CHAPTER IV

METHODOLOGY

Methodology refers to the theory of getting knowledge, to the consideration of the best ways, methods or procedures, by which data that will provide the evidence basis for the construction of knowledge about whatever it is that is being researched, is obtained. The decision about the method depends upon the nature of the problem selected and kind of data necessary for its solution. The validity and the reliability of the findings depend upon the method adopted and hence methodology occupies a very important place in any type of research.

The major objective of the present study is to find out the influence of emotional intelligence, locus of control and rigidity on mathematics achievement of students at degree level. The details of method adopted, the variables, tools used for the collection of data, selection of sample, procedures for collection of data, scoring and consolidation of data and statistical methods used for the analysis of data in the present study are described in details under the suitable heads as given below.

4.1 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 present study the investigator has adopted the normative survey method. The word ‘survey’ indicates the gathering of data regarding current condition. 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.

4.2 VARIABLES OF THE STUDY

“Variables are the conditions or characteristics that the experimenter manipulates, controls or observes” (Best & Kahn, 2007, p.162). The present study is an attempt to find out the influence of emotional intelligence, locus of control and rigidity on mathematics achievement at degree level. Hence ‘mathematics achievement’ is taken as the dependent variable in this study. The variables such as ‘emotional intelligence’, ‘locus of control’ and ‘rigidity’ are taken as the independent variables. The differences in sex (males/females), location of institution (urban/rural), and type of management of college (government/private) are taken as the background variables in this study. The independent variables are also sub categorized as low, average and high.

4.3 TOOLS USED FOR THE STUDY

The following tools were used for the collection of data.

1. Mathematics Achievement Test (Developed and Standardized by the Investigator).
2. Emotional Intelligence Scale (Developed and Standardized by the Investigator).
3. Locus of Control Scale (Developed and Standardized by the Investigator).
4. Rigidity Scale (Developed and Standardized by the Investigator).
4.4 PREPARATION OF TOOLS

The details regarding the preparation of the tools employed for the present study are outlined below.

4.4.1 Mathematics Achievement Test

An achievement test is intended to measure the outcome of learning in relation to the objectives of learning the subject.

Various aspects involved in the content were given due weightage by analyzing it properly. This helped the investigator to have an objective-based achievement test giving due weightage to content. Multiple-choice items were included in the test under each content unit. The contents selected for the study were included from the topics: Applications of Integration, Ordinary Differential Equations, Set theory, Vectors and Algebra from the syllabus of the second year degree mathematics (main) of the Mahatma Gandhi University. Since no specific mathematics achievement test in the topics selected was available, the investigator prepared a mathematics achievement test from the above content area. The planning of the test is described below.

A. The Planning for a Mathematics Achievement Test

A good testing needs adequate, thorough and extensive planning. The important points to be considered while planning a test are,

(i) the subject and class for which the test is to be constructed

(ii) weightage to content units
(iii) weightage to objectives

(iv) weightage to form of question

(v) weightage to difficulty level of the items

(vi) test-length, duration, maximum marks, method of answering and scoring procedures of the test

(vii) Sample for try-out and other such details

The details of each point are given below.

(i) **Subject and class of the test**

The test to be prepared in the subject mathematics is meant for second year degree students of the Mahatma Gandhi University.

(ii) **Weightage to content units**

The second important point to be followed is to specify content units. The units planned to include in the test are (i) Application of Integration, (ii) Ordinary Differential Equation, (iii) Set Theory, (iv) Vectors, (v) Algebra.

After consultation with the teachers in the departments of mathematics, the final weightage of marks to content units is fixed. Weightage given to different content units in the test are given in Table 4.1.
TABLE 4.1
WEIGHTAGE TO CONTENT UNITS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Content units</th>
<th>Weightage given by teachers</th>
<th>Average marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application of Integration</td>
<td>7 7 6 7</td>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td>2</td>
<td>Ordinary Differential Equation</td>
<td>2 2 1 3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Set theory</td>
<td>15 17 15 16</td>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Vectors</td>
<td>10 12 11 12</td>
<td>11</td>
<td>27.5</td>
</tr>
<tr>
<td>5</td>
<td>Algebra</td>
<td>5 4 4 3</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Based on the weightage to content in Table 4.1, more than double number of questions is to be prepared for the draft test.

(iii) Weightage to objectives

After deciding the content, the objectives to be tested were decided. Determination of objectives has a significant role in construction of any achievement test. The following objectives in the cognitive domain were set for testing: i) knowledge, ii) comprehension, iii) application, iv) analysis, v) synthesis, and vi) evaluation.

Weightage to different objectives in the test are given in Table 4.2.
### TABLE 4.2
WEIGHTAGE TO OBJECTIVES IN THE MATHEMATICS ACHIEVEMENT TEST

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Objectives</th>
<th>No. of questions</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knowledge</td>
<td>5</td>
<td>5</td>
<td>12.50</td>
</tr>
<tr>
<td>2</td>
<td>Comprehension</td>
<td>12</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Application</td>
<td>13</td>
<td>13</td>
<td>32.50</td>
</tr>
<tr>
<td>4</td>
<td>Analysis</td>
<td>5</td>
<td>5</td>
<td>12.50</td>
</tr>
<tr>
<td>5</td>
<td>Synthesis</td>
<td>3</td>
<td>3</td>
<td>7.50</td>
</tr>
<tr>
<td>6</td>
<td>Evaluation</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>40</strong></td>
<td><strong>40</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(iv) **Weightage to form of question**

The investigator has planned to include objective type of questions with multiple-choice items in the mathematics achievement test.

The objective item, which is highly structured and requires the student to apply a word or to select correct answer from a number of alternatives (Gronlund & Linn, 1990). While preparing the objective type items, the following general rules were followed:

(i) ask questions as simple and concisely as possible to ensure valid and reliable test results.

(ii) ask students to apply, rather than simply to recall information.

(iii) make sure that each item is meaningful and independent.

(iv) do not put trivial questions.
Thus considering all the merits of objective type items, it was decided to prepare a test as said above. Of the different objective type items, the investigator decided to prepare multiple-choice items, because they could be used to measure a variety of learning outcomes from simple to complex.

While preparing the multiple-choice items, the following principles were followed:

(i) put as much of the statement as possible into the stem. The stem represents the problem and the options give possible answers to that problem. If the stem is clear, it gives the student an idea of what is sought before reading the options.

(ii) make sure that incorrect options or clues are not provided.

(iii) make the options reasonable.

(iv) check the format: skip a line between stem and options to make it easier for the students to visually separate these components.

