CHAPTER: IV

ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

Analysis of data is one of the important aspects of each and every research. By analysis we mean to break the material into different parts and in research analysis means to break the collected data into smaller parts and apply various statistical techniques to give appropriate meaning to the data. After data collection it is the next step of research. In other words, to make a lay man understand what the research is revealing and what are the outcomes of the data collected, etc. Analysis makes the nature of data easily understandable and it can be done in different ways, i.e. both quantitatively and qualitatively. In the present study, investigator has done analysis by applying both quantitative and qualitative approaches. Koul (1984) in his book *Methodology of Educational Research* wrote that “analysis of data means studying the organized material in order to discover inherent facts. The data studied from as many angles as possible to explore the new facts. Analysis requires an alert, flexible and open-mind. It is worthwhile to prepare a plan of analysis before the actual collection of data.” Good, Barr and Scates (1941) suggested four helpful modes to get started on analysing the gathered data:

1. To think in terms of significant tables that the data permit.

2. To examine carefully the statement of the problem and earlier analysis and to study the original records of the data.

3. To get away from the data and to think about the problems in layman’s terms, or to actually discuss that problem with others.

4. To attack the data by making various statistical calculations.

The order in which analysis of data is done comprises categorizing, ordering, manipulating and summarizing the obtained data to arrive at solutions of research questions. In order to discover the inherent facts and hidden meanings, the
data is organized. Data are nothing but observed facts which do not have any meaning until and unless it is cautiously edited, thoroughly analyzed, wittily interpreted and logically concluded. Analysis and interpretation of the data is the most skilful assignment in research. It needs a skilful researcher who can apply his or her own discretion to reach to the conclusions. Analysis is done to test hypothesis or research questions framed as necessary component of a research. Raw data cannot speak what results it shows so we need to give it a proper shape to make it understandable through interpretation of results. Only through analysis and interpretation of data, generalizations could be made. So, without analysis and interpretation of data, no research is possible.

There are various statistical methods applied for analysing the data. There are various parametric and non-parametric techniques like mean, median, mode, standard deviation, quartile deviation, t-test, CR, ANOVA, ANCOVA, MANOVA, chi-square, sign test, median test, etc. Some apply content analysis instead of statistical analysis for analysing the data. Some calculate the data manually and some do it through various packages like SPSS, reliability calculators, SAS, R, etc. In the present study, the investigator analysed the data through SPSS, XL-Stats, MS-Excel and some data were manually analysed.

4.1 STATISTICAL TECHNIQUES:

According to Koul (1984), “Statistical techniques have contributed greatly in gathering, organizing, analyzing and interpreting numerical data. The processing of numerical data through statistics calls for competence in the use of statistical methods and for understanding of concepts that underline their development and their application. The researcher must know the strengths and weaknesses of the statistical methods which he uses so that he may not mislead or be misled by such methods.” Statistical techniques are useful for researcher as it helps in analyzing and interpreting the data.

The purpose of the present research work was to study the effect of metacognition, self-system and home environment among secondary school
students. To study the levels of metacognition, self-system and home environment Quartile Deviation (Q1 and Q3) was applied. Mean was employed to compare the groups in different variables. For assessing the significance of differences Three Way ANOVA (2×2×2) factorial design and t-test were employed. Along with statistical techniques, content analysis was done and percentage was used followed by case studies. In the present study, the investigator has used various statistical techniques to analyse and interpret the data. The description of the techniques along with the calculation part is given as follows:

4.2 ANALYSIS OF VARIANCE (ANOVA):

The concept of Analysis of Variance has been propounded by Sir Ronald A. Fisher. It is an extension of t-test which is used for comparing significance of differences between means of two groups. But whenever the number of groups in comparison exceed two, it has been advisable to make use of Analysis of Variance as a statistical technique. In other words, a composite procedure for testing simultaneously the difference between several sample means is known as the analysis of variance. It helps us to know whether any differences between the means of the given samples are significant. It is considered as an effective statistical technique to determine whether the means of more than two samples having drawn from the same population were too different to attribute to chance or sampling error.

By variance, we mean the arithmetic average of the squared deviation from their means. In simple words, it is the square of standard deviation. Variance has a quality of additivity which means that the variance can be added up and broken into components. Thus, the term analysis of variance relates with the task of analyzing the breaking up of total variance. It generally includes two types of variances:

i) Within group variance: This is the average variance of the members of each group around their respective group means, i.e. the mean value of the
values in a sample (as members of each group may vary among themselves).

ii) Between group variance: This represents the variance of group means around the total or grand mean of all groups, i.e. the best estimate of the population mean (as the group means may vary considerably from each other). (Mangal, S.K., 2002, p. 321).

The variability or variation or differences or variances is judged in dependent variable which is caused by the influence of independent variable. The classification of ANOVA depends upon the number of independent variables used. The dependent will always remain to be one variable, in which the changes have to be found out on account of either number independent variables or in combination of independent variables. They become the source for causing variation in dependent variable which is to be analysed through the process of ANOVA. (Verma, L.K., and Sharma, N.R., 2004, pp.188-190).

According to Best and Kahn (2006), the analysis of variance consists of following operations:

i) The variance of the values for three groups is combined into one composite group known as the total-groups variance ($V_t$).

