PA</th>
<th>Intra PM</th>
<th>Inter PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra PA</td>
<td>-</td>
<td>0.716</td>
<td>0.501</td>
</tr>
<tr>
<td>Inter PA</td>
<td>0.716</td>
<td>-</td>
<td>0.452</td>
</tr>
<tr>
<td>Intra PM</td>
<td>0.501</td>
<td>0.452</td>
<td>-</td>
</tr>
<tr>
<td>InterPM</td>
<td>0.437</td>
<td>0.480</td>
<td>0.476</td>
</tr>
</tbody>
</table>

Criterion related Approach

Two different external measures used for this purpose were (i) Adjustment Inventory for college students developed by A.K.P. Sinha and R.P. Singh and (ii) Emotional Maturity Scale developed by Yasvir Singh and Mahesh Bhargava.

The validity coefficients (the Product Moment correlation coefficients obtained between total scores on Emotional Intelligence Inventory and Adjustment Inventory as well as Emotional Maturity Scale) obtained through these two measures have been given in the table 3.3.

<table>
<thead>
<tr>
<th>Measures used</th>
<th>N</th>
<th>Validity coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment Inventory for college students</td>
<td>400</td>
<td>-0.662</td>
</tr>
<tr>
<td>Emotional Maturity Scale</td>
<td>400</td>
<td>-0.613</td>
</tr>
</tbody>
</table>
Instructions

This inventory can be administered individually or in group. It contains 100 items. In the inventory there are items where the response ‘yes’ is indicative of the presence of emotional intelligence and ‘no’ for the lack of emotional intelligence. Similarly, there are items where ‘no’ response provides clue for the presence of emotional intelligence and ‘yes’ for its absence. The mode of response to each of the item of the inventory is in the form of a forced choice i.e. either Yes or No, indicating complete agreement or disagreement with the proposed statement respectively. There is no time limit for providing responses. Ordinarily, an individual takes 30-40 minutes for completing it. Investigator should see that the students must have responded to every statement.

Scoring

Scoring can be done by hand or with the help of stencil. Thus, for scoring, one mark is to be provided for the response indicating presence of emotional intelligence and zero for the absence of emotional intelligence.

(II) Metacognition Inventory (MCI)

The Metacognition Inventory has been designed to differentiate between high and low level of students in respect to metacognition. This test is helpful in identifying students with poor metacognitive level who may need counselling and training to help them move towards high achievement.

Reliability

The reliability coefficients found through these tests are given in the table 3.4.

<table>
<thead>
<tr>
<th>Method used</th>
<th>N</th>
<th>Reliability Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach alpha coefficient</td>
<td>700</td>
<td>0.85</td>
</tr>
<tr>
<td>Test-retest method</td>
<td>300</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Validity

To ascertain the validity of the test, the draft was given to a panel of experts consisting of 20 eminent scholars of different universities. Each expert was asked to indicate the degree to
which each item assessed the metacognition of the respondents. The degree of agreement of experts on each item indicated the validity of the test. Corrections were made in the test items in accordance with their suggestions. According to their views, they possess satisfactory content validity.

**Instructions**

This Inventory can be administered individually or in group. The respondents should be asked to fill in the personal data blank printed on the front page. The administrator should explain the mode of responding to the items of the Inventory. There is no time limit for completing the Inventory. Ordinarily, an individual takes 15 to 20 minutes in completing it. Investigator should see that the students must have responded to every statement.

**Scoring**

The Inventory contains 30 items, each item being a statement followed by a four-point scale: ‘not at all’, ‘somewhat’, ‘to a considerable extent’ and ‘very much so’. If a respondent marks ‘not at all’ he is given a weightage of 1 point. Similarly, 2, 3 and 4 points are given for markings on ‘somewhat’, ‘to a considerable extent’ and ‘very much so’ respectively. The sum total of weightages assigned on all items is the total score of the respondent.