(v) Weightage to difficulty level of the items

Weightage to difficulty level of the items in the test are given in Table 4.3.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Type of questions</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>9</td>
<td>22.5</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>21</td>
<td>52.5</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Based on the Table 4.3, more than double number of items is to be included in the draft test.

(vi) **Test-length, duration, maximum marks, method of answering and scoring procedures of the test**

The investigator has planned to include forty items in the final test, which may be answered in thirty minutes. The maximum mark of the test is forty. The subject need to put a cross mark (x) on the appropriate letter in the response sheet, which he thinks is the correct answer. Scoring of the test can be done by using punched scoring key.

(vii) **Sample for the try-out for construction of Mathematics Achievement Test**

A sample of four hundred second year degree students in mathematics is to be selected for the try-out of the draft test containing hundred items. From the data collected, difficulty index and discriminating power of each item can be found out. Based on these values, forty items are to be selected for the final test. Before finalizing, the test can be administered on another sample of hundred second year degree students in mathematics for calculating the reliability of the test.

B. **Preparation of Mathematics Achievement Test**

The preparation of blue print, construction of test items, arranging the written items, printing question papers and response sheets with necessary direction are included in this stage.
(i) Preparation of the blue print

The blue print is a three-dimensional chart containing coverage of content, objectives and type of questions. A blue print was prepared and discussed with experts. The cell in the blue print represents the number of items to be included in the test in relation to any particular objective. The blue print of the Mathematics achievement test (final form) is given in Table 4.4.

**TABLE 4.4**

BLUE PRINT OF THE MATHEMATICS ACHIEVEMENT TEST (Final form)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Objectives</th>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Analysis</th>
<th>Synthesis</th>
<th>Evaluation</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Form of questions</td>
<td>Objective</td>
<td>Objective</td>
<td>Objective</td>
<td>Objective</td>
<td>Objective</td>
<td>Objective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Content</td>
<td>(1)</td>
<td>(2)</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>Application of Integration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ordinary Differential Equation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Set theory</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Vectors</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>Algebra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: Numbers inside the bracket indicate marks allotted to each item and numbers outside the bracket indicate number of items.
(ii) **Construction of test items**

In order to write items for the test, the topics selected for the study were analysed in detail. Experienced teachers in the field were also consulted.

The general maxims for item writing are given below:

i) each item is on a specific objective.

ii) do not lift statements verbally from the text book.

iii) try to avoid ambiguity of statements.

iv) avoid trick and catch items.

v) in planning a set of items for a test, take care that one item does not provide clues to the answer of another item or items.

(iii) **Preparation of the draft test**

A draft question paper consisting of hundred multiple-choice items was prepared. Majority of the items were intended for average students, but neither the intelligent nor the dull was ignored. Items written were given to experts for getting their suggestions for improvement. The modifications were made accordingly. Each item bears four alternative answers marked as A, B, C and D.

The items were arranged according to their expected level of difficulty, the easiest questions were included in the beginning for motivating the students. The draft form was printed in the form of a booklet. Necessary directions were printed in the booklet. Separate answer sheets were printed. A scoring key was also prepared for the
test. A copy of draft test is given as Appendix I (a). The scoring key of the draft test is given as Appendix I (b).

C Try-out of the Test

The draft test has been prepared according to the plan and is subjected to try-out.

The try-out includes the following:

(i) Selection of the sample

The draft test prepared was administered to a sample of four hundred second year degree students in mathematics from eleven colleges in Ernakulam district. Details regarding sample selected are given in Table 4.5.
TABLE 4.5
LIST OF COLLEGES SELECTED FOR TRY-OUT

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of College</th>
<th>Urban/Rural</th>
<th>Govt./Private</th>
<th>Males/Females/Mixed</th>
<th>No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>St. Paul’s College, Ernakulam</td>
<td>Urban</td>
<td>Private</td>
<td>Mixed</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Sree Sankara Vidya Peedom, Valayanchirangara</td>
<td>Rural</td>
<td>Private</td>
<td>Mixed</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>St. Albert’s College, Ernakulam</td>
<td>Urban</td>
<td>Private</td>
<td>Males</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Nirmala College, Muvattupuzha</td>
<td>Rural</td>
<td>Private</td>
<td>Mixed</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>Maharaja’s College, Ernakulam</td>
<td>Urban</td>
<td>Govt.</td>
<td>Mixed</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>St. Peter’s College, Kolenchery</td>
<td>Rural</td>
<td>Private</td>
<td>Mixed</td>
<td>36</td>
</tr>
<tr>
<td>7</td>
<td>St. Xavier’s College, Aluva</td>
<td>Urban</td>
<td>Private</td>
<td>Females</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td>Bharatamata College, Thrikkakara</td>
<td>Rural</td>
<td>Private</td>
<td>Mixed</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>St. Theresa’s College, Ernakulam</td>
<td>Urban</td>
<td>Private</td>
<td>Females</td>
<td>79</td>
</tr>
<tr>
<td>10</td>
<td>Union Christian College, Aluva</td>
<td>Urban</td>
<td>Private</td>
<td>Mixed</td>
<td>35</td>
</tr>
<tr>
<td>11</td>
<td>Sacred Heart College, Thevara</td>
<td>Urban</td>
<td>Private</td>
<td>Mixed</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>400</strong></td>
</tr>
</tbody>
</table>

(ii) Administration and scoring of draft test

After obtaining permission from heads of colleges, the draft test was administered by the investigator to four hundred second year degree students in
mathematics. The Heads of Department of Mathematics were present during the administration of the test. After motivating the students properly and developing a close rapport with them, the test was given with necessary instructions. Enough time was given to the students to complete the test. Separate answer sheets were printed for answering the test. When the students completed the test, the test booklet along with answer sheets were collected back. The average time used was noted for the final test. The answers were scored using the punched scoring key already prepared. The scoring was done by giving one point credit for each correct response and zero point for each wrong response.

(iii) **Item analysis**

Item analysis is the process of determining the relative difficulty and discriminating power of the test item. It provides valuable information concerning student performance, teaching effectiveness and characteristics of test item. The quality of each item is ascertained by analyzing two important characteristics of the item, i.e., (i) difficulty index and (ii) discriminating power.

Difficulty index: test item difficulty means the percentage of students who responded correctly to a given test item.

Discriminating power: item discriminating power is that quality which can differentiate between students in the upper level and those in the lower level.