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

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

$$\frac{V_b}{V_w}$$

iv) The F ratio is computed as $F = \frac{V_b}{V_w}$

v) The logic of the F ratio is that the within-groups variance represents the sampling error in the distributions and is also referred to as the error variance or residual. The between-groups represent 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 researcher would conclude that the difference between the means is probably only a reflection of sampling error. If the F ratio were substantially greater than 1, it would seem that the ratio of the between-groups variance and the within-groups variance was probably too great to attribute to sampling error.

vi) The critical values of the F ratio are found in an F table which indicates the critical values necessary to test the null hypothesis at selected levels of significance.

vii) The calculation of F involves finding the mean of the deviations from the mean, squared. Thus, the between-group variance ($V_b$) is more commonly referred to as the mean squared between (MS$_b$), and the within-groups variance ($V_w$) is more commonly referred to as the mean squared within (MS$_w$).

According to Koul, L. (1984, pp. 328-329) in many experimental studies, we are concerned with the effect of two or more independent variables, usually called factors, on a dependent variable. The number of ways in which a factor is varied is called the number of levels of the factor. A factor that is varied in two ways is said to have two levels and a factor that is varied in three ways is said to have three levels. With two or more factors each with two or more levels, a treatment in some experiments consists of a combination of one level for each factor.

Johnson (1961, cited by Koul, 1984, p.324) stressed on the following assumptions of ANOVA:

i) The population distribution should be normal. This assumption however, is not especially important. Eden and Yates showed that even with a population departing considerably from normality, the effectiveness of the normal distribution still held. Besides, the findings of Eden and Yates, the
study of Norton cited by Guilford (1965, pp. 300-301) also points out that F is rather insensitive to variations in the shape of population distribution.

ii) All the groups of certain or of the combination of more than one criterion should be randomly chosen from the sub population having the same criterion or having the same combination of more than one criterion.

iii) The sub-groups under investigation should have the same variability. We should test this assumption before we run through the analysis of variance. Otherwise, a false interpretation of the results may follow. This assumption is tested either by applying Bartlett’s test of homogeneity or by applying Hartley’s test.

4.2.1 Basic Assumptions of ANOVA:

Verma, L.K., and Sharma, N.R. (2004, p. 191) stressed that while using analysis of variance as a statistical technique for studying mean differences between more than two groups, the following assumptions should be met:

i) Independence of Groups: It is assumed that the groups selected should be made up of randomly selected subjects and are independent. The observations being independent and have the equal chances to occur.

ii) Homogeneity of Variances: It means variances within sets should be equal. It is assumed that the population from which groups have been selected have equal variances. In symbols, it is presented as \( \sigma^2_1 = \sigma^2_2 = \ldots = \sigma^2_k \). The mean square for within (\( MS_w \)) is an indicator of variances among different groups.

iii) Normality of Distribution: The sample selected from the population should have normal distribution.

iv) Additivity: It has been stated that the total variance is obtained due to sum of two other sources of variances, i.e. variations caused by between and within estimates. Any ANOVA model therefore, confirms that the total
variance is a sum of between and within variances. So, the contribution to total variances must be additive.

4.3 Phases of Analysis Done in the Present Study:

The data have been analysed in two phases which is described in the following manner:

**Phase I: Analysis of Quantitative Data**

1. **Quartile Deviation:** To study the levels of independent variables like metacognition, motivation, locus of control, self-efficacy and home environment, quartile deviation was used for determining the high and low groups of data.

2. **Mean values:** For objective one of the study i.e. ‘To study the levels of metacognition, motivation, locus of control, self-efficacy and home environment of secondary school students on the basis of gender, type of institution and locality’ Mean Values were found. These were found to study the levels of independent variables like metacognition, motivation, locus of control, self-efficacy and home environment. With the help of Mean, it has been found that which group performed better with regard to demographic variable like gender (boys-girls), type of institutions (government-private) and locality (urban-rural).

3. **Analysis of Variance:** For objective two of the present study i.e. ‘To study the effect of metacognition, motivation, locus of control, self-efficacy and home environment on the academic achievement of secondary school students on the basis of gender, type of institutions and locality’ and for objective three i.e. ‘To study the interactional effect of metacognition, motivation, locus of control, self-efficacy and home environment on the academic achievement of secondary school students on the basis of gender, type of institutions and locality’, Three-way ANOVA (2×2×2) factorial
design was used. It has been applied to study the significance of differences between the means of various groups.

4. **T-test:** It has been used to authenticate the results of ANOVA. For this formula for t-test used was \( t = \sqrt{F} \). (Garrett, H.E., and Woodsworth, R.S. (1961). *Statistics in psychology and education*, P. 290).

**Phase II: Analysis of Qualitative Data:**

For objective four i.e. ‘To analyze the data based on Case Studies and Interview Schedule’ following techniques were used to analyze the data:

1. **Content Analysis:** For analysis of responses of students obtained with the help of ‘Interview Schedule’, content analysis was used. Percentage and graphs were used to represent the data in a figural form.

2. **Case Studies:** Case studies were done for supporting the data as it helps in understanding the concepts in a broader and deeper manner. In the present study, case studies were recorded of those falling under extreme categories. The investigator found these cases as different from the rest of the sample which supported the results of the study.