**(III) Dimensional Personality Inventory (DPI)**

This inventory is devised on the basis of observations of behaviour of different age group people. This test is based on the lines of internationally acclaimed personality test – Minnesota Multiphasic Personality Inventory (MMPI) by Hathaway and Mckinley (1951). The present inventory consists of 60 statements. It measures six important personality dimensions: (i) Activity-Passivity (ii) Enthusiastic-Non enthusiastic (iii) Assertive-Submissive (iv) Suspicious-Trusting (v) Depressive-Non depressive (vi) Emotional instability-Emotional stability. It is assumed that each of the personality traits is normally distributed. Names of the traits given here are postulated to be located to the right end of the normal curve and opposites of the names are located towards left end of the curve. The areas of Dimensional Personality Inventory are described as below:

(i) **Activity-Passivity:** The person is active, energetic, regular, persistent and busy with ability to concentrate for long duration of time, on the one hand and passive, dull, inactive, slow, irregular in working and unwillingness to act on the other hand. Higher score on this
dimension shows activity trait of one’s personality whereas lower score tends the passiveness of an individual.

(ii) **Enthusiastic-Non enthusiastic:** It indicates the tendency to be warm hearted person, enjoying life, fond of being in company of others, social and outgoing, witty and loves courageous work. This is indicated by cyclothymic temperament and higher scores indicate the greater tendency. On the other hand, lower scores indicate reservedness, shyness, inhibited, cold, keeping aloof, feeling difficulty to contact other people and also known as schizothymic personality.

(iii) **Assertive-Submissive:** It indicates the assertiveness of an individual as person is straight forward in all dealing of life, bold, having traits of leadership, independent and dominant, whereas submissiveness keeps his ideas to himself only, fearful to meet and exchange views with others and hesitant to oppose other’s views. High scores indicate the assertiveness trait of personality, whereas low score is near to submissiveness dimension.

(iv) **Suspicious-Trusting:** High score shows the paranoid tendency of the individual which is reflected in his suspicious nature about others, apprehensive, having no faith in others, whereas low score tends to trusting trait of personality. This positive dimension of personality is characterized by adaptable, cheerful, uncompetitive, a good team worker and an open and tolerant person.

(v) **Depressive-Non depressive:** High scores on this personality trait indicates feeling of helplessness, hopelessness, worthlessness, unwanted, unloved, feeling of inferiority, highly frustrated, lack of confidence and full of tension. Whereas low scores tend to be non-depressive characterized by relaxedness, unfrustrated, composed and satisfied.

(vi) **Emotional instability-Emotional stability:** The high score on this personality trait indicates emotional instability where individual is affected by feelings, emotionally less stable, easily annoyed, highly anxious and sensitive. The low score is indicative of emotionally stable trait of the personality where person is with full control over his emotional expressions, emotionally mature, stable and possessing high level of adjustment with unsolved emotional problems.

**Administration**

This test may be administered on all individuals regardless to sex above the age of 14 years. It can be used individually as self administration as well as in groups also.
Instructions

Every individual group is to be instructed that they should read every statement carefully and the response is to be recorded on the basis of 3 alternatives- Yes, Undecided and No. The total time required for completing the inventory is 15 minutes.

Scoring

Each yes response is to be scored as 2, undecided is to be scored as 1 whereas no and unmarked response is to be scored as zero. All the six dimensional areas of personality are grouped as Part I, II, III, IV, V and VI, each containing 10 statements. Thus, on each area of personality, score may range from 0 to 20.

Reliability

The reliability of DPI is determined by following methods:

(i) The coefficient of stability of DPI has been computed by employing test-retest method and it is found significant at 0.01 level in all the cases as shown in table 3.5 and ensure high reliability.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Personality Traits</th>
<th>College going Boys</th>
<th>College going Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Activity-Passivity</td>
<td>0.69</td>
<td>0.72</td>
</tr>
<tr>
<td>(ii)</td>
<td>Enthusiastic-Non enthusiastic</td>
<td>0.78</td>
<td>0.74</td>
</tr>
<tr>
<td>(iii)</td>
<td>Assertive-Submissive</td>
<td>0.72</td>
<td>0.64</td>
</tr>
<tr>
<td>(iv)</td>
<td>Suspicious-Trusting</td>
<td>0.82</td>
<td>0.78</td>
</tr>
<tr>
<td>(v)</td>
<td>Depressive-Non depressive</td>
<td>0.76</td>
<td>0.72</td>
</tr>
<tr>
<td>(vi)</td>
<td>Emotional instability-Emotional stability</td>
<td>0.84</td>
<td>0.82</td>
</tr>
</tbody>
</table>

