CHAPTER IV
METHODOLOGY

4.1 METHOD ADOPTED
4.2 VARIABLES SELECTED FOR THE STUDY
4.3 SAMPLE SELECTED FOR THE STUDY
4.4 TOOLS USED FOR THE STUDY
4.5 PROCEDURE ADOPTED FOR EXPERIMENTATION
4.6 STATISTICAL TECHNIQUES EMPLOYED FOR ANALYSIS
METHODOLOGY

Methodology is the systematic, theoretical analysis of the methods applied to a field of study or the methodological analysis of the body of methods and principles associated with branch of knowledge. It typically encompasses branches such as paradigm, theoretical model phases and quantitative and qualitative techniques. A methodology does not set out to provide solutions but offers the theoretical underpinning for understanding which method, set of methods so called best practices can be applied to the specific case. Methodology describes the various step of the plan of attack to be adopted in solving a research problem such as the manner in which the problem formulated, the definition of forms, the choice of the subject for investigation, the validation of data gathering, tools, the collection, analysis and interpretation of data and the process of inferences and generalizations. According to Mc Millan and Shumacher (1989), methodology refers to the way one collects and analyses, data for acquiring knowledge by reliable trustworthy procedures. Thus the researcher should formulate the methodology best suited to the nature of the problem under study, research hypotheses, theoretical constructs and feasibility to evolve the most valid and reliable findings.

A Research Design deals with four main ideas – the strategy, the conceptual framework, the question of who or what will be studied, and the tools to be used for collecting and analysing empirical materials (Punch, 2009). The purpose of Research Design is to determine as unambiguously as possible, whether or not, Hypotheses are true (Slavin, 1992). It is the overall plan for a piece of research. Research methods are only a part of research design.
The present study aims to find out the effectiveness of an Instructional Strategy based on Path-Smoothing Model on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of students at Secondary level. The variables considered under the study are the Instructional Strategies, Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics.

The different aspects related to the research design are discussed under the following heads:

4.1 METHOD ADOPTED

By methods, we mean that range of approaches used in educational research to gather data which are to be used as a basis for inference and interpretation, explanation and prediction (Cohen et al. 2000). The accuracy of the result of educational research or any research depends upon the methods through which the conclusions are arrived at. Research methods are of at most importance in research process. Research methods and techniques are useful for the classification and organization of unorganized mass of data. Methods refers to the techniques and procedures used in the process of data gathering. They are the ways in which data are collected, classified, hypotheses formed and tested and the laws formulated.

The present study mainly intends to improve Creative Problem Solving Ability and Perceptual Speed and to test the effectiveness of an Instructional Strategy based on Path-Smoothing Model on Creative Problem Solving Ability, Perceptual Speed and thereby improve the Achievement in Mathematics of Students at Secondary Level. Experimental Research is the description and analysis of what will be, or what will occur, under carefully controlled situation (Best & Khan, 2010)
The method used for the present study is the experimental method. Two comparison groups were set up; the Experimental Group and the Control Group. The Experimental Group was subjected to the treatment namely teaching through an Instructional Strategy based on Path-Smoothing Model and the Control Group was taught through the Activity Oriented Method. The students were randomly assigned to the comparison groups. Thus the design of the experiment becomes a Pre-test Post-test non equivalent group design. (Punch, 2009). Here the researcher has no control over the experimental treatment, but the researcher has some control over when to measure outcome variables in relation to exposure to independent variable.

4.1.1 Experimental Design Selected

Experimental design is the blueprint of the procedures that enables the researcher to test the hypothesis by reaching valid conclusions about the relationship between independent and dependent variables (Best & Khan; 2010)

Since the classroom intact groups were selected for the study, getting equivalent groups are practically impossible. So for the present study investigator adopted Pre-Test, Post-Test Non- Equivalent Group Design. The Experimental design in general case is presented in the figure 4.1

![Experimental Design Diagram](image)

\[ O_1, O_3 \] - Pre-Tests; \[ O_2, O_4 \] - Post-Tests

*Fig: 4.1 Symbolic Representation of the Experimental Design in General*
4.2 VARIABLES SELECTED FOR THE STUDY

Variables are the conditions or the characteristics that the experimenter manipulates, controls or observes (Best & Khan, 2010). For an experimental study, there are Independent variables, Dependent variables and Extraneous Variables.

The Independent variables are the conditions or characteristics that the experimenter manipulates or control in his or her attempt to ascertain their relationship to observed phenomena (Best & Khan, 2010). They are introduced as treatments to which experimental groups are exposed. It is also called as treatment variable.

Since the present study aims to compare the effectiveness of an Instructional Strategy based on Path- Smoothing Model and Activity Oriented Method on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics, the independent variables for the present study are

- The Instructional Strategy based on Path- Smoothing Model
- Activity Oriented Method

Dependent variables are the conditions or characteristics that appear, disappear or change as the experimenter introduces/ removes or change independent variables (Best & Khan, 2010). They are measured before and after the treatment to see whether any changes occurred. The dependent variable may be a test score, the number of errors or measured speed in performing a task (Best & Khan, 2010).
Dependent variables considered in the present study are

- Creative Problem Solving Ability
- Perceptual Speed
- Achievement in Mathematics.

**Extraneous Variables** are those uncontrolled variables (ie, variables not manipulated by the experimenter) that may have a significant influence upon the results of the study (Best & Kahn, 2007). Extraneous Variables considered in the present study are

- General Mental Ability
- Previous Achievement in Mathematics
- Age level of students
- Teacher factor
- Time of Instruction

The variables used for the study are diagrammatically presented in the figure 4.2
Methodology

**Fig. 4.2** Variables of the Study

- **Independent Variables**
  - Instructional Strategy based on Path-Smoothing Model
  - Activity Oriented Method

- **Dependent Variables**
  - Creative Problem Solving Ability
  - Perceptual Speed
  - Achievement in Mathematics

- **Extraneous Variables**
  - General Mental Ability
  - Prev. Achv. In Mathematics
  - Age Level of Students
  - Teacher factor
  - Time of Instruction
4.3 SAMPLE SELECTED FOR THE STUDY

Sampling is the process of selecting a number of individuals for the study in such a way that the individuals represent the larger group from which they were selected (Gay, 1996). The purpose of sampling is to gain information about a population. The sample of the present study consists of 296 students of standard VIII in Secondary schools of Kerala, under the Department of General Education.