There are a variety of techniques for doing item analysis. In the present study, the method suggested by Ebel (1972) was used to calculate difficulty index and discriminating power of each item. Based on the marks obtained, the response sheets
of draft test were arranged in descending order of magnitude, which is from highest to lowest. Of the four hundred answer sheets, defective sheets were removed and thus the total number was reduced to three hundred and seventy. Then the first 27 per cent and the last 27 per cent answer sheets were used for item analysis. The difficulty index and discriminating power were calculated using the formula:

\[
\text{Difficulty index} = \frac{U + L}{2N}
\]

\[
\text{Discriminating power} = \frac{U - L}{N}
\]

where,

\(U = \) the number of students who gave correct answers to the item in the upper group.
\(L = \) the number of students who gave correct answers to the item in the lower group.
\(N = \) Number of students in each group.

Items having discriminating power 0.38 and above, and difficulty index 0.41 to 0.66 were selected for final test.

The details of item analysis of the draft test are given as Appendix I(c).

(iv) **Preparation of the final test**

Out of hundred items included in the draft test, forty items were selected for the final test, based on the difficulty index and discriminating power of items. It was decided to give thirty minutes for answering the test. The test was printed in the form
of a booklet with necessary instructions. Separate answer sheets for marking the answers were also prepared. To find out the reliability of the prepared test consisting of forty items, it was administered to a sample of hundred second year degree students in mathematics. A copy of the final test, the response sheet and scoring key are given as Appendices I (d), I (e) and I (f) respectively.

D Evaluation of the Test

Evaluation is the last step in the test construction. After the response sheets have been scored, results must be interpreted and evaluated from two points of view. First is the quality of the test itself and second is the quality of students’ response.

(i) Requirements of the test

Any measuring instrument must satisfy some requirements if it is to be a useful one. The success of an evaluation programme ultimately depends on the satisfaction of these requirements. The most important requirements of the test are (a) validity (b) reliability (c) objectivity and (d) practicability.

(a) Validity of the test

The validity of the test represents the extent to which a test measures what it purports to measure. As far as an achievement test of this nature is concerned, content validity and criterion related validity are important.

(1) Content Validity

Content validity is the degree to which a test measures an intended content area. Content validity is of particular importance for achievement tests. A careful
consideration of the subject matter will yield satisfactory validity with regard to the content. Procedure adopted for constructing the test provides ample evidence regarding the content validity of the test.

(2) **Criterion-Related Validity**

It refers to the relation between the test scores and criterion, the latter being an independent and direct measure of that which the test is designed to predict (Anastasi, 1954).

The criterion can be university examination marks, rating by competent raters or marks obtained in a test of same function. In this study, the criterion used was the marks of university examination.

The criterion related validity of this test was calculated by correlating the scores of the mathematics achievement test of hundred students with their second year degree university examination marks in mathematics. The value of correlation coefficient ‘r’ obtained is 0.753. Hence the test can be considered a valid one.

(b) **Reliability of the test**

Reliability is the degree to which a test consistently measures whatever it is measuring.

In this study, split-half method and test-retest method were used for determining the reliability of the test. The split-half reliability was calculated by correlating the scores of odd numbered items and even numbered items for a sample of hundred. Value of coefficient of correlation between the half tests was 0.88. The
reliability coefficient of the whole test can be calculated using Spearman Brown Prophecy formula $R = \frac{2r}{1+r}$ where ‘$R$’ is the reliability coefficient of the whole test and ‘$r$’ is the coefficient of correlation between the half tests. The reliability coefficient of the whole test was calculated as 0.936. Hence the test is reliable.

The reliability of the test was also calculated using test-retest method. The test was administered two times to the same sample (N=100) in an interval of three weeks. The scores of the individuals in the two tests were calculated. The product moment coefficient of correlation between the two scores of the sample of hundred was calculated. The value of the correlation coefficient ‘$r$’ (test-retest reliability) obtained is 0.86.

(c) Objectivity of the test

It is an important factor that affects both the validity and the reliability of a test. In the prepared achievement test, objectivity was ensured by including objective type items and providing a scoring key.

(d) Practicability of the test

Duration of the test, provision of scoring key, and type of items included are all added to the practicability of the test.

(ii) Norms of the test

A norm is a quantitative measure representing the standard of a specific group. It is based on the average performance of a particular group at a particular period of time.
In this study percentile norms were calculated and the results are given in Appendix I(g).

(iii) **Test manual**

A test manual was prepared and a copy of it is given in Appendix I (h).

4.4.2 **Emotional Intelligence Scale**

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

4.4.2.1 **Preparation of items**

The investigator reviewed books, periodicals, and other descriptive materials to procure the requirements to construct the items for the Emotional Intelligence Scale. Experts in the field were also consulted and their suggestions were taken into consideration. It was decided to include five dimensions of emotional intelligence (Goleman, 1998). These were self- awareness, self- regulation, motivation, empathy and social skills.

An initial pool of one hundred and sixty items was prepared. This pool of statements was given to a group of five judges and only those items were retained about which the judges were unanimous on their opinion. Based on their suggestions, those items, which were complex and vague, were eliminated. The investigator took utmost care in avoiding ambiguous and indefinite statements.
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The following criteria were followed in screening and editing of the statements:

(a) As far as possible, statements were retained in the form of simple sentences, avoiding words, which may not be understood by the subjects.
(b) Statements were clear, brief and precise.
(c) Statements having more than one meaning and those with double negatives were not used.

Thus seventy-two statements were included in the draft form of the Emotional Intelligence Scale. This scale was developed following the Likert method. Out of the seventy-two statements, thirty-six were of negative polarity and remaining thirty-six were of positive polarity. Fifteen statements were to rate the views on self-awareness, fifteen to rate the views on self-regulation, fourteen to rate the views on motivation, fourteen to rate the views on empathy and fourteen to rate the views on social skills. The scale thus developed was a five point scale having five categories of response, namely, ‘A’ (Strongly agree), ‘B’ (Agree), ‘C’ (Undecided), ‘D’ (Disagree) and ‘E’ (Strongly disagree). Appropriate response sheet was also prepared.

4.4.2.2 Pre-try-out

After preliminary screening and editing of the items, the scale was pre-tried out on twenty students in order to find out the accuracy and relevance of each statement. After this preliminary administration of the test, minor changes were made in the language and sentence constructions in some of the items. It was also ascertained that the vocabulary used in the test item was appropriate for degree
students. A copy of the draft form of Emotional Intelligence Scale in Malayalam, its English translation and the scoring key are given as Appendices II (a), II (b), and II(c) respectively.