(ii) The inventory has indicated the satisfactory reliability coefficient when split half method was used. All the reliability coefficients are significant and ensure the high reliability as shown in table 3.6.
Table 3.6  Coefficient of reliability of DPI

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Personality Traits</th>
<th>Coefficient of stability</th>
<th>College going</th>
<th>College going</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>(i)</td>
<td>Activity – Passivity</td>
<td>0.56</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>Enthusiastic – Non enthusiastic</td>
<td>0.62</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td>Assertive – Submissive</td>
<td>0.57</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>(iv)</td>
<td>Suspicious – Trusting</td>
<td>0.75</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>(v)</td>
<td>Depressive – Non depressive</td>
<td>0.68</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>(vi)</td>
<td>Emotional instability – Emotional stability</td>
<td>0.78</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total No. (N)</td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

(iii) The inventory has also shown satisfactory reliability by using method of rational equivalence where inter-relationship of various personality traits have determined in 6x6 inter- correlation matrix. It is also known as internal consistency. All the coefficients of correlations given in the following table are significant at 0.01 level.

Table 3.7  Inter-correlations between various Personality Traits (N=100)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Personality Traits</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Activity – Passivity</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(ii)</td>
<td>Enthusiastic – Non enthusiastic</td>
<td>0.34</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(iii)</td>
<td>Assertive – Submissive</td>
<td>0.39</td>
<td>0.37</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(iv)</td>
<td>Suspicious – Trusting</td>
<td>-0.48</td>
<td>-0.52</td>
<td>0.31</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(v)</td>
<td>Depressive – Non-depressive</td>
<td>-0.52</td>
<td>-0.42</td>
<td>-0.18</td>
<td>0.46</td>
<td>1.0</td>
<td>-</td>
</tr>
<tr>
<td>(vi)</td>
<td>Emotional instability – Emotional stability</td>
<td>-0.42</td>
<td>0.20</td>
<td>0.29</td>
<td>0.33</td>
<td>0.41</td>
<td>1.0</td>
</tr>
</tbody>
</table>

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Validity

In order to establish the validity of DPI, it is correlated with other measures of personality and allied concepts as external validating criteria -

(i) When different personality traits of DPI are correlated with the same personality traits of original English version of Sen’s (1966) Personality Trait Inventory on six factors out of eight, on a group of 80 subjects, the obtained coefficients of correlation are found highly significant at 0.01 level as shown in the following table:

Table 3.8 Coefficients of Correlation between DPI and Sen’s original Personality Trait Inventory in English

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Personality Traits</th>
<th>Coefficient of Correlation</th>
<th>Sen’s PTI Personality areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Activity – Passivity</td>
<td>0.74</td>
<td>Activity</td>
</tr>
<tr>
<td>(ii)</td>
<td>Enthusiastic – Non enthusiastic</td>
<td>0.69</td>
<td>Cyclothymia</td>
</tr>
<tr>
<td>(iii)</td>
<td>Assertive- Submissive</td>
<td>0.79</td>
<td>Dominance</td>
</tr>
<tr>
<td>(iv)</td>
<td>Suspicious- Trusting</td>
<td>0.82</td>
<td>Paranoid tendency</td>
</tr>
<tr>
<td>(v)</td>
<td>Depressive – Non depressive</td>
<td>0.66</td>
<td>Depressive tendency</td>
</tr>
<tr>
<td>(vi)</td>
<td>Emotional instability- Emotional stability</td>
<td>0.84</td>
<td>Emotional instability</td>
</tr>
</tbody>
</table>

(ii) When six dimensions of DPI are correlated with the Hindi Translation of Sen’s Personality Trait Inventory which was done by Verma, Pershad and Mahajan (1990) on a sample of 80 subjects, the obtained coefficients of correlation are found highly significant at 0.01 level as shown in the following table.
### Table 3.9 Coefficients of Correlation between DPI and Hindi Translation of Sen’s Personality Trait Inventory