4.3.1 Sampling Technique

A sample is a small proportion of the population that is selected for observation and analysis (Best & Khan, 2010). From the population, sufficient sample for the experimental study was taken using Random Sampling technique, giving due importance to Gender and Type of school Management. For conducting the experiment, investigator selected 296 Secondary School Students following Kerala State Syllabus from four schools of Thrissur district for the experimental study. The students of Eighth standard were selected for the study. Piaget described age 12+ as the formal operational stage, where the children develop the capacity to understand abstract concepts and engage in systematic logical reasoning and Problem solving (Banerjee, 2011). The school authorities, teachers and students were highly cooperative and provided help whenever needed during the course of the study. The details of the schools under study and samples selected for experimental study are presented in the table 4.1.
### Table 4.1

**Break-up Sample for the Study**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of school</th>
<th>Type of Management</th>
<th>Boys/Girls Co-edu</th>
<th>No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Govt</td>
<td>Co-edu</td>
<td>Experimental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Group</td>
</tr>
<tr>
<td>1</td>
<td>Govt Model Higher Secondary School, Kunnamkulam</td>
<td>Govt</td>
<td>Co-edu</td>
<td>16 17 33</td>
</tr>
<tr>
<td>2</td>
<td>Govt Higher Secondary School, Thrissur</td>
<td>Govt</td>
<td>Co-edu</td>
<td>18 19 37</td>
</tr>
<tr>
<td>3</td>
<td>Mary Magdhelene Convent School, Adupputty</td>
<td>Aided</td>
<td>Co-edu</td>
<td>20 21 41</td>
</tr>
<tr>
<td>4</td>
<td>St.Marys GHS, Chowannoor</td>
<td>Aided</td>
<td>Co-edu</td>
<td>18 19 37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72 76 72 76</td>
</tr>
</tbody>
</table>

**4.4 TOOLS USED FOR THE STUDY**

Tools are the instruments employed for gathering the necessary data. A tool is a measuring instrument that has generally accepted units of measurements. Aggarwal (1966) defined tool as “The instruments employed as a means to gather new factors to explore new fields”. It is the
appropriateness of the tools selected for research that determines the credibility of the study. The success of any investigation depends on the proper choice and intelligent application of the tools.

The following tools were employed for collecting necessary data:

4.4.1 Questionnaire on the present status of Teaching Mathematics.

4.4.2 Lesson Transcripts on Instructional Strategy based on Path-Smoothing Model (Prepared by the Investigator)

4.4.3 Lesson Transcripts on Activity Oriented Method. (Prepared by the Investigator)

4.4.4 Creative Problem Solving Ability Test (Prepared and Standardized by the Investigator)

4.4.5 Perceptual Speed Test (Prepared and Standardized by the Investigator) includes the following Sub tests.

   (i) Perceptual Speed Sub Test-I (Number Comparison Test)

   (ii) Perceptual Speed Sub Test-II (Word Comparison Test)

   (iii) Perceptual Speed Sub Test-III (Alpha Numeral Comparison Test)

   (iv) Perceptual Speed Sub Test-IV (Mathematical Operation Comparison Test)

   (v) Perceptual Speed Sub Test-V (Figure Comparison Test )

   (vi) Perceptual Speed Sub Test -VI (Formulae Comparison Test )
Methodology

(vii) Perceptual Speed Sub Test - VII (Roman Numeral Comparison Test)

(viii) Perceptual Speed Sub Test-VIII (Figure Identification Test)

4.4.6 Achievement Test in Mathematics (Prepared and Standardized by the Investigator)

4.4.7 Raven’s Standard Progressive matrices.

The descriptions of the tools are given below:

4.4.1 Questionnaire on the present status of Teaching Mathematics

The Questionnaire for identifying the present status of teaching Mathematics at Secondary level was prepared by the investigator by consulting with experts and teachers in Mathematics and Mathematics Education. This questionnaire was intended to collect information from Secondary school Mathematics teachers about the present status of teaching Mathematics at Secondary Level.

For the development of the questionnaire, the investigator held long discussions with the teachers who are handling Mathematics in Secondary Classes. The questionnaire contains two sections: Section-I includes details with the personal information of the teachers including their Name, Educational Qualifications and Teaching Experience. Section-II includes information regarding the methods of Teaching Mathematics and the problems faced by teachers while handling the portions in Mathematics. Initial Questionnaire includes 30 questions having two sections as noted above. This questionnaire was given to experts in this field and based on their suggestions the items in the questionnaire were reduced to 20.
The draft questionnaire was pre-tried out on five teachers and this enabled the investigator to know the clarity of the wordings and also to ensure the time needed for responding the questionnaire. Based on the feedback received from the pre-try out, certain modifications were made in the order of questions and its form. The final form of the questionnaire consists of 20 items consisting of two sections: 5 items in Section I and 15 items in Section II.

A copy of the final form of the Questionnaire is given as Appendix I.

4.4.2 Lesson Transcripts based on Path-Smoothing Model

The investigator developed the Instructional Strategy based on Path-Smoothing Model. In this approach the teachers attempt plausible explanations, or encourage pupils to gather data about particular cases before offering a generalization. The methodology of this model is to smooth the path for the learner.

