CHAPTER- III

DESIGN AND PROCEDURE OF THE STUDY

Planning is the foundation upon which the superstructure of any research study is based. It is a process for accomplishing the intended purposes. It is a blue-print of growth and a road map of development. It helps in deciding objectives both in quantitative and qualitative terms. It is setting of goals on the basis of objectives and keeping in view resources. Planning is also used to describe the formal procedures used in such an endeavour, such as the creation of documents, diagrams or meetings to discuss the important issues to be addressed, the objectives to be met and the strategy to be followed. A scheme devised a method of action or procedure expressed in words is known as plan. A plan is the realistic view of the expectations. Plan is the most important document and key to growth for any project. Likewise, the formal process of making decisions for research is known as planning for research.

A systematic research plan is a prerequisite in the research process, that brings to focus the preliminary planning that will be needed to accomplish the purpose of the proposed study. It is just like a blue print which the architect prepares before the construction of a building starts. The research plan describes the main part of an investigator’s proposed research, stating its importance and how it will be conducted. Research plan depends on what information researcher needs to collect in order to make major decisions about what he wants to gain by this research and how effective and efficient he can be in his research. Research plan is a tentative outline of proposed research work. If research is a journey with definite points of departure and arrival, then the plan of it must project and predict in between sequences of activities. Proper research plan provides firm foundation for research. In research plan, one has to choose appropriate combination of methods and techniques based on objectives, implications of results, environmental factors, resources, kind of data required etc.

In other words, research plan is a conceptual structure, or an outline or a blue-print drawn after selecting a problem which helps the investigator in selection of different ways and means for collection, measurement and analysis of data, so as to combine relevance in the research problem.
Procedure is an operational guide to action; chronological sequence of steps to be undertaken to enforce a policy and to attain an objective. All scientific researches and investigations demand certain appropriate methods of carrying out of results, conclusions and their application depends upon the clarity or pre-planning of the research programme. John Balen says that research project is an investigation that weighs the merits of various procedures for collecting evidence.

The research plan helps the researcher to proceed directly without confusing with concomitant events. It describes just what must be done, how it will be done, what data will be needed, which data gathering devices will be required, which method will be employed, how sources of data will be selected, how the data will be analyzed and finally the conclusions reached. It helps in smooth and efficient sailing (set boundaries and prevent blind research); yields maximum information (avoids collection of unnecessary data); costs least in terms of efforts, time and money; maximizes reliability of results; provides firm foundation to the endeavour; averts misleading conclusions and thoughtless futile exercise; helps in organizing one’s ideas; gives chance to foresee flaws and inadequacies (anticipates problem); incorporates learning from others’ critical comments and evaluations; and finally, like a successful journey, broadens the mind of the researcher; gives fascinating and exciting experiences and insight into work around as well as provides great opportunity to meet different people for the fun and reward of the study.

The methods and procedure of conducting a research study are, by and large, determined by the design of the study to realize its objectives, stipulated purposes and testing the variables involved, etc. Broadly, it includes subheads like:

3.1 Design of the Study
3.2 Sample
3.3 Procedure Followed
3.4 Statistical Tools Used
3.5 Precautions Observed
3.6 Constraints and Difficulties
3.1 DESIGN OF THE STUDY

Experimental Method

An educational research is described as experimental when the researcher first, specifies a set of researchable hypotheses and then, establishes a systematic programme of data gathering under precisely defined conditions in an effort to test the hypotheses. The hypotheses provide a network of statements relating the impact of an independent variable or a set of independent variables on some outcome variables or dependent variables (Ingersoll, 1982).

The experiment is the only means for settling disputes regarding educational practice, the only way of verifying educational improvements and the only way of establishing a cumulative tradition in which improvements can be introduced without the danger of a faddish discard of old wisdom in favour of inferior novelties (Campbell and Stanley, 1963). According to Weiner (1977), the experimental method, which is suitable for testing hypotheses, is the strongest method for developing and understanding psychological concepts. Any experimental problem has two interrelated aspects, the design of the experiment and statistical analysis of the data. The latter aspect is directly dependent upon the former. Statistical methods can greatly increase the efficiency of an experiment and also strengthen the conclusions so obtained (Montgomery, 1984).

A good experimental design should provide some explanation with respect to all the objectives of the experiment (Weiner, 1977) and be kept as simple as possible (Montgomery, 1984).

Purposive Sampling Design

In the present study pre-test, post-test group control quasi-experimental design was employed with a purposive sample in the form of intact sections of class VII of the same school. It involved three groups of students’, i.e., experimental groups (EI and EII) and control group (C). Experimental groups were taught in cooperative learning setting involving STAD and Jigsaw methods and the control group was taught through traditional approach.
The intact sections were equated on intelligence and socio-economic status. Quasi-experimental design of the study, as given in Table 3.1., comprising three stages. The first stage involved pre-testing of all the students of three groups on academic achievement in Mathematics, socio-economic status, intelligence and self-concept. The second stage involved the experimental treatment, which consisted of teaching five units of VII grade Mathematics through cooperative learning methods, i.e., STAD and JIGSAW approach to two experimental groups, EI and EII, respectively; and through traditional method to control group C.