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Personality Traits</th>
<th>Coefficient of Correlation</th>
<th>Verma, Pershad and Mahajan’s Hindi Translation of Sen’s PTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Activity-Passivity</td>
<td>0.58</td>
<td>Activity</td>
</tr>
<tr>
<td>(ii)</td>
<td>Enthusiastic – Non enthusiastic</td>
<td>0.67</td>
<td>Cyclothymia</td>
</tr>
<tr>
<td>(iii)</td>
<td>Assertive- Submissive</td>
<td>0.57</td>
<td>Dominance</td>
</tr>
<tr>
<td>(iv)</td>
<td>Suspicious- Trusting</td>
<td>0.72</td>
<td>Paranoid tendency</td>
</tr>
<tr>
<td>(v)</td>
<td>Depressive –Non depressive</td>
<td>0.68</td>
<td>Depressive tendency</td>
</tr>
<tr>
<td>(vi)</td>
<td>Emotional instability- Emotional stability</td>
<td>0.56</td>
<td>Emotional instability</td>
</tr>
</tbody>
</table>

When this inventory was correlated on a sample of 80 students of undergraduate classes with the most appropriate 6 dimensions of Kapoor’s (1970) Hindi Version of 16 P.F. Questionnaire Form A, the obtained coefficients of correlation are found significant at 0.01 level as shown in the following table.

### Table 3.10 Coefficients of Correlation between six areas of DPI with six possible factors of 16 P.F.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Personality Traits</th>
<th>Coefficient of Correlation</th>
<th>16 P.F.Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Activity – Passivity</td>
<td>0.68</td>
<td>Group oriented-Self sufficient, (Factor Q2)</td>
</tr>
<tr>
<td>(ii)</td>
<td>Enthusiastic – Non –enthusiastic</td>
<td>-0.74</td>
<td>Reserved-Outgoing (Factor A)</td>
</tr>
<tr>
<td>(iii)</td>
<td>Assertive- Submissive</td>
<td>-0.79</td>
<td>Submissiveness-Dominance, (Factor E)</td>
</tr>
<tr>
<td>(iv)</td>
<td>Suspicious- Trusting</td>
<td>-0.85</td>
<td>Trusting-Suspicious (Factor L)</td>
</tr>
<tr>
<td>(v)</td>
<td>Depressive –Non-depressive</td>
<td>-0.68</td>
<td>Relaxed-Tense (Factor Q4)</td>
</tr>
<tr>
<td>(vi)</td>
<td>Emotional instability- Emotional stability</td>
<td>0.88</td>
<td>Affected by feelings-Emotional stability (Factor C)</td>
</tr>
</tbody>
</table>

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Norms
For the purpose of finding out the Personality traits based on the scores obtained for each of the Six Personality Dimensions, raw scores can be converted in Z-score.

3.5 PROCEDURE OF DATA COLLECTION
Before administering the tests in the selected institutions, the investigator contacted the principals of those institutions and explained them the purpose of investigation and requested for their cooperation in this work. Most of the principals gave full cooperation to the investigator. All the tests were administered one by one on the subjects. The instructions were issued to the subjects very carefully for each test. Mode of answering was explained in case of each test with the help of examples.

For measuring academic achievement, the percentage of marks obtained by students in the previous class was collected from school records. For the assessment of non-academic achievement, class teachers were asked to rank their students on the basis of their participation in non-academic activities mentioned in the instruction sheet. It was judged on a five point rating scale, i.e., A, B, C, D and E grades. The grades given by the class teachers were used for further analysis. Responses of the subjects for other tests administered were scored conveniently on the basis of procedures laid down for the concerned tests.

3.6 STATISTICAL TECHNIQUES USED
The following statistical techniques are used in the present study for the analysis of data:

(i) Mean: It is the best known measure of central tendency. It may be defined as the sum of the separate scores divided by their number.

\[
\text{Mean} = A + \frac{\sum_{i=1}^{n} f_i x_i}{\sum_{i=1}^{n} f_i} \times h
\]

Where: A is the assumed mean.

- \( f_i \) is the frequency of the \( i^{th} \) cell.
- \( x_i \) is the mid point of the \( i^{th} \) cell.
- \( h \) is the length of the class interval.
(ii) **Median**: It is the positional average of a series, when arranged in array.

\[
\text{Median} = L + \frac{(N/2 - c.f.) \times h}{f}
\]

Where:
- \(L\) is the lower limit of the median class.
- \(N\) is the total frequency.
- \(c.f.\) is the cumulative frequency of preceding value of median class.
- \(f\) is the frequency of the median class.
- \(h\) is the length of the class interval.