The main steps of this model are:

(1) The teacher or text states the kind of problem on which the class will be working

(2) Pupils are guided through a method for tackling the problems

(3) Pupils work on exercises to practice the methods given aimed at involving learners more actively

(4) Revision

Based on the Path-Smoothing Model the investigator developed an innovative strategy for enhancing Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics. In consultation with the supervising teacher and experts in the field of Mathematics education, the investigator formulated the new strategy.
4.4.2.1 Syntax of the Instructional Strategy based on Path-Smoothing Model

Syntax of the model describes the main Phases of teaching and learning through this strategy. Main Phases are

- Introduction of Concept
- Intra Group Discussion
- Inter Group Discussion
- Connecting the Ideas
- Revisiting the Problem
- Revision
- Practice and Reinforcement

4.4.2.2 Social System

Prior to teaching with the Instructional Strategy based on Path-Smoothing Model, teacher provides examples, activities and chances for the students for simple group discussions and large group discussions within the classroom. The major function of the teacher during teaching using Instructional Strategy based on Path-Smoothing Model, is to develop the students new ideas by discussing, thinking and there by develop Creative thinking and Problem Solving Ability and giving some help by the teacher and there by develop Creative Problem Solving Ability and Perceptual Speed of the students also to improve the Achievement. Thus the class is semi structured since there were group discussions as the part of the strategy.
4.4.2.3 Principle of Reaction

The students are actively involved in the discussions initiated by the teacher. They discuss about the topic and the content the teacher given to them. The teacher guides the students in all their discussions. The teacher motivates the students to clear all their doubts. Thus teacher is the centre of all the activities.

4.4.2.4 Support System

In the Instructional Strategy based on the Path-Smoothing Model, by the discussions made in the classroom with the help of teacher students develop Creative Problem Solving Ability and Perceptual Speed. The teacher provides the environment for the students to think creatively by themselves to solve the problems along with the Audio-Visual aids and thereby to improving their perceiving speed.

4.4.2.5 Instructional / Nurturant Effect

Instructional Effect: At the end of the class, students will get a clear understanding about the concepts dealt and they Achieve more in Mathematics. The students will be able to apply it in their daily life situations.

Nurturant Effect: The students will be able to develop Creative Problem Solving Ability and to improve their Perceptual speed. Also they develop cooperating mentality in groups.

Description of the syntax of the Strategy

Phase I: Introduction of Concept

Teacher wants to introduce a concept. For that, teacher is introducing the theoretical aspects of Mathematical concept in brief. Then presenting the problem for discussion.
Phase II: Intra Group Discussion

Students are divided into small different groups. Teacher encourage them to discuss the problem that given by the teacher by giving the concept and asked the students to find out a life situation which is similar to the problem presented by the teacher. The students with the help of class representative divided into different groups of small numbers and they discussed that topic which their teacher introduced with the help of a concept.

Phase III Intergroup Discussion

Teacher asked the students to combine different small groups together which are built up in the classroom and ask the groups to discuss each situations they found out. Also the students are asked to take the situations they found out which is similar to the problem given, that is the concept given by the teacher. Students analyses the relationship between the given problem and life situations

Phase IV: Connecting the ideas

Teacher also helps the students to connect the Mathematical Concepts and real life situations and also explain the mathematical theories for solving that problem. Teacher also encourages students to solve the problem with the help the different ideas and Mathematical theories.
Phase V: Revisiting the problem

Students with the help of the teacher reached up into the solution. After solving the problem teacher asked the students to discuss their doubts and confusions which arouse at the time of solving the problem. Teacher encourage students to analyse a life situation and relate it with the mathematical theory they learned.

Phase VI: Revision

After they analyzed the problem, the teacher first given and reached into the solution and get the idea of the Mathematical concept given, the teacher then dictate another problem and asks the students to solve by themselves by connecting with their life situations.

Phase VII: Practice and Reinforcement

After solving some problems with the help of the teacher by introducing the concept and giving some clues and relating with their own life situations and directing to some other life situations, by grouping the students; students attained the skill to solve the problems by their own. Then the teacher gives more exercises for practicing the theory and supports them with reinforcement.
Fig 4.3 Syntax of the Developed Instructional Strategy based on Path-Smoothing Model

The step by step representation of different phases of the Instructional Strategy based on Path-Smoothing Model is shown in the figure 4.4 given below.
Fig 4.4 Step by Step representation of different phases of the Instructional Strategy based on Path-Smoothing Model

The investigator selected the topic from Kerala state syllabus Mathematics reader of Standard VIII having the unit Ratio and Proportion and prepared 20 lesson transcripts. The investigator made a careful content analysis of this unit and identified the facts, concepts, principles and theories. The lesson transcripts were prepared keeping in view of the phases of the strategy developed by the investigator based on Path-smoothing model. A model of the
lesson transcript in Malayalam and English version were given under Appendix II.A(1&2) and II.B(1&2).

4.4.3 Lesson Transcripts based on Activity Oriented Method

To teach the control group the investigator selected the same content i.e. Ratio and Proportion and prepared 20 lesson transcripts based on Activity Oriented method. The teacher gave explanation regarding the terms, facts, concepts, principles and rules etc. connected with the topic. Appropriate learning activities were used to transact the content area. Model for the lesson transcript based on Activity Oriented method of teaching in Malayalam and English version were given under Appendix III.A(1&2) and Appendix III.B(1&2).

4.4.4 Creative Problem Solving Ability Test

(i) Preparation of Draft Test

The investigator in collaboration with supervising teacher prepared the draft of the Creative Problem Solving Ability Test. Test consists of two parts, Part A and Part B. Part A includes instructions to the candidates and personal informations of the students. Part B consists of 25 questions based on Creative Problem Solving Ability. Each question carries one mark. The draft test and its scoring key are given in Appendix IV.A & IV.A(1)

(ii) Try out of the test

A draft was administered on a sample of 125 students of standard VIII from a school in Thrissur district. Sufficient time was given for completing the test, so that the average time taken was noted to fix the time frame for the final test. The duration of the draft test was fixed as 50 minutes.
The investigator selected 100 answer scripts which were complete and properly answered were taken up for item analysis.

(iii) Item Analysis

The Kelley’s method (Ebel and Frisbie, 1991) was used to calculate the Discriminating Power (DP) and Difficulty Index (DI). The items of the difficulty index between 0.32 and 0.73 and discriminating power (DP) above 0.26 was selected for the final test. The details regarding Difficulty Index and Discriminating Power are given in Appendix IV.A (2).

