CHAPTER III

RESEARCH DESIGN
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3.0 INTRODUCTION

According to Kerlinger (1973) research design is the plan, structure and strategy of investigation conceived so as to obtain answers to research questions and to control variance. Therefore, research design is the most vital aspect of any scientific study. Without it, the research work is just like wandering in the wilderness. Research design makes it possible to plan how the research objectives will be reached and how the problems encountered in the research will be tackled.

The appropriate research design is determined by the nature of the problem under investigation. It includes choice of method of research, defining the population, drawing the sample, nature of variables involved, use of suitable tools for data collection, procedure adopted for data collection and statistical techniques used etc.

The present chapter intends to provide the details of research design followed in the present study.

3.1 METHOD OF RESEARCH

The present study’s prime concern was to ascertain the difference in thinking styles of college students in relation to their cognitive (academic achievement) and non-cognitive characteristics (gender, stream, personality type and motivational orientation). Thus the nature of the study required descriptive analysis of existing thinking styles of college students. For this purpose, neither historical, philosophical, case study nor the experimental research was suitable. Only normative survey under the descriptive research could serves the purpose of the present investigation.

Normative survey method deals with what it is? Its scope is very vast. It describes and interprets what exists at present. In a normative
survey we are concerned with conditions or relationships that exists, practices that prevail, beliefs, points of view or attitudes that are held, processes that are going on, influences that are being felt, and trends that are developing.

**Good, C.V. (1963)** has pointed out that Descriptive Research Method includes presentation of facts or current conditions concerning the nature of a group of persons, number of subjects or class of events and involves the procedure of induction, analysis, classification, enumeration or measurement.

Thus in view of the objectives of the study, the investigator thought it proper to use *Normative Survey method* of research.

### 3.2 POPULATION OF THE STUDY

According to **Guilford (1965)** A population is a well-defined group of individuals or of observations. In the words of **Best and Kahn (1996)**, A population is any group of individuals that have one or more characteristics in common that are of interest to the researcher. The population may be all the individuals of a particular type or a more restricted part of that group.

The population of this study included all the students studying in IIIrd year of science, arts and commerce in all the colleges of Jhansi city. It included students of government and aided colleges.

### 3.3 SAMPLE OF THE STUDY

A sample is small proportion selected for observation and analysis. By observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is drawn.

Samples are not selected haphazardly, they are chosen in a systematic random way, so that chance or the operation of probability can be utilized.
The essential requirement of any sample is that it is representative of the population. Miller (1977) states that the scope of generalization of the findings depend on the representativeness of the sample. Infact, good sample is one, which is unbiased and representative of the whole population.

In the present study an attempt was made to select a representative and unbiased sample. The random cluster method technique was employed to draw the sample.

First of all, a list of all colleges of Jhansi was prepared. Then colleges were randomly chosen adopting simple lottery method. Thereafter, one section of science, arts and commerce stream was selected randomly from each selected colleges.

Details of the structure of sample has been given in Table 3.1.

**Table 3.1**

**Structure of the Sample: Stream and Gender wise**

<table>
<thead>
<tr>
<th>S.No</th>
<th>College</th>
<th>Stream</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Science</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1</td>
<td>Bipin Bihari College, Jhansi</td>
<td>71</td>
<td>91</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Bundelkhand College, Jhansi</td>
<td>42</td>
<td>68</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Shri Guru Hari Krishna Degree College, Jhansi</td>
<td>-</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Arya Kanya Degree College, Jhansi</td>
<td>37</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>Govt. Degree College, Jhansi</td>
<td>43</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td>193</td>
<td>198</td>
<td>173</td>
</tr>
</tbody>
</table>
It is clear from Table 3.1 that the total sample consisted 371 college students. Out of this 193 belonged to science, 106 belonged to Arts and 72 belonged to Commerce streams. Further, 198 students were male and 173 students were female. Thus the sample was large enough and also representative of the population.

3.4 VARIABLES INVOLVED

In the presented study, two types of variables were considered:

i. Independent and

ii. Criterion variables.

Independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to observe phenomena. In the present study one cognitive characteristics - academic achievement and four non-cognitive characteristics namely gender, stream, personality and motivational orientation were the independent variables. These were used for classifications of the subjects.