4.4.2.3 Try-out

After pre-try-out, the test was administered on a sample of four hundred students under study. In this step of actual try-out, item analysis was done. Out of the four hundred response sheets obtained, only three hundred and seventy response sheets were selected for item analysis. Fifteen incomplete entries were exempted, and the remaining fifteen entries were rejected at random to bring down the number to three hundred and seventy for convenience. Keeping in view the applicability of the method, the investigator applied t-test for item discrimination. The sum of the scores of all the items constituted the total score of the scale. The response sheets were arranged in a descending order of the total score. The highest 27% and the lowest 27% of the response sheets were separated. These were criterion groups in terms of which to evaluate individual statements. In evaluating the responses of the high and low groups to the individual statements, the ratio was found out using the formula,

\[ t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum (X_H - \bar{X}_H)^2 + \sum (X_L - \bar{X}_L)^2}{n(n-1)}}} \]

where,

\( \bar{X}_H \) – the mean score on a given statement for the high group

\( \bar{X}_L \) – the mean score on the same statement for the low group
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\[ X_H \] – the score for a given individual for a given statement in the high group

\[ X_L \] – the score for a given individual for a given statement in the low group

\[ n \] – number of subjects in the criterion groups

The statement for which ‘t’ value is greater than or equal to 1.75 was regarded as an item, which possesses internal consistency and hence discriminating power (Edwards, 1957). Thirty statements having ‘t’ values lower than 1.75 and two other statements having comparatively lower ‘t’ values were rejected from the draft form. Thus forty statements were selected for the final scale. Out of the forty statements, twenty were of positive polarity and twenty were of negative polarity. The details of item analysis are given as Appendix II (d).

4.4.2.4 Final form of the scale

The final form of the Emotional Intelligence Scale (EIS) contained forty statements and specific directions for the respondents. To avoid the tendency to give a stereotyped response, items of positive and negative responses were evenly arranged. An appropriate response sheet was also prepared.

The distribution of statements in the final form is given in the following Table 4.6.
## TABLE 4.6

### DISTRIBUTION OF STATEMENTS IN THE EMOTIONAL INTELLIGENCE SCALE

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the dimension</th>
<th>Serial number of statements</th>
<th>Total number of statements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Positive polarity</td>
<td>Negative polarity</td>
</tr>
<tr>
<td>1</td>
<td>Self-awareness</td>
<td>1,3,5,7,9</td>
<td>2,4,6,8</td>
</tr>
<tr>
<td>2</td>
<td>Self-regulation</td>
<td>11,13,15,17</td>
<td>10,12,14,16,18,20</td>
</tr>
<tr>
<td>3</td>
<td>Motivation</td>
<td>19,21</td>
<td>22,24,26</td>
</tr>
<tr>
<td>4</td>
<td>Empathy</td>
<td>23,25,27,29,31</td>
<td>28,30,32,34</td>
</tr>
<tr>
<td>5</td>
<td>Social skills</td>
<td>33,35,37,39</td>
<td>36,38,40</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

- **Instructions for administration of the final scale**

  The subject is required to enter a tick mark (✔) in the appropriate place in the response sheet to express his/her degree of acceptance or rejection of the idea contained in the statement.

- **Scoring of the scale**

  The scale consists of forty statements, each statement is to be rated on the five-point scale- ‘A’ (Strongly agree), ‘B’ (Agree), ‘C’ (Undecided), ‘D’ (Disagree) and ‘E’ (Strongly disagree). The strongly agree response of the positive statement should be assigned with a score of 5, agree response with score of 4, undecided with a score of 3, disagree with 2, and strongly disagree with a score of 1. In the case of negative statements, the strongly agree response should be assigned with a score of 1, agree with a score of 2, undecided 3, disagree 4 and strongly disagree with a score of
5. The maximum and minimum scores, which the students may score on Emotional Intelligence Scale (EIS), will be 200 and 40 respectively.

Two representative items are given below:

1. I have clear vision on how to make use of my abilities for the benefit in life.
   A B C D E (Item No.1 in the scale).

2. I feel restless on occasions while new ideas and information are to be accepted.
   A B C D E (Item No.12 in the scale).

4.4.2.5 Reliability of the scale

Test-retest reliability of the Emotional Intelligence Scale was found out. The scale was administered twice with a time interval of fifteen days to a sample of hundred students. The reliability coefficient was found to be 0.782.

In the split-half reliability method, the test was split into two equal halves on the basis of odd numbered item and even numbered item. The correlation coefficient between the scores of two halves for a sample of hundred was found using Pearson’s product moment formula. The half test reliability estimated was 0.678. The split half reliability of the whole test was found using Spearman-Brown Prophecy formula. The reliability coefficient of the whole test was calculated as 0.808.

4.4.2.6 Validity of the scale

The criterion validity of the scale was found out by correlating the present scale with an external criterion, that is, EI scale (Hyde, Pethe & Dhar, 2002). Both the
tests were administered on a sample of hundred students and correlation was found out. The validity coefficient thus obtained was 0.784.

The content validity of the scale is maintained by careful reference to the current literature as well as by consultation with experts.

Thus the scale as a whole is a reasonably valid and reliable instrument for the purpose of the present investigation.

A copy of the final scale of Emotional Intelligence in Malayalam, its English translation, the response sheet, scoring key, percentile norms and scoring manual are given as Appendices II (e), II (f), II (g), II(h), II(i), and II(j) respectively.

4.4.3 Locus of Control Scale

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

4.4.3.1 Preparation of the draft form

The items of the daft scale were prepared only after a review of relevant literature, and also with the advice of experts in the field. An initial pool of one hundred and twenty items were prepared and subjected to scrutiny by a panel of experts. The items with hundred per cent approval were retained and rest were dropped. Thus seventy items were selected for the draft scale.
The scale was developed following the Likert’s method. The statements cover two extreme ends of the continuum of the variable like external and internal locus of control. Out of the seventy items thirty-five were of negative polarity and remaining thirty-five were of positive polarity.

The items representing internal locus of control were considered as positive and those, which represented external locus of control as negative. Directions for the respondents also were prepared along with the draft. There are five response categories: ‘A’ (Strongly agree), ‘B’ (Agree), ‘C’ (Undecided), ‘D’ (Disagree) and ‘E’ (Strongly disagree) for each of the seventy items. For a positive item, a weightage of 5, 4, 3, 2, and 1 was given for the responses A, B, C, D, and E respectively and for a negative item, the weightage was reversed as 1, 2, 3, 4, and 5 respectively. A copy of the draft form of locus of control scale in Malayalam, its English translation and the scoring key are given as Appendices III (a), III (b), and III(c) respectively.

4.4.3.2 Item analysis

The draft scale was administered to a representative sample of four hundred second year degree students in mathematics. The sum of the scores of all the items constituted the total score of the scale. Twenty incomplete entries were exempted, and the rest of ten entries were rejected at random to bring down the number to three hundred and seventy for convenience.