Difficulty Index is calculated by the formula

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

Discriminating Power is calculated by using the formula

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

Where,

U - The number of students in the Upper group who made correct response

L - The number of students in the lower group who made correct response.

N – The number of students of each group

(iv) Distracter Analysis

If the distracters are properly given, guessing can be eliminated. Since the test consists of multiple choice items, a distracter analysis was also done to eliminate guessing.
(v) Preparation of the Final Test

Out of the 25 items included in the tryout 20 were selected for the final test based on the Discriminating Power and Difficulty Index of the items, with a maximum score of 20. The final test consisting of the selected items was printed with all necessary instructions. A copy of the final test and its scoring key are given in Appendix IV.B & IV.B(1)

(vi) Reliability and Validity of Creative Problem Solving Ability Test

(1) Reliability of the test

The test-retest method was used for determining the reliability of the test. In this method the final test was administered twice to a group of 65 pupils of St’ Marys G.H.S, Thrissur, giving an interval of two weeks between the two tests. Marks of 50 pupils who attended both the test were taken and the reliability of the test was then determined by using Pearson’s Product Moment Coefficient of Correlation formula and the coefficient obtained was 0.866 which shows the test is highly reliable for the purpose.

(2) Validity of the test

Validity is the quality of a data gathering instrument that enable it to measure what it is supposed to measure. Although there are many types of validity. The investigator tried to establish Content Validity and Intrinsic validity.

(a) Content Validity

The content validity is established by showing the behaviors sampled by the test are representative sample of the attribute, being measured. There is no exact statistical measure of content validity. Content validity represents a
judgment regarding a degree to which a test provides an adequate sample of a particular content domain.

The basic procedure for assessing content validity consists of three steps. (i) describe the content domain, (ii) determine the areas of content domain that are measured by each test item, (iii) Compare the structure of the test with the structure of content domain.

Before the construction of the test, a thorough analysis was done with the help of standard text books. The test was constructed by giving due weightage for components and weightage given to difficulty level on one hand and experts’ comments and opinions on the other. So this test is treated as valid.

(b) Intrinsic Validity

In order to establish the validity, the investigator found out the intrinsic validity. The intrinsic validity is stated in terms of proportion of true variance. This can be found out by finding the square root of its reliability to the test. The intrinsic validity of the tool is found to be 0.83.

(vii) Objectivity and Practicability

In the prepared Creative Problem Solving Ability Test, objectivity was ensured by including only objective type items and by using scoring key for valuation. The test was easy to administer as it was in the booklet form and necessary directions to complete the test are given in the front sheet of the booklet itself. The time fixed for the test is 40 minutes which is convenient. Hence, the test had good practicability.
4.4.5 Perceptual Speed Test

In this study, Perceptual Speed test includes 8 sub tests based on 8 categories of Perceptual Speed.

(i) Perceptual Speed Sub Test- I (Number Comparison Test)

(ii) Perceptual Speed Sub Test-II (Word Comparison Test)

(iii) Perceptual Speed Sub Test-III (Alpha Numeral Comparison Test)

(iv) Perceptual Speed Sub Test-IV (Mathematical Operation Comparison Test)

(v) Perceptual Speed Sub Test-V (Figure Comparison Test)

(vi) Perceptual Speed Sub Test-VI (Formulae Comparison Test)

(vii) Perceptual Speed Sub Test-VII (Roman Numeral Comparison Test)

(viii) Perceptual Speed Sub Test-VIII (Figure Identification Test)

(i) Preparation of draft test

The investigator with the help of supervising teacher prepared and standardised Perceptual Speed tests in eight categories. Test consists of two parts: Part A and Part B. Part A include instructions to the candidates. Part B consists of 8 categories with 30 questions in each category of Perceptual Speed. Separate response sheet was prepared for marking the right answers. Each question carries 1 mark. The draft test and its scoring key are given as Appendix V.A and Appendix V.A (1)

(ii) Try out of the test

A draft was administered on a sample of 120 students of standard VIII from a school of Thrissur district. Sufficient time was given for completing the
test, so that the average time taken was noted to fix the time frame for the final test. The duration of the draft test was fixed as 30 minutes for each sub test.

The investigator selected 100 answer scripts which were complete and properly answered were taken up for item analysis.

(iii) **Item Analysis**

The Kelley’s method (Ebel and Frisbie,1991) was used to calculate the discriminating power and difficulty index(DI) between 0.34 and 0.72 and discriminating power (DP) above 0.25 were selected for the final test. The details regarding DI and DP are given in Appendix V.A(2).

Difficulty Index is calculated by the formula

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

Discriminating Power is calculated by using the formula

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

Where,

- \( U \) - The number of students in the Upper group who made correct response
- \( L \) - The number of students in the lower group who made correct response.
- \( N \) – The number of students of each group

The investigator selected the items with Discriminating Power greater than 0.25 and the Difficulty Index greater than 0.37 for the study.
(iv) **Distracter Analysis**

If the distracters are properly given, guessing can be eliminated. Since the test consists of multiple choice items, a distracter analysis was also done to eliminate guessing.

(v) **Preparation of the Final Test**

After the try out, out of the 30 item included in each sub test, 25 were selected for the final test based on the Discriminating Power and Difficulty index of the items, with a maximum score of 25. The final test consisting of the selected items with all necessary instructions in each categories. A copy of the final test is given as Appendix V.B. The scoring key and the copy of Response sheet is given as Appendix V.B (1) & V.B (2).

(vi) **Reliability and Validity of Perceptual Speed Test**

(i) **Reliability of the test**

The test-retest method was used for determining the reliability of the test. In this method the final test was administered twice to a group of 65 pupils of St’ Mary’s G.H.S, Thrissur, giving an interval of two weeks between the two tests. Marks of 50 pupils who attended both the test were taken and the reliability of the test was then determined by using Pearson’s Product Moment Coefficient of Correlation formula and the coefficient obtained was 0.868 which shows the test is highly reliable for the purpose.