Criterion variables are those characteristics of the learner on which comparison are made. Under this category sixteen thinking styles were included. Criterion variables are also referred to as dependent variables, which are conditions or characteristics that appear, disappear or change as the experimenter introduces, removes or changes independent variables.

3.5 TOOLS USED

To carry out the investigation, the data is gathered with which hypotheses are tested. Because each data - gathering tool has its own particular weakness or bias, there is need to evaluate them in terms of certain desirable attributes of good tool and finally select the one which seems to be free from major weakness and serve the purpose i.e. generate more adequate data. Reliability, validity, suitability and appropriateness
are studied before any tool is selected out of the available tools. Since selection of suitable tool is of vital importance for successful research.

In the present study the following tools were employed for data collection:

- Your Style of Learning and Thinking (by Torrance et al.)
- Thinking Style Inventory (by Sternberg and Wagner)
- Maudsley Personality Inventory (M P I) (by Eysenck)
- The Student Work Preference Inventory (by Ambile et al.)

In following paragraphs, description of each tool is given.

(1) YOUR STYLE OF LEARNING AND THINKING (FORM B)

For assessing the thinking styles two tools were used. One tool was Your Style of Learning and Thinking (Form B) of Torrance et al. This contains 40 forced items having three choices - One representing a specialized function of left cerebral hemisphere, the second representing a parallel specialized function of the right cerebral hemisphere and the third representing the integrated functioning of both cerebral hemispheres.

Test takers are asked to indicate which of the three styles of thinking or learning best describes their own typical behaviour. “Select the one that describes most accurately your strength of reference.”

The reliability coefficient of correlation with the Form ‘B’ after an investigation of 6 weeks were:

- Right = 0.72
- Left = 0.74
- Integrative = 0.68

A major claim for the validity of these forms of SOLAT is based on research findings concerning the specialized functions of the cerebral hemisphere (Reynolds, Riegel, Torrance and Ball, 1978). It is also based on their styles of processing information and that they will report
them accurately, as is true of almost all self-report instruments. However, a great variety of approaches are being used by the authors and their associates in validating these instruments.

However, before the use of this tool for data collection, its reliability by test-retest method was calculated by following the procedure mentioned below:

First of all a sample of 60 students of B.A., B.Sc. and B.Com. final year was selected randomly from two colleges of Jhansi. They were administered Torrance et al’s Your Style of Learning and thinking after explaining the procedure of recording the response and establishing the rapport. After completing the test, scoring was done. Then after 15 days again the same test was administered on the same sample. Second time test was scored out and Pearson’s coefficient of correlation was found between the two sets of scores for Left, Right and Integrated styles. The obtained statistics has been displayed in the table 3.2

Table — 3.2

Coefficient of Correlation between YSLT Scores Obtained on First and Second Administration (N = 60, Interval= Two Weeks)

<table>
<thead>
<tr>
<th>Test Administration</th>
<th>Coefficient of Correlation (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Administration and 2nd Administration of the YSLT</td>
<td>Left Style = 0.71</td>
</tr>
<tr>
<td></td>
<td>Right Style = 0.70</td>
</tr>
<tr>
<td></td>
<td>Integrative Style = 0.67</td>
</tr>
</tbody>
</table>

The obtained coefficients of correlation on Indian college’s students for the three styles are approximately the same.

Here the test was considered reliable for using in the study. A copy of Your Style of Learning and Thinking is given in Appendix – A-1 and data of test-retest reliability in Appendix - B.
(2) THINKING STYLE INVENTORY

Thinking styles inventory by Sternberg and Wagner (1992) was also used to assess the thinking style of college students. It is a self-reporting test consisting of 104 items. The inventory has 13 scales with 8 items on each scale.

For each item, the respondents are asked to rate themselves on a 7-point scale anchored by 1, which indicates that the statement does not characterize them at all, and 7, which indicates that the statement characterize them extremely well. These 13 scales correspond to the 13 thinking styles described in Sternberg's styles are Legislative, Executive, Judicial, Monarchic, Hierarchic, Oligarchic, Anarchic, Internal, External, Global, Local, Liberal and Conservative.