(iii) **Mode**: Mode is the score with maximum occurrence or with maximum frequency.

\[
\text{Mode} = L + \frac{\Delta f_1 - \Delta f_2}{2\Delta f_1 - \Delta f_2 - \Delta f_3} \times h
\]

Where:
- \(L\) is the lower limit of the modal class.
- \(f_1\) is the frequency of the modal class.
- \(f_0\) is the frequency of the preceded class.
- \(f_2\) is the frequency of the succeeded class.
- \(h\) is the length of class interval

(iv) **Standard Deviation**: It is the square root of the arithmetic average of the squares of the deviations measured from the mean.

\[
\sigma = \sqrt{\frac{\sum f_i x_i^2}{N} - \left(\frac{\sum f_i x_i}{N}\right)^2} \times h
\]

Where:
- \(f\) is the frequency of the class.
- \(x\) is the deviation taken from the assumed mean.
- \(N\) is the total frequency.
- \(h\) is the length of class interval.

(v) **Skewness**: A distribution is said to be skewed when the mean, the median and the mode fall at different points in the distribution and the balance is shifted to one side or the other, to right or left. The skewness in a frequency distribution may be determined on the bases of moments.
\[ \beta_1 = \frac{\mu_3}{\mu_2^2} \]

Where: \( \mu = \text{Moment of correlation} \)
\[ \mu_r = \frac{\sum (x - \bar{x})^r}{N} \]

(vi) **Kurtosis**: It indicates the peakness or flatness of a frequency distribution as compared with the normal. The frequency distribution which is more peaked than the normal is said to be leptokurtic, whereas which is more flattened than the normal is platykurtic.
\[ \gamma_1 = \frac{\mu_2^2}{\mu_4} \]

(vii) **Product Moment Correlation**: For finding the degree of relationship, Pearson product-moment correlation coefficient is used which measures the strength of the linear association between variables.
\[ r = \frac{n \sum x y - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \sqrt{n \sum y^2 - (\sum y)^2}} \]

Where: \( x \) and \( y \) are raw scores.
\( \sum x^2 \) and \( \sum y^2 \) are the sum of the squares of \( x \) and \( y \).
\( N \) is the number of cases.

(viii) **Chi Square test**: It is used to determine whether sample data are consistent with a hypothesized distribution.
\[ \chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \]

Where: \( O_i \) is the observed frequency count for the \( i \)th level of the categorical variable
\( E_i \) is the expected frequency count for the \( i \)th level of the categorical variable.
(ix) Fisher’s z-test: It was applied to test if two independent random samples of sizes $n_1$ and $n_2$ and correlation coefficients $r_1$ and $r_2$ respectively have been drawn from same bivariate normal population or from different normal populations with same correlation coefficients.

$$Z = \frac{|Z_1 - Z_2|}{\sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}}$$

where $Z_1 = 0.5 \log_e \left[ \frac{1 + r_1}{1 - r_1} \right]$ 

$Z_2 = 0.5 \log_e \left[ \frac{1 + r_2}{1 - r_2} \right]$

(x) t-test: were applied to test the significance of differences with regard to different factors, viz. gender, locale, type of school and subject streams.

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Where: \( \sum x_i \) 

and \( s^2 = \frac{\sum (x_i - \bar{x})}{n-1} \)

(xi) Median Test: The median test is used to compare the performance of two independent groups. First, the two groups are treated together and a common median is found. The scores of the groups are divided into two parts i.e. below and equal median and above median. To test the null hypothesis, (2 x 2) contingency table is drawn and $\chi^2$ is calculated.

(xii) Analysis of Variance (ANOVA) is applied to see the interactional effect of gender, locale, type of school and subject streams in relation to different variables.

(xiii) Bifurcation of high and low groups is done by using the formula $M \pm 0.675 \text{ SD}$. High groups are recognized by and low groups are recognized by $M + 0.675\text{SD}$ and $M - 0.675\text{SD}$

(xiv) Data is presented graphically in the form of frequency polygons and bar graphs wherever required.