(ii) **Validity of the test**

Validity is the quality of a data gathering instrument that enable it to measure what it is supposed to measure. Although there are many types of validity, for these types of test, Content validity and intrinsic validity are
important. So the investigator tried to establish Content Validity and Concurrent validity.

(a) Content Validity

The content validity is established by showing the behaviors sampled by the test are representative sample of the attribute, being measured. There is no exact statistical measure of content validity. Content validity represents a judgment regarding a degree to which a test provides an adequate sample of a particular content domain.

The basic procedure for assessing content validity consists of three steps. (i) describe the content domain, (ii) determine the areas of content domain that are measured by each test item, (iii) Compare the structure of the test with the structure of content domain.

Before the construction of the test, a thorough analysis was done with the help of standard text books. The test was constructed by giving due weightage for components and weightage given to difficulty level on one hand and experts’ comments and opinions on the other. So this test is treated as valid.

(b) Intrinsic Validity

In order to establish the validity, the investigator found out the intrinsic validity. The intrinsic validity is stated in terms of proportion of true variance. This can be found out by finding the square root of its reliability to the test. The intrinsic validity of the tool is found to be 0.81.

(vii) Objectivity and Practicability

In the prepared Perceptual Speed test, objectivity was ensured by including only objective type items and by using scoring key for valuation. The test was easy to administer as it was in the booklet form and necessary
directions to complete test are given in the front sheet of the booklet itself. It was economical, as it was reusable, since the answer sheets were provided separately. The time fixed for the test is 25 minutes for each sub test which is convenient. Hence, the test had good practicability.

4.4.6 Achievement Test in Mathematics

(i) Preparation of Achievement Test (Draft)

Achievement tests are designed to maximize discrimination between the performances of the students and tests are constructed to provide information on the relative levels of achievement reached (Hawk and Hill, 1996). An Achievement test was prepared by the investigator for selected topics from the Mathematics reader (Kerala state syllabus) of standard VIII. Before preparing the items in the test, the content was thoroughly analyzed. The test was prepared in English and Malayalam. The test consists of two parts: Part A and Part B. Part A consists of instructions to the candidates. Part B consists of 40 items under the objectives, Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation.

Objectives occupy a central position in the teaching learning programme and hence the determination of objectives and their weightages play a crucial role in any Achievement test construction. The Achievement test was prepared by the investigator based on the Objectives: Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation for the Achievement test.

All questions were objective type multiple choice items carrying one mark each. Students were requested to indicate the right answers by darkening the space provided. The draft test prepared and scoring key of (Malayalam and English Versions) is given as Appendix VI.A and its scoring key is given as Appendix VI.A(1)
(ii) Try Out of the Test

For tryout, the Achievement test was administered to a random sample of 125 Secondary school students of Thrissur district. Students were given a fixed time as 55 minutes to complete the test. In scoring, one score was given for each correct response. The scoring was done according to the scoring key prepared for this purpose. The test was conducted under identical conditions, especially regarding the instructions given to the examinees. Enough time was given so as to enable all the students to complete the test. The scoring was done according to the scoring key prepared for this purpose.

(iii) Item Analysis

It is the process of establishing the suitability of an item for inclusion in the final test. The quality of each item was ascertained by analysing two important characteristics of the item, namely 1) Difficulty index and 2) Discriminating power.

From the obtained answer scripts, 100 answer scripts complete in all respects were finally selected for analysis. Based on the scores obtained, response sheets of the students were arranged in descending order from highest to the lowest. From the arranged answer sheets, top 27 percent and bottom 27 percent of the answer sheets were separately taken. The responses of the top scoring 27 percent and bottom scoring 27 percent were used for item analysis. For the present study the procedure and formula suggested by Ebel and Frisbie (1991) were used to calculate the difficulty index and discriminating power.

- Difficulty Index is calculated by the formula
  \[ \text{Difficulty Index} \ DI = \frac{U+L}{2N} \]
- Discriminating Power is calculated by using the formula
  \[ \text{Discriminating Power} \ DP = \frac{U-L}{N} \]
Where,

U - The number of students in the Upper group who made correct response
L - The number of students in the lower group who made correct response.
N – The number of students of each group

In the present study, items having difficulty index between 0.37 and 0.78 and discriminating power above 0.4 were selected for the final test. Out of the 40 items, 30 were selected for the final test. The details regarding Difficulty Index and Discriminating Power is given as Appendix VI.A (2).

(iv) Preparation of the final test

The final Achievement Test in Mathematics for students at Secondary level of Kerala state syllabus was thus developed after the Item Analysis by selecting 30 items from the draft test. Proper instructions were provided along with the question paper. The total time allotted for the students to answer these questions is 45 minutes. A copy of the final Achievement test (Malayalam & English versions) is given as Appendix VI.B.

The details regarding the weightage given to the Content, Objectives, difficulty level and blueprint of the test are given below.

(a) Weightage to Objectives

The categories of the objectives selected for the preparation of Achievement test (final) are shown below.
Table 4.2
*Weightage to Objectives of Achievement Test*

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Objectives</th>
<th>No: of questions</th>
<th>Marks</th>
<th>% of marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knowledge</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Understanding</td>
<td>8</td>
<td>8</td>
<td>26.66</td>
</tr>
<tr>
<td>3</td>
<td>Application</td>
<td>10</td>
<td>10</td>
<td>33.34</td>
</tr>
<tr>
<td>4</td>
<td>Analysis</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Synthesis</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Evaluation</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td><strong>30</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(b) Weightage to Content

The weightage given to the content is given in the Table 4.3.

Table 4.3
*Weightage to Content of Achievement Test*

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Content</th>
<th>Marks</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ratio</td>
<td>22</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>Proportion</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(c) Weightage to Difficulty level of questions
Based on the difficulty level of questions, the items in the test were classified into three difficulty levels; namely easy, average and difficult. Adequate weightage was given to each of the difficulty level of questions in the Achievement test.