Sternberg and Wagner (1992) collected norms for various age groups on the long version of the TSI. For their college sample, scale reliabilities ranged from 0.42 (Monarchic) to 0.88 (External), with a medium reliability of 0.78.

According to Sternberg (1997), the 13 scales of the thinking styles Inventory was found to have internal-consistency reliability ranging from 0.57 to 0.88 with a median of 0.82. Only one reliability was in the 0.50s, two were in the 0.60s, and one was in the 0.70s and rest were in the 0.80s.

One thing is worthwhile to be recorded here that instead of 7-point, the investigator used 5-point rating for this inventory and an attempt was made by the investigator to determine the reliability of Thinking Style Inventory (of Sternberg by test-retest method) on sample of 60 Indian college students selected through random method with an interval of two weeks. The obtained results have been shown in table 3.3.
Table - 3.3

Test Retest Reliability of Sternberg’s Styles of Thinking - inventory on Indian College Students (N = 60, Interval=2 weeks)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Styles</th>
<th>Coefficients of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Legislative</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>Executive</td>
<td>0.76</td>
</tr>
<tr>
<td>3</td>
<td>Judicial</td>
<td>0.77</td>
</tr>
<tr>
<td>4</td>
<td>Monarchic</td>
<td>0.75</td>
</tr>
<tr>
<td>5</td>
<td>Hierarchic</td>
<td>0.76</td>
</tr>
<tr>
<td>6</td>
<td>Oligarchic</td>
<td>0.75</td>
</tr>
<tr>
<td>7</td>
<td>Anarchic</td>
<td>0.80</td>
</tr>
<tr>
<td>8</td>
<td>Internal</td>
<td>0.79</td>
</tr>
<tr>
<td>9</td>
<td>External</td>
<td>0.77</td>
</tr>
<tr>
<td>10</td>
<td>Global</td>
<td>0.80</td>
</tr>
<tr>
<td>11</td>
<td>Local</td>
<td>0.78</td>
</tr>
<tr>
<td>12</td>
<td>Liberal</td>
<td>0.60</td>
</tr>
<tr>
<td>13</td>
<td>Conservative</td>
<td>0.65</td>
</tr>
</tbody>
</table>

The obtained coefficients of correlation were quite satisfactory. Hence the tool was considered suitable for the use in the present study.

A copy of the Thinking Style Inventory is given in the Appendix – A-2 and data of test-retest reliability in Appendix - B.

(3) MAUDSLEY PERSONALITY INVENTORY (M P I)

The Maudsley Personality Inventory is a brief but standard as well as an easily scored inventory. It is designed for assessing Neuroticism - Stability and Introversion - Extroversion dimensions of personality. It is considered suitable for normal and abnormal adults and
also for adolescents. The inventory can be used in group or with an individual. The vocabulary required is that of the average newspaper. Although the time limit is enforced in testing, but the short scale takes about 3 to 5 minutes, while the long scale takes about 15 to 20 minutes. The items from serial number 1 to 12 given on the front page of the test booklet make the short scale, while all 48 items of the booklet constitute the long scale. Each of these items is answerable by making a tick-mark into one of the three boxes and marked with instruction to answer the questions are given on the front cover page of the test booklet.

The reliability-coefficient by comparing the first half with the 2nd half, yielded for \( N = +0.567 \) and \( E = \pm 0.358 \). When corrected to full length, these figures became for \( N = 0.73 \) and \( E = 0.68 \). These figures are lower than the English data, but are likely that an odd/even reliability would be in any case higher figures than would be a comparison of the first half versus second half.

However, it may be mentioned here that original inventory had reliability coefficients for Neuroticism (ranging between 0.85 and 0.90) and for Extroversion (ranging between 0.75 and 0.85) calculated on many sample by split-half and Kuder-Richardson’s method.

For estimating validity the full scale was administered on postgraduate male and female students. For the full scales the mean neuroticism score for the male and female groups combined was 232 with a SD of 10.0, this corresponds with English norms of 19.9 and SD 11.0. For Extraversion scale the mean combined score was 27.8 and SD 6.2, this compares with English Norms of 24.9, SD 9.7. There were no difference of any significance between males and females and the data suggest that the Indian group was slightly more neurotic and extroverted than the English Standardization group. Findings with the short scale are similarly showing the comparable values of means and SDs.
The test is scored with the help of standard key. Test-retest reliability was also ascertained by the investigator on a sample of 60 college students (drawn randomly) with an interval of 2 weeks. The obtained results are shown in table 3.4.