For the purpose of item analysis, the present study used, “Mathew Item Analysis Table” (Mathew, 1982) – a correlational method. The response sheets of the students were arranged in the descending order of total scores. The highest 27% and
the lowest 27% of the response sheets were separated ($P_U = 100$ and $P_L = 100$). These were the criterion groups in terms of which the individual statements were to be evaluated. The number of persons marking “undecided” category was counted separately and this number was divided equally and added to the frequencies in the dichotomous categories, i.e., items which can be scored as right or wrong and items which have only one response as the keyed answer.

$P_L$: Percentage of individuals in the lower tail marking the keyed answer.

$P_U$: Percentage of individuals in the upper tail marking the keyed answer.

From the “Mathew Item Analysis Table”, for each item, the $P_L$ value of the item was located, first, then in that section, the $P_U$ value of the item along the left margin was located and the ‘corresponding ‘phi’ and ‘p’ values were noted. The special feature of ‘phi’ values is that, since ‘phi’ values are found to be high for items having medium ‘p’ value, item selection based on ‘phi’ value alone would give the desired results. Items with ‘phi’ values below five per cent level of significance are not considered usually. ‘phi’-values were computed for every combination of $P_L$ and $P_U$ values by means of Guilford’s (1954) formula. The ‘p’ value is the mean of $P_L$ and $P_U$ values. From the items having highest correlation values (phi values) and medium ‘p’ values, the required numbers of items were selected. Thus forty-eight statements were selected for the final scale. Out of the forty-eight statements, twenty-four were of negative polarity and twenty-four were of positive polarity. Items with positive and negative polarity were distributed evenly.

The details of item analysis of the draft scale are given as Appendix III (d).
4.4.3.3 Final form of the scale

The final form of the Locus of Control Scale (LOCS) contained forty-eight statements and specific directions for the respondents. An appropriate response sheet was prepared.

- Scoring of the scale

For scoring the scale, a score of 5, 4, 3, 2, and 1 was given to category A, B, C, D and E for a positive statement and a score of 1, 2, 3, 4, and 5 was given to the category A, B, C, D and E for a negative statement. Scoring is in the direction of internal locus of control. That is, higher scores indicate high internality. The sum of the scores of all the statements constituted the total score of the scale. The maximum and minimum scores, which the students may score on LOCS, will be 240 and 48 respectively.

The distribution of statements in the final form is given in Table 4.7.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Extreme ends of the continuum of the variable</th>
<th>Serial number of statements</th>
<th>Total no. of statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>External locus of control</td>
<td>1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Internal locus of control</td>
<td>2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>48</td>
</tr>
</tbody>
</table>

Two representative items are given below:
1. Unnatural death in any house occurs due to the curse of dissatisfied souls.
   A B C D E (Item No. 21 in the scale).

2. I believe that I can chalk out a programme according to my ability and make it a success.
   A B C D E (Item No. 38 in the scale).

Note:

A  –  Strongly agree
B  –  Agree
C  –  Undecided
D  –  Disagree
E  –  Strongly disagree

4.4.3.4 Reliability of the scale

The test-retest reliability was calculated for the present scale with N=100. The test-retest reliability coefficient was found to be 0.843, by calculating coefficient of correlation between two sets of scores of the same individuals on the same scale, after two weeks time.

In the split-half reliability method, the test was split into two equal halves on the basis of odd numbered item and even numbered item. The correlation coefficient between the scores of two halves for a sample of hundred was found using Pearson’s product moment formula. The half test reliability estimated was 0.740. The split half reliability of the whole test was found using Spearman-Brown Prophecy formula. Thus the reliability coefficient of 0.850 was obtained.
4.4.3.5  Validity of the scale

A test’s concurrent validity indicates the extent of its agreement with other present criteria measuring similar or same psychological operations or traits. The present scale was validated by correlating it with Levenson’s Locus of Control Scale (Vohra, 1992). The validity of the scale was found to be 0.79 for a sample of hundred.

The content validity of the scale was ensured by subjecting the items prepared for the initial try-out before a panel of five experts for scrutiny. The items, which were accepted by the experts as effective for measuring locus of control, were selected.

The high validity and reliability coefficients thus obtained show that the scale is a reasonably valid and reliable one.

A copy of the final scale of Locus of Control in Malayalam, its English translation, the response sheet, scoring key, percentile norms and scoring manual are given as Appendices III (e), III (f), III (g), III (h), III (i), and III (j) respectively.

4.4.4  Rigidity Scale

This scale was developed and standardized by the investigator with the help of the supervising teacher and in consultation with experts in the field. The details of the procedure involved in the development of the scale are given below.
4.4.1.1 Selection of statements

After consulting experts in the field and teacher educators, owing to usability it was decided to use the technique developed by Likert.

The selection of statements was done as follows:

The investigator reviewed books, periodicals, and other descriptive materials to select the statements for the rigidity scale. Experts in the field were also consulted and their suggestions were taken into consideration. It was decided to include seven dimensions of rigidity (Chadha, 1986); these being intellectual rigidity, emotional rigidity, dispositional rigidity, social rigidity, behavioural rigidity, perceptual rigidity, and creative rigidity.

It was decided to write fifteen to twenty statements under each of the seven dimensions. In this way an initial pool of one hundred and thirty five statements were prepared. The language was checked for ambiguity of wording, if any. It was also ascertained that the vocabulary used in the test item was appropriate for the sample under study. These statements were given to five experienced and qualified teachers in the department of psychology for rating. The panel of teachers was asked to evaluate the statements keeping in mind the following points:

(i) accuracy and relevance of each statement.
(ii) language used for each statement.
(iii) whether there were enough statements under each of the dimensions of rigidity.
Based on the suggestions of the panel, those statements, which were vague, complex, and not appropriate to measure rigidity, were deleted. The items with cent per cent approval were retained. Thus, seventy statements formed the draft form of the rigidity scale. Out of the seventy statements thirty-five were of positive polarity and remaining thirty-five were of negative polarity. The seventy statements were randomly arranged. To avoid any error or tendency to give a stereotyped response, items of positive and negative responses were evenly arranged. Directions for the respondents were also prepared. The scale thus developed was a five-point scale having five response categories. The five responses were ‘A’ (Strongly agree), ‘B’ (Agree), ‘C’ (Undecided), ‘D’ (Disagree) and ‘E’ (Strongly disagree).

The following weightage was given to each response category.