Table 4.4

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Objectives</th>
<th>No of questions</th>
<th>Marks</th>
<th>% of marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>5</td>
<td>5</td>
<td>16.67</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>18</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>7</td>
<td>7</td>
<td>23.33</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

(d) Distracter Analysis

If the distracters are properly given, guessing can be eliminated. Since the test consists of multiple choice items, a distracter analysis was also done to eliminate guessing.

(e) Blueprint

The Blueprint is the three dimensional chart showing the weightage given to the objectives, content and form of questions in an Achievement test. It gives in summary, all necessary information about the designs of the test. The blue print for the Achievement test in Mathematics is given below.
### Table 4.5

**Blueprint of the Achievement Test**

<table>
<thead>
<tr>
<th>Contents</th>
<th>Form of Questions</th>
<th>Objective Type</th>
<th>Objective Type</th>
<th>Objective Type</th>
<th>Objective Type</th>
<th>Objective Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td></td>
<td>2(1)</td>
<td>4(1)</td>
<td>5(1)</td>
<td>1(1)</td>
<td>2(1)</td>
</tr>
<tr>
<td>Proportion</td>
<td></td>
<td>1(1)</td>
<td>4(1)</td>
<td>5(1)</td>
<td>2(1)</td>
<td>1(1)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Figure inside the bracket indicates mark of one question and figure outside the bracket indicates the number of questions.
(f) Preparation of the scoring key

In order to maintain objectivity, scoring was done as per the scoring key prepared by the investigator. For every right answer a score 1 was provided. The scoring key of Achievement test is given as Appendix VI.B (1) and the copy of the response sheet is given as Appendix VI.B(2).

(v) Reliability and Validity of Achievement Test in Mathematics

(i) Reliability of the test

The test-retest method was used for determining the reliability of the test. In this method the final test was administered twice to a group of 60 pupils of St’ Mary’s G.H.S, Thrissur, giving an interval of two weeks between the two tests. Marks of 50 pupils who attended both the test were taken and the reliability of the test was then determined by using Pearson’s Product Moment Coefficient of Correlation formula and the coefficient obtained was 0.856 which shows the test is highly reliable for the purpose.

(ii) Validity of the test

Validity is the quality of a data gathering instrument that enable it to measure what it is supposed to measure. The investigator tried to establish Content Validity and Concurrent validity.

(a) Content Validity

The content validity is established by showing the behaviors sampled by the test are representative sample of the attribute, being measured. Content validity represents a judgment regarding a degree to which a test provides an adequate sample of a particular content domain.

The basic procedure for assessing content validity consists of three steps. (i) describe the content domain, (ii) determine the areas of content
domain that are measured by each test item, (iii) Compare the structure of the test with the structure of content domain.

Before the construction of the test, a thorough analysis was done with the help of standard text books. The test was constructed by giving due weightage for components and weightage given to difficulty level on one hand and experts’ comments and opinions on the other. So this test is treated as valid.

(c) Intrinsic Validity

In order to establish the validity, the investigator found out the intrinsic validity. The intrinsic validity is stated in terms of proportion of true variance. This can be found out by finding the square root of its reliability to the test. The intrinsic validity of the tool is found to be 0.81.

(b) Empirical or statistical validity

Empirical or statistical validity of the test was calculated by correlating the scores of the test with marks of a recently conducted test obtained from the school (Ebel & Frisbie, 1991). The validity coefficient was computed by Pearson Product moment method and got the validity 0.84. This value ensures the empirical validity of the test.

(vi) Objectivity and Practicability

In the prepared Achievement Test in Mathematics, objectivity was ensured by including only objective type items and by using scoring key for valuation. The test was easy to administer as it was in the booklet form and necessary directions to complete the test are given in the front sheet of the booklet itself. It is economical, as it is reusable, since the answer sheets were provided separately. The time fixed for the test is 45 minutes which is convenient. Hence, the test had good practicability.

120
4.4.7 Raven’s Standard Progressive Matrices

Raven’s Progressive Matrices (1938) is widely used non-verbal intelligence tests. The Standard Progressive Matrices (SPM) was designed to measure a person’s ability to form perceptual relations and to reason by analogy independent of language and formal schooling, and may be used with persons ranging in age from 6 years to adult. The matrices measure two complementary components of general intelligence: the ability to think clearly and make sense of complex data, which is known as educative ability, and the ability to store and reproduce information, known as reproductive ability. It is the first and most widely used of three instruments known as the Raven’s progressive matrices. Taking into consideration the opinion of the experts in this field, the investigator decided to use Raven’s Standard Progressive Matrices to measure the General mental ability. The Response Sheets of Raven’s Standard Progressive Matrices is shown in Appendix VII

Scoring

Ravens Progressive Matrices are multiple choice tests of abstract reasoning. It is published in 1938, is a non-verbal test administrated to measure a person’s capacity to apprehend meaningless figures presented for observation, see the relation between them, conceive the nature of the figure completing each system of relations presented and so develop a systematic method of reasoning. The SPM consists of 60 items arranged in five sets (A, B, C, D, and E) of 12 items each. Each item contains a figure with a missing piece. Below the figure are either six (sets A & B) or eight (sets C through E) alternative pieces to complete the figure, only one of which is correct. Each set involves a different principle or ‘theme’ for obtaining the missing piece, and within a set the items are roughly arranged in increasing order of difficulty. All items are presented in black ink on a white background. In each set, the
first problem is the easiest one and the consecutive problems became gradually
difficult.

Reliability

Test-retest correlations range from a low of 0.46 for an eleven-year
interval to a high of 0.97 for a two-day interval. The median test-retest value is
approximately 0.82. Coefficients close to this median value have been obtained
with time intervals of a week to several weeks, with longer intervals associated
with smaller values. Raven provided test-retest coefficient for the age group 13
years plus as 0.88.

Validity

The majority of students which have factor analyzed the RSPM along
with other cognitive tests. Concurrent validity coefficients between the SPM
and the Stanford-Binet and Wechsler scales range between 0.54 and 0.89, with
the majority in the 0.70s and 0.80s.