**Table - 3.4**

Test-Retest Reliability of MPI on Indian College Students

(N = 60, Interval = 2 weeks)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraversion</td>
<td>0.68</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>0.73</td>
</tr>
</tbody>
</table>

The obtained coefficients of correlations were found comparable to the coefficients of correlation got by Eysenck. Hence this inventory was considered appropriate to be used in the study.

A Copy of the MPI is given in Appendix – A-3 and data obtained for test-retest reliability in Appendix - B.

(4) **THE WORK PREFERENCE INVENTORY. Teresa M. Ambile (1987)**

The Work Preference Inventory (WPI) is designed to assess individual differences in intrinsic and extrinsic motivational orientations. There are two versions of it. One is meant for college student’s and another for working adults. Both versions aim to capture the major elements of intrinsic motivation (self-determination), competence, task involvement, curiosity, enjoyment and interest) and extrinsic motivation (concerns with competitions, evaluation, recognition, money or other tangible incentives and constraint by others).

The final version of college students Work Preference Inventory has 30 items, 15 for intrinsic motivation and 15 for extrinsic motivation. The items have been written in the first person. The respondents are asked to indicate the
extent to which each item describes them on a 4-point scale, from 1 = never or almost never of me to 4 = always or almost always true of me.

The instrument is scored on two primary scales - intrinsic motivation and extrinsic motivation and each sub divided into two subscales.

Test-retest reliability (6 months, n = 18) was found to be 0.84 and 0.94 for intrinsic and extrinsic motivation respectively. Cronbach’s reliability was also quite satisfactory 0.79 and 0.78 for intrinsic and extrinsic motivation scales.

Scale norms were also developed for college students, men and women students.

Relationship between two scales was essentially orthogonal. For students, the intrinsic and extrinsic primary scales correlated -0.21.

Further WPI scores were found to be related in meaningful ways to other questionnaire and behavioural measure of motivation, as well as personal characteristics, attitudes and behaviours.

Test-retest reliability of the Work Preference Inventory was also ascertained by the investigator. On a sample of 60 college students (drawn randomly) with an interval of two weeks, the following coefficients of correlation were obtained as reported in table 3.5.

Table - 3.5

Test-retest Reliability of The Work Preference Inventory

(N =60, interval = 2 weeks)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsic Motivation</td>
<td>0.69</td>
</tr>
<tr>
<td>Extrinsic Motivation</td>
<td>0.71</td>
</tr>
</tbody>
</table>
Research Design

The obtained coefficients of correlations were somewhat lower as compared to original one obtained by the authors of the inventory. But values were high and were indicative of the facts that inventory could be used in the Indian context.

A copy of the Work Preference Inventory is given in Appendix - A-4 and the obtained data of test-retest reliability in Appendix - B.

3.6 DATA COLLECTION

For data collection, first of all class teachers of concerned colleges were contacted by the investigator and schedule of test administration was decided. Thereafter, selected tools were administered on the subjects in two phases. In the first phase the following tools were administered:

➢ Your Style of Thinking and Learning (Torrance et al) and
➢ Thinking Style Inventory (Sternberg and Wagner)

In the second phase, tools mentioned below were administered:

➢ Maudsley Personality Inventory (M P I) and
➢ The Student Work Preference Inventory (by Ambile)

However, before administration of the tests, students were told the purpose of the study and importance of their cooperation in data collection. After putting them into proper frame of mind, tests were distributed according to schedule. The obtained data have been given in Appendix – C.

3.7 CLASSIFICATION OF SUBJECTS

Subjects were classified on extraversion, neuroticism, extrinsic motivation and intrinsic motivation variables. M ± 1SD formula was applied on scores of each variable. Subjects scoring M + 1SD or above were identified as having high level and subjects scoring M − 1SD or
below were identified as having low level. For instance on extraversion dimension, subjects scoring $M + 1SD$ and above were classified as high extraversion (extroverts) and those who scored $M - 1SD$ and below were classified as low extraversion (introverts). Similarly subjects scoring $M + 1SD$ and above on neuroticism dimensions were classified as high neuroticism (neurotic) and those scored $M - 1SD$ and below on neuroticism dimension were classified as low neuroticism (stable).