<table>
<thead>
<tr>
<th>Positive Item</th>
<th>Negative Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree - 5</td>
<td>Strongly agree - 1</td>
</tr>
<tr>
<td>Agree - 4</td>
<td>Agree - 2</td>
</tr>
<tr>
<td>Undecided - 3</td>
<td>Undecided - 3</td>
</tr>
<tr>
<td>Disagree - 2</td>
<td>Disagree - 4</td>
</tr>
<tr>
<td>Strongly disagree - 1</td>
<td>Strongly disagree - 5</td>
</tr>
</tbody>
</table>

Appropriate response sheet was also prepared along with the draft form of the scale. A copy of the draft form of the rigidity scale in Malayalam, its English translation and the scoring key are given as Appendices IV (a), IV (b) and IV(c) respectively.
4.4.4.2 Item analysis

Item analysis was done to select suitable items for the final scale. The scale (draft form) was administered to a sample of four hundred second year degree students in mathematics. The total score obtained for each respondent was calculated and the response sheets were arranged in the order of magnitude of the total score. Out of the four hundred response sheets obtained, three hundred and seventy response sheets were selected for item analysis. The three hundred and seventy response sheets were arranged in the descending order of the total scores. The top 27 per cent (the top 100) and the bottom 27 per cent (the bottom 100) response sheets were taken from each group for items analysis since 27 per cent provide the best compromise between two desirable aims (i) to make extreme groups as large as possible and (ii) to make extreme groups as different as possible.

There are a variety of techniques for doing item analysis. The present study used correlation method by using the “Mathew Item Analysis Table” (Mathew, 1982). From the ‘Mathew Item Analysis Table’, for each item, ‘phi’ and ‘p’ values were noted. Phi values were computed for every combination of $P_L$ and $P_U$ values by means of Guilford’s (1954) formula. The ‘p’ value is the mean of $P_L$ and $P_U$ values. From the items having highest correlation values (phi values) and medium ‘p’ values, the required numbers of items were selected. Thus forty statements were selected for the final scale. Out of the forty statements, twenty were of negative polarity and twenty were of positive polarity. Items with positive and negative polarity were distributed evenly.

The details of items analysis of the draft form are given as Appendix IV (d).
4.4.4.3 Final form

The final form of the Rigidity Scale (RS) contained forty statements and specific directions for the respondents. An appropriate response sheet was also prepared.

The distribution of statements in final form is given in the following Table 4.8.

**TABLE 4.8**
DISTRIBUTION OF STATEMENTS IN THE RIGIDITY SCALE

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the dimension</th>
<th>Serial number of statements</th>
<th>Total No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Positive polarity</td>
<td>Negative polarity</td>
</tr>
<tr>
<td>1</td>
<td>Intellectual rigidity</td>
<td>1,3,5,7</td>
<td>2,4,6</td>
</tr>
<tr>
<td>2</td>
<td>Emotional rigidity</td>
<td>9,11</td>
<td>8,10</td>
</tr>
<tr>
<td>3</td>
<td>Dispositional rigidity</td>
<td>13,15</td>
<td>12,14,16,18</td>
</tr>
<tr>
<td>4</td>
<td>Social rigidity</td>
<td>17,19,21</td>
<td>20,22,24</td>
</tr>
<tr>
<td>5</td>
<td>Behavioural rigidity</td>
<td>23,25,27</td>
<td>26,28,30</td>
</tr>
<tr>
<td>6</td>
<td>Perceptual rigidity</td>
<td>29,31</td>
<td>32,34</td>
</tr>
<tr>
<td>7</td>
<td>Creative rigidity</td>
<td>33,35,37,39</td>
<td>36,38,40</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

- **Scoring of the statements**

For scoring, numerical values were assigned to the five categories of the responses. For the positive item in the scale a weightage of 5, 4, 3, 2, and 1 was given for the responses A, B, C, D and E respectively and for a negative item, the weightage was reversed as 1,2,3,4 and 5 respectively. The sum of the scores of all the items
constituted the total score of the scale. The maximum and minimum scores, which the students may score on Rigidity Scale, will be two hundred and forty respectively.

Two representative items are given below:

1. I find it difficult to think differently from preconceived matters.
   A  B  C  D  E  (Item No. 1 in the scale).

2. I am prepared to change my habits if they cause inconvenience to others.
   A  B  C  D  E  (Item No. 16 in the scale)

Note:

A  –  Strongly agree
B  –  Agree
C  –  Undecided
D  –  Disagree
E  –  Strongly disagree

4.4.4.4 Reliability of the scale

Test-retest method of reliability was calculated for a sample of hundred students in an interval of two weeks. The reliability coefficient was found to be 0.832.

Split-half reliability was found for a sample of hundred. The value was found to be 0.872.

4.4.4.5 Validity of the scale

The empirical/criterion validity of the scale was found out by correlating the present scale with an external criterion, that is, ‘Dimensions of Rigidity Scale’
Methodology

(Chadha, 1986). Both the tests were administered on a sample of hundred students and correlation was found out. The validity coefficient thus obtained was 0.712.

The content validity was established through the review of relevant literature as well as by consultation with experts.

The above indices of reliability ad validity indicate that the test will yield reliable and valid scores for the purpose of present investigation.

A copy of the final scale of rigidity in Malayalam, its English translation, the response sheet, scoring key, percentile norms and scoring manual are given as Appendices IV (e), IV (f), IV (g), IV (h), IV (i), and IV (j) respectively.

The list of experts selected for the preparation of tools is given in Appendix V.

4.5 SAMPLE SELECTED FOR THE STUDY

The selection of a sample or sampling is an integral part of the research. It governs the reliability and dependability of the result obtained. Sample means a small group drawn from a population, carefully selected to reflect closely the characteristics of the population. 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, p.325). The population of the present study was degree students of various colleges in mathematics under Mahatma Gandhi University. For the case of preparing a mathematics achievement test, the study was confined to second year
degree students in mathematics. Treating this as reference population, the investigator had to take decisions regarding size of the sample, techniques of sampling, and factors to be represented in the sample. The details are given below:

4.5.1 Size of the Sample

Considering the special nature of the study and type of statistical methods intended to be used, the size of the sample was tentatively fixed as eight hundred and fifty second year degree students in mathematics from Ernakulam, Idukki, Kottayam, Pathanamthitta and Alappuzha districts.

4.5.2 Techniques of Sampling

Of the various techniques, stratified random sampling was found to be the best suited for the present study. “Stratified random sampling is a technique designed to ensure representativeness and avoid bias. The scheme 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 sub groups” (Garrett, 2004, p.206). The stratified random sampling technique is widely accepted as the best procedure when heterogeneous samples have to be brought under study, as in the present case.