Marking procedure

A student’s score on the scale is the total number of problems solved
correctly when allowed to work quickly through the series from the beginning
to the end. The total score provides an idea of his intellectual capacity. To
record the answers, a record form is available with the Booklets of SPM. The
copy of the response sheet of the Raven’s Standard Progressive Matrices is
given as Appendix VII

4.5 PROCEDURE ADOPTED FOR EXPERIMENTATION

A preliminary survey was conducted to find out the present status of
Mathematics teaching at Secondary level by administering a Questionnaire to
Mathematics teachers at the Secondary level. The obtained data were analysed
properly and based on that investigator prepared the Instructional Strategy based on Path-Smoothing Model. Tools for measuring Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics were also prepared and standardized by the investigator.

The steps involved in the collection of data for this purpose are given below.

4.5.1 Administration of the Questionnaire

The investigator consulted 20 Mathematics teachers to find out the present status of teaching Mathematics in Secondary level. The questionnaire was given to them to enter their opinion regarding each item as ‘yes’ or ‘no’ by putting a tick mark in the appropriate column. The responses were collected and then scored. 18 questionnaires which are complete in all respect were used for the analysis.

The data collected was then analysed and is given in the next chapter.

4.5.2 Initial Comparison of the Students

After finalising the sample and tools to be used, the investigator approached the authorities of the schools and sought their permission for conducting the study. The investigator discussed with heads of the schools and class teachers and their co-operation was ensured.

The investigator compared the Previous Achievement in Mathematics of students in the selected divisions. The Raven’s Standard Progressive Matrices was administered to compare the General mental ability of the students. From the two divisions in each school, one was taken as the Experimental group and the other one as Control group.
4.5.3 Administration of Pre-tests

A short explanation of the aim, need and scope of the study was given to the students and their cooperation was ensured. The Creative Problem Solving Ability Test, Perceptual Speed and Achievement test in Mathematics were administered as pre-tests in both experimental and control groups. The rules and procedure prescribed for each type of test were strictly followed. The response sheets were collected back after the allotted time and were scored in accordance with the pre designed evaluation scheme. The scores obtained by the students were used for further analysis.

4.5.4 Experimentation

The study comprised of two groups – Experimental group and Control group. The experimental group was taught using lesson transcripts based on Instructional strategy based on Path-Smoothing Model and control group was taught through the existing Activity Oriented Method. The treatment given to both of these groups are described below.

After the Pre-test procedures, in the experimental group , the investigator gave a formal introduction to the students about the selected units in Mathematics and the steps in the strategy. While teaching using this Instructional Strategy, the investigator was cautious enough to give directions to the students wherever necessary. The investigator also paid attention in their individual work and group work. Care was taken to keep the students in the right track throughout the study according to the Phases of the Instructional Strategy based on Path-Smoothing Model. Scaffolding by the teacher helped the students in their course of learning. Necessary corrections were made in their works without any delay.

After administering all the Pre-tests, the control group was taught the same content through the Activity Oriented Method. In Activity Oriented
Method, the teacher serves the function of facilitator, assisting students through the learning process and providing them with guidance and drawing them into a lesson so that they become a participant in their own learning. The investigator explained the facts, concepts, principles etc. connected with the topic. Group works were given to students to work together to get better understanding of different topics. Assignments and home works were also given. Equal time and effort was given to the control group also.

4.5.5 Administration of Post-tests

After the completion of teaching in both the experimental and control groups, the investigator administered the same Creative Problem Solving Ability Test, Perceptual Speed Tests and Achievement Test in Mathematics to both the groups as Post tests. Prior information regarding the date of conducting the tests was given and the tests were administered to both the groups on the same day under the supervision of the investigator and class teacher. The responses for all the Post-tests were scored strictly in accordance with the pre-designed evaluation scheme. The scores obtained after evaluation of the answer sheets were subjected to statistical analysis.

4.5.6 Administration of Delayed post Test

After a period of one month from the post test, the investigator administered the same test (questions rearranged) to both the experimental and control groups to find out their retention in Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics. The responses of the test were scored and the scores were subjected to statistical analysis.

Symbolic representation of Experimental Design used for this study is shown in fig 4.5
Fig 4.5 Symbolic Representation of Experimental Design of the Study
4.5.7 Scoring Procedure

The data regarding Previous Achievement and General Mental Ability were scored and compared. The Pre-tests and Post-tests given to the students are Creative Problem Solving Ability Test, Perceptual Speed Test and Achievement test in Mathematics and Delayed Post Test.

In Creative Problem Solving Ability 20 questions were used. For each correct answer 1 mark is given and zero for incorrect answer. The maximum mark for the test was 20.

In each Perceptual Speed tests 25 questions were used. For each correct answer 1 mark is given and zero for incorrect answer. The maximum mark for the test was 25.

In the Achievement Test, 30 multiple choice questions were used. Four alternatives were given for each question. For each correct answer 1 mark is given and zero for incorrect answer. The maximum mark for the test was 30.

In Delayed Post Test (Creative Problem Solving Ability) 20 questions were used. For each correct answer 1 mark is given and zero for incorrect answer. The maximum mark for the test was 20.

In each Delayed Post Test (Perceptual Speed tests) 25 questions were used. For each correct answer 1 mark is given and zero for incorrect answer. The maximum mark for the test was 25.

In the Delayed Post Test (Achievement Test), 30 multiple choice questions were used. Four alternatives were given for each question. For each correct answer 1 mark is given and zero for incorrect answer. The maximum mark for the test was 30.
4.6 STATISTICAL TECHNIQUES EMPLOYED FOR ANALYSIS

After collecting the data, they were tabulated and consolidated for statistical analysis. Statistical analysis of the data was undertaken using procedures appropriate for the purpose of this study. The statistical techniques used were:

(a) Critical Ratio

(b) Analysis of Covariance (ANCOVA)

(a) Critical Ratio

\[
C.R. = \frac{(M_1 - M_2)}{S.E_D}
\]

Where

C.R = Critical Ratio

\(M_1\) = Mean of first group

\(M_2\) = Mean of Second group

\(S.E_D\) = Standard Error of the Difference between Means

Here we calculated the Standard Error of the difference between uncorrelated means when samples are large. Its equation is,

\[
S.E_D = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}
\]

Where \(\sigma_1\) = Standard Deviation of first group

\(\sigma_2\) = Standard Deviation of second group

\(N_1\) = Sample Size of first group

\(N_2\) = sample size of second group
(b) ANCOVA

ANCOVA is a statistical technique for equating groups on one or more variables when testing for statistical significance; it adjusts scores on a dependent variable for initial differences on other variables, such as pre-test performance or IQ (Frenkel & Walen, 1993).