High and low levels of extrinsic motivation and intrinsic motivation were also identified in the same manner.

3.8 STATISTICAL TECHNIQUES USED

Statistics is a body of mathematical techniques or processing for gathering organizing, analyzing and interpreting numerical data. Because most research yields such quantitative data, statistics is a basic tool of measurement, evaluation and research.

As the focus in the present study was to ascertain the significant differences in mean scores of thinking style (s) of college students in relation to achievement, gender, stream, personality type and motivational orientation, two statistical techniques namely one-way analysis of variance and ‘t’ tests were performed depending upon the comparison of three and two groups. In case of comparison three groups, One-way-ANOVA was used and in case of comparison of two groups, ‘t’ test was employed. In case of significant ‘F’ also ‘t’ test was used to pin point the exact source of difference in three means.

3.8.1 One-Way-Analysis of Variance

In single classification, or one-way-analysis of variance, the relationship between one independent and one dependent variance is examined.
This technique involves three operations mentioned below:

1. The variance of the scores for three groups are combined into one composite group, known as the total groups variance \((V_t)\).

2. The mean value of the variances of each of the three groups, computed separately, is known as the within groups variance \((V_w)\).

3. The difference between the total groups variance and the within groups variance is known as the between groups variance \((V_t - V_w = V_b)\).

4. The F ratio is computed.

\[
F = \frac{V_b}{V_w}
\]

\[= \text{Between-groups variance} / \text{Within-groups variance}\]

**The Logic of the ‘F’-Ratio:**

The logic of F-ratio is as follows -

The within - groups variance represents the sampling error as the error variance or residual. The between-groups variance represents the influence of the variable of interest or the experimental variable. If the between-groups variance is not substantially greater than the within-groups variance, the research would conclude that the difference between the means is probably only a reflection of sampling error. If the ‘F’ ratio were substantially greater than one, it would seem that the ratio of the between-groups variance was probably too great to attribute to sampling error.

The critical values of the ‘F’-ratio (named for Sir Ronald Fisher) are found in an F-table, which indicates the critical values necessary to test the null hypothesis at selected levels of significance (in education conventionally 0.05 and 0.01 levels). The ‘F’-ratio is seen against the two different degrees of freedom, one for \(V_b\) (the numerator) and the one for \(V_w\), (the denominator).
In the mathematical development of the analysis of variance a number of assumptions have been made. According to Ferguson (1981) the following assumptions may be specially noted:

1. The distribution of dependent variable in the population from which samples are drawn is assumed to be normal.
2. Another assumption made in its use is that the variances in the population from which the samples are drawn, are equal. This is known as homogeneity of variance.
3. The effects of various factors on the total variation are additive, as distinct from, say, multiplicative.

Thus, the basic model underlying the analysis of variance is that a given may be partitioned into independent and additive bits, each bit resulting an identifiable source. In most situations there are no ground rules to suspect the validity of this model.

Several statisticians held that if the sample is large enough and has been drawn randomly with all care, there is no need to test the basic assumptions of ANOVA before it’s applying to the data.

In the present study One-way-ANOVA was employed without any testing of its assumptions because first of all institutions were selected randomly. Secondly, sample was drawn by random cluster method. Thirdly, the size of the sample was large enough.

Post-hoc analysis in case of significant ‘F’ was done by ‘t’ test, so that exact source of mean differences may be ascertained.

3.8.2 The ‘t’ test of Independent Samples

The test of significance of the difference between two means is known as a ‘t’ test. It involves the computation of the ratio between experimental variance (observed difference between the two sample means) and error variance (the sampling error factor).
The obtained value of ‘t’ was evaluated at 0.05 and 0.01 level of significance. If the ‘t’ value was equal or exceeded the table value of for the particular degree of freedom and level of significance the difference between the two means was considered significant at that level (0.05 or 0.01). If the obtained ‘t’ value was not found significant at even 0.05 level of significance, the difference between the two means was treated as false and attributable to chance factor or sampling fluctuations.

In addition to the above-mentioned statistics, graphs were also used to depict the difference in means.