4.5.3 Factors to be represented in the Sample

The next important decision to be taken regarding sampling was the factors to be represented in the sample selection. As such the investigator decided to give representation to the following factors in the sample selection.
The basal variables are:

a) sex of the subjects

b) urban-rural location of the institution

c) type of management of the college

a) Sex of the subject

The achievement of the students may be influenced by their sex. The influence of independent variables (emotional intelligence, locus of control and rigidity) may be also different in males and females.

b) Urban-Rural location of the institution

The achievement of the students may be connected with location of institution. Generally there may be differences in the performance of students in urban and rural colleges.

c) Type of management of the college

The type of management of the college (run by government or private agencies) is known to influence achievement. There may be differences in the performance of students studying in government colleges and private colleges. Both are having their own merits and limitations. A comparison exists between the achievement of students of these colleges. Hence the sample was taken from both government and private colleges.
The study covered twenty-six colleges in five districts viz., Ernakulam, Idukki, Kottayam, Pathanamthitta, and Alappuzha that come under the Mahatma Gandhi University.

4.5.4 The Initial Sample for Analysis

On the basis of characteristics of population, an initial break up of a tentative sample was worked out and it was decided to cover a basal sample of eight hundred and fifty students. The break up was estimated as given below.

**TABLE 4.9**

<table>
<thead>
<tr>
<th>Males</th>
<th>Females</th>
<th>Urban</th>
<th>Rural</th>
<th>Government</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>260</td>
<td>590</td>
<td>540</td>
<td>310</td>
<td>100</td>
<td>750</td>
</tr>
</tbody>
</table>

4.5.5 The Final Sample available for Analysis

Though the basal sample was fixed as eight hundred and fifty, the investigator could collect data from a sample of eight hundred and twenty six students. In all the colleges, the test was conducted on two different days. So when a student was absent for any one test, the remaining data was not usable. Rejecting all such cases, a final sample of eight hundred was available for analysis. The details of the actual sample covered and final sample are given in Table 4.10 and Table 4.11.
The list of colleges from where the final sample was selected is given as Appendix VI.

### 4.6 PROCEDURE FOR DATA COLLECTION

After the selection of sample and preparation of tools, the next phase to be accomplished was the collection of required data from the sample by using the tools. The investigator studied the basic literature relating to selected psychological tests contained in the test manuals and other references and acquainted with the testing procedure, possible eventuality before the commencement of the actual testing. The investigator contacted the Principals of the selected colleges and the heads of the department of mathematics and had discussions with them in order to fix a schedule
for administering the tests. A request was made by the investigator to the heads of department of mathematics to render necessary assistance for the successful administration of the tools. The investigator obtained adequate copies of tools for the collection of data. Before administration of the tools, the aim and importance of the study were explained to the students, for ensuring their conscious participation and co-operation. The investigator administered the tests with the help of the heads of department of mathematics. Rules and procedure described already were strictly followed in all colleges for the uniformity of the testing procedure.

The following steps were invariably followed while administering the tools:

- Distribution of test booklets and response sheets to the subjects.
- Giving instructions for filling up the necessary information in the response sheet before starting the test.
- Making the students familiar with response sheet and mode of entering responses.
- Clearing the doubts of students and giving additional instructions, if necessary.
- Strictly ensuring the marking of independent responses.
- Giving intervals between tests.
- Collecting back the test booklets and response sheets.

The above steps were strictly followed in the administration of each test. Every precaution was taken to make the study valid and reliable.
4.6.1 **Scoring and Consolidation of Data**

Scoring of the response sheets was done in accordance with the scoring scheme of each test. During scoring, incomplete entries were eliminated. Only those subjects who completed the tests in all respects were selected for the analysis. Thus the final sample obtained was eight hundred. The scores on different tools were tabulated on a consolidated data sheet. The total sample was classified on the basis of sex, location of institution and type of management of the college. 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.

4.7 **STATISTICAL METHODS USED FOR THE ANALYSIS OF DATA**

The following statistical methods were employed for analyzing, interpreting and testing hypothesis of the study:

I. In the aspect of variables studied descriptive statistics like mean, median, mode, standard deviation, skewness and kurtosis were calculated for the general sample and sub samples based on sex, location of the institution and management of the college.

II. **Pearson’s Product-Moment Coefficient of Correlation ‘r’ (Best & Kahn, 2007)**

This was employed to assess the relation between independent variables and dependent variable.

The Pearson’s product moment coefficient of correlation formula for calculating ‘r’ is
Methodology

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

where,

\( r \) = Pearson’s Product Moment Coefficient of Correlation

\( \Sigma X \) = Sum of the X scores

\( \Sigma Y \) = Sum of the Y Scores

\( \Sigma X^2 \) = Sum of the squared X scores

\( \Sigma Y^2 \) = Sum of the squared Y scores.

\( \Sigma XY \) = Sum of the products of paired X and Y scores.

\( N \) = Number of paired scores

The obtained correlation coefficients were interpreted by means of the following approaches:

a) **Verbal interpretation of Pearson’s Product Moment Coefficient of Correlation ‘r’ (Garret, 2004)**

The verbal interpretation of the significance of the correlation coefficient ‘r’ is given below:

‘r’ from .00 to ± .20 denotes indifferent or negligible relationship;

‘r’ from ± .20 to ± .40 denotes low correlation; present but slightly;

‘r’ from ± .40 to ± .70 denotes substantial or marked relationship;

‘r’ from ± .70 to ±1.00 denotes high to very high relationship.
b) **The .99 confidence interval of ‘r’** (C I₀.₉₉) (Ferguson, 1976)

For each of the coefficient of correlation ‘r’ obtained, the .99 confidence interval was calculated. The limits of the .99 confidence interval was calculated using the formula,

\[
r \pm 2.58 \text{SE}_r
\]

where,

\[
\text{SE}_r \text{ is the Standard Error of ‘r’}.
\]

c) **Percentage variance** (Fox, 1969)

An idea of percentage variance is given by the square of coefficient of correlation ‘r’ expressed as percentage (that is, \(r^2 \times 100\)). This means the contribution of independent variable expressed in percentage, to the variance in the dependent variable.

d) **Test of significance of difference between two r’s** (Garrett, 2004)

The test of significance of difference between correlations was done by two-tailed test for the significance of difference between r’s of large independent samples, using the formula,

\[
\text{CR} = \frac{Z_1 - Z_2}{\sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}}
\]

where,

\(Z_1 \text{ and } Z_2 = ‘r’ \text{ of two samples converted to Fisher’s Z coefficient.}\)

\(N_1 \text{ and } N_2 = \text{sizes of the two samples.}\)
III. In the present study the general (whole) sample was categorized into three for every independent variable studied. This division was based on the scores of the sample for the independent variables. Thus the divisions as low, average and high scores of eight hundred subjects, for the three independent variables, were used to calculate the mean and standard deviation.