In applying the statistical technique ANCOVA, the procedure suggested and illustrated by Garret (2005) was followed. It includes nine major steps as follows

**Step 1. Computation of Correction term**

Determine the correction terms $C_x$, $C_y$ and $C_{xy}$ being correction of ‘$x$’ scores and ‘$xy$’ scores respectively that are required to make adjustments of the standard deviation calculated from original measures, taking zero as the assumed mean. These are calculated using the formula:

$$C_x = \frac{(\Sigma x)^2}{N} \quad C_y = \frac{(\Sigma y)^2}{N} \quad C_{xy} = \frac{(\Sigma x \Sigma y)}{N}$$

Where,

$$\Sigma x = \Sigma x_1 + \Sigma x_2$$

$$\Sigma y = \Sigma y_1 + \Sigma y_2$$

$N =$ Number of scores of both the groups

$\Sigma x_1 =$ Sum of the Pre-test scores of Experimental group

$\Sigma x_2 =$ Sum of the pre test scores of control group

$\Sigma y_1 =$ Sum of the post test scores of Experimental group

$\Sigma y_2 =$ Sum of the post test scores of Control group
Step 2. Computation of the total sum of squares (Total SS)

In this step, total sum of the squares (total SS) for ‘x’, ‘y’ and ‘xy’ are calculated. These are calculated using the formulae:

\[ \text{Total SS for } x, \ SS_x = \sum x^2 - C_x \]

\[ \text{Total SS for } y, \ SS_y = \sum y^2 - C_y \]

\[ \text{Total SS for } xy, \ SS_{xy} = \sum xy - C_{xy} \]

Where

\[ \sum x^2 = \sum x_1^2 + \sum x_2^2 \]

\[ \sum y^2 = \sum y_1^2 + \sum y_2^2 \]

Step 3. Computation of sum of squares (SS) among the means of the groups

In this step, sum of the squares among the group mean are calculated using the following formulae:

a) SS among means for X = \((\sum x_1)^2/n_1 + (\sum x_2)^2/n_2\) - C_x

b) SS among the means for Y = \((\sum y_1)^2/n_1 + (\sum y_2)^2/n_2\) - C_y

c) SS among means for XY = \((\sum x_1)(\sum y_1)/n_1 + (\sum x_2)(\sum y_2)/n_2\) - C_{xy}

Where \(n_1\) = no. of scores in the Experimental group

\(n_2\) = no. of scores in the Control group

Step 4. Computation of sum of squares within groups

Sum of squares (SS) within groups can be calculated by the formulae:-
a) Within groups SS for X = SSx-SS among means for X

b) Within groups SS for Y = SSy-SS among means for Y

**Step 5. Analysis of Variance of X and Y scores**

In this step, analysis of variance of ‘x’ and ‘y’ scores are taken respectively. The F-test is applied to the two sets of scores using the following formulae.

\[ F_x = \frac{\text{Mean square variance of among groups (for x)}}{\text{Mean square variance of within groups}} \]

\[ F_y = \frac{\text{Mean square variance of among groups (for y)}}{\text{Mean square variance of within groups}} \]

where,

\[ F_x = \text{F ratio for x scores} \]

\[ F_y = \text{F ratio for y scores} \]

**Step 6. Computation of adjusted sum of squares (SS for y ie, SSyx)**

The computations carried out in this step are for the purpose of computing the final (Y) scores for differences in initial (X) scores. The equation for finding adjusted sum of squares is given below.

\[ SSyx = SS_y - \frac{(SS_{xy})^2}{SS_x} \]

From the adjusted sum of squares thus calculated, the variance can be computed by dividing each ‘SS’ by its degree of freedom.

Then F-test is applied to the adjusted, among and within variance to determine whether the adjusted means differ significantly.
Step 7. Computation of regression coefficient for within groups

From the SS’s in x, y and xy, it is possible to compare several coefficients of correlations. These are helpful in the interpretation of the result obtained in step 6.

The general formula used is,

\[ r = \frac{SS_{xy}}{\sqrt{SS_x \times SS_y}} \]

It may be applied to the appropriate SS’s for total, among means and within groups.

The correlation among scores and the correlation among means may be used, in a preliminary way to decide, analysis of co-variance is worthwhile.

Regression coefficients for total, among means and within groups have been calculated using the formulae.

\[ b_{within} = \frac{SS_{xy}}{SS_x} \]

\( b_{within} \) is used in the computation of the adjusted y means in step 8.

Step 8. Calculation of adjusted Y means

It can be calculated by the formula,

\[ My_x = My - b (M_x - GM_x) \]

This step is to find which mean differences noticed in step 6 are significant.

Step 9. Significance of differences among adjusted Y means

For calculating this, the standard error of difference between two means is calculated using the formula
S.E_D = \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}

Then the ‘t’ value is found by the equation \( t = \frac{D}{S.E_D} \) and compared with the Table values.

**Conclusion**

This chapter gives a clear picture on the procedures involved in the present study. It also describes about the method adopted, sample selected for the study, tools used, scoring, statistical techniques used for analysis of data etc. The investigator collected the data by following the methods described in the procedure for data collection. The obtained data were analyzed using appropriate statistical techniques described above. The results obtained when data analyzed are discussed in the light of hypotheses formulated.

The details of analysis and interpretation of data using the above mentioned statistical techniques are given in the next chapter.