Taking ‘M’ as the mean score and ‘σ’ as the standard deviation eight hundred subjects were categorized into three for every independent variable. Those who scored above (M + ½ σ) for an independent variable belong to the high group. A subject who scored below (M -½σ) was categorized as belonging to low group. Those subjects whose scores fall from (M -½σ) to (M + ½σ) belong to the average group. Thus three groups are there for each independent variable as given below:

- Emotional Intelligence: Low – Average – High
- Locus of Control: Low – Average – High
- Rigidity: Low – Average – High

IV. Two-tailed test of significance of the difference between means for large independent groups:

The general sample was categorized into three groups namely, Low, Average and High based on the scores of each of the three independent variables studied. Significance of difference in mean scores of dependent variable for the sub samples based on sex, location of institution, management of college in each of the three
groups (low, average 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 significance of difference between means is given by the formula,

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

where,

\[
M_1 = \text{Mean test score of the first group}
\]

\[
M_2 = \text{Mean test score of the second group}
\]

and \( SE_{(M_1 - M_2)} = \text{The standard error of the difference between means } M_1 \text{ and } M_2. \)

\( SE_{(M_1 - M_2)} \) was estimated by using the formula,

\[
SE_{(M_1 - M_2)} = \sqrt{SE_{M_1}^2 + SE_{M_2}^2}
\]

where, \( SE_{M_1} \) and \( SE_{M_2} \) are the standard error 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

\[
SE_{M_1} = \frac{\sigma_1}{\sqrt{N_1}}
\]

\[
SE_{M_2} = \frac{\sigma_2}{\sqrt{N_2}}
\]

The t-value (critical ratio) obtained was treated as belonging to a normal distribution. If the obtained ‘t’ value falls between + 1.96 and – 1.96, the difference
between means was treated as not being significant at .05 level. If the ‘t’ value falls outside the interval ± 1.96, then the difference between means was considered as significant at .05 level. If the estimated ‘t’ value falls inside the interval ± 2.58, then the difference between means was not treated as being significant at .01 level and if it falls outside the range ± 2.58, it was considered significant at .01 level.

V. Analysis of Variance (Best & Kahn, 2007)

The analysis of variance (ANOVA) is an effective way to determine whether the means of more than two samples are too different to attribute to sampling error.

The one-way analysis of variance consists of these operations:

a) The variance of the scores for the groups is combined into one composite group known as the total groups variance ($V_t$).

b) The mean value of the variances of each of the groups, computed separately, is known as the within-groups variance ($V_w$).

c) The difference between the total groups variance and the within-groups variance is known as the between-groups variance ($V_t - V_w = V_b$)

d) The F-ratio is computed.

$$F = \frac{V_b}{V_w} = \frac{\text{between-groups variance}}{\text{within-groups variance}}$$

VI. Multiple comparisons using Scheffe’s Method (Ferguson, 1976)

The calculation for the Scheffe test is quite simple and sample sizes do not have to be equal.

To apply the Scheffe’s method, follow these steps:
a) Calculate the following F ratio between pairs of means by using the within-group variance estimate $S_w^2$:

$$F = \frac{(\bar{X}_i - \bar{X}_j)^2}{S_w^2/n_i + S_w^2/n_j}$$

b) Consult a table of F and obtain the value of F required for significance at the .05 or .01 level, or any desired level, for $df_1 = k-1$ and $df_2 = N-k$.

c) Calculate the quantity $F'$, which is $k-1$ times the F required for significance at the desired significance level; that is, $F' = (k-1) F$.

d) Compare the values of $F$ and $F'$. For any difference to be significant at the required level, $F$ must be greater than or equal to $F'$.

**VII. Partial Correlation (Best & Kahn, 2007)**

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

$$r_{12.3} = \frac{r_{12} - (r_{13})(r_{23})}{\sqrt{(1-r_{13}^2)(1-r_{23}^2)}}$$

**VIII. The Coefficient of Multiple Correlation, ‘R’ (Garrett, 2004)**

The multiple correlation coefficient ‘R’ of the variables $X_1$ and variables $X_2$, $X_3$ and $X_4$ is given by

$$R_{1(234)} = \sqrt{1 - \frac{\sigma_{1.234}^2}{\sigma_{1}^2}}$$
in which $\sigma_{1.234}$ is the standard deviation of the variable $X_1$ when the effect of the variables $X_2$, $X_3$ and $X_4$ are held constant.

The coefficient of multiple correlation 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’.

IX. Multiple Regression Equation (Garrett, 2004)

Multiple regression equations were derived to predict the mathematics achievement of the degree students by using the three independent variables. The contribution of each independent variable on mathematics achievement also can be found out.

The regression equation 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 $x_4$ in the score form is given by

$$X_1 - M_1 = b_{12.34} (X_2 - M_2) + b_{13.24} (X_3 - M_3) + b_{14.23} (X_4 - M_4)$$

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, $b_{12.34}$, $b_{13.24}$ and $b_{14.23}$ 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.

Beta ($\beta$) coefficients or “beta weights” may be calculated from b’s.

Thus  $\beta_{12.34} = b_{12.34} \times \frac{\sigma_2}{\sigma_1}$
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

$$R^2_{1(234)} = \beta_{12 \cdot 34} \times r_{12} + \beta_{13 \cdot 24} \times r_{13} + \beta_{14 \cdot 23} \times r_{14}$$

$R^2$ of the multiple regression equation 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 variable attributable to the joint action of independent variables also can be calculated. Similarly $\beta_{12 \cdot 34} \times r_{12}$, $\beta_{13 \cdot 24} \times r_{13}$ and $\beta_{14 \cdot 23} \times r_{14}$ each gives percentage of variance of dependent variable attributable to the action of that particular independent variable.

X. Multiple Classification Analysis

The results of regression equation were adapted to multiple classification analysis table. The table contains adjusted and unadjusted means of mathematics achievement corresponding to different groups of independent variables with corresponding $R^2$. The unadjusted mean was calculated from the simple regression equation using the specified independent variable. The adjusted mean of mathematics achievement was calculated by using multiple regression equation by fixing the
independent variables at their mean except the variable taken into consideration. The adjusted $R^2$ was taken as the square of partial correlation between mathematics achievement and the variable under consideration by partialling out the other independent variables.
References