Table 3.1
Design of the Study

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-Test</th>
<th>Independent Variables</th>
<th>Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>T1</td>
<td>Teaching through cooperative learning i.e. STAD</td>
<td>T2</td>
</tr>
<tr>
<td>Group (EI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>T1</td>
<td>Teaching through cooperative learning i.e. JIGSAW</td>
<td>T2</td>
</tr>
<tr>
<td>Group (EII)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>T1</td>
<td>No intervention</td>
<td>T2</td>
</tr>
<tr>
<td>(C)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the third stage, students were post-tested on academic achievement in Mathematics and self-concept. A schematic view of the phases of the experiment is presented in the table 3.2.
Table 3.2
Phases of the Study

<table>
<thead>
<tr>
<th>Stage</th>
<th>Treatments</th>
<th>Control Group (C)</th>
<th>Experimental Group EI</th>
<th>Experimental Group EII</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-testing</td>
<td>Measurement of</td>
<td>Measurement of</td>
<td>Measurement of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Intelligence of students</td>
<td>1. Intelligence of students</td>
<td>1. Intelligence of students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. S.E.S of students</td>
<td>2. S.E.S of students</td>
<td>2. S.E.S of students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Achievement in Mathematics</td>
<td>3. Achievement in Mathematics</td>
<td>3. Achievement in Mathematics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Self-Concept of students</td>
<td>4. Self-Concept of students</td>
<td>4. Self-Concept of students</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>Teaching Mathematics through traditional method</td>
<td>Teaching Mathematics through STAD under Cooperative Learning method</td>
<td>Teaching Mathematics through Jigsaw under Cooperative Learning method</td>
</tr>
<tr>
<td></td>
<td>Post-testing</td>
<td>Measurement of students</td>
<td>Measurement of students</td>
<td>Measurement of students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Achievement in Mathematics</td>
<td>1. Achievement in Mathematics</td>
<td>1. Achievement in Mathematics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Self-Concept of students</td>
<td>2. Self-Concept of students</td>
<td>2. Self-Concept of students</td>
</tr>
</tbody>
</table>

3.1.1 Study Variables

Variables are the conditions or characteristics that the experimenter manipulates, controls or observes. The relationship between two types of variables, namely independent and dependent variables, is studied generally in an experimental research. The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to observed phenomena. Independent variables are the causes, while dependent ones are effects. The dependent variables are the conditions or
characteristics that appear or change as the experimenter introduces, removes, or changes independent variables. Another category of variables, which is equally important, is of the intervening variables. The three kinds of variables, identified for the study are as discussed below.

a. **Independent Variables**

   As a comparative study of the cooperative learning vis-à-vis traditional approach, the methods of instruction or teaching in the form of cooperative learning strategies involving Student-Teams Achievement Divisions (STAD) and Jigsaw methods were used as independent variables to see their effect on the achievement of students in Mathematics, and their self-concepts. Both the experimental groups, EI and EII, were taught through STAD and Jigsaw method of cooperative learning respectively, and the control group was taught through the traditional method. Thus, cooperative learning methods and traditional learning method formed independent variables for the study.

b. **Dependent Variables**

   Achievement in Mathematics and self-concept were taken as dependent variables, measured twice during the course of study; first, before beginning of the experimental treatment, i.e., at the pre-test stage and then, after completing the experimental treatment, i.e., at the post-test stage.

c. **Intervening Variables**

   Variables known as intervening variables have their effect on the learning outcomes and can influence both independent and dependent variables. Intervening variables include elements such as nature of school, grade level, subject to be taught, intelligence of pupils, socio-economic status of pupils, previous knowledge of pupils, etc. that were controlled experimentally.

3.1.2 **Control Employed**

   It is necessary to control all those variables that may significantly affect the dependent variables. Hence, such intervening variables were controlled by employing suitable controls, as given below.
1. **Nature of school**
   The sample was selected from a single public school, named as S.B.S. Senior Secondary School, Railway Road, situated in an urban area of Karnal.

2. **Grade level**
   Seventh grade students were selected for the study and grade level was thus kept constant during the study.

3. **Teacher**
   The two experimental groups, EI and EII, and the third group, i.e., control group were taught by the investigator herself to avoid any variation.

4. **Subject**
   The three groups were taught same units of Mathematics prescribed by CBSE.

5. **Duration**
   The three groups were taught for 60 days of 40 minutes period each.

6. **Socio-Economic Status**
   All the three groups, including experimental and control groups, were tested on a socio-economic status scale. Bartlett’s test was applied on the scored data to find out the significant difference between SES test scores of all the three groups, which showed no significant difference between SES of the three groups.

7. **Intelligence**
   General mental ability is an index of intelligence which might also effect the independent variables. It is measured through Raven’s Standard Progressive Matrices. To eliminate the initial variability of the students statistically in the three groups, they were measured and analyzed on general mental ability. Bartlett’s test was applied on the scored data, to find out the difference between general mental ability test scores of all the three groups, which showed that there is no significant difference between general mental ability of the three groups. Initially, general mental ability was thought to be controlled statistically through covariance but since the three groups selected...
did not differ on general mental ability at the pre-test stage, there was no need to control covariate.

The independent variables, dependent variables and control variables with the kind of control employed in the study are summarized in Table 3.3.

### Table 3.3

**Independent, dependent and control variables**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Control Variables</th>
<th>Control Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods of Teaching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. STAD</td>
<td>1. Achievement in Mathematics</td>
<td>1. Nature of School</td>
<td>1. Administrative (single school)</td>
</tr>
<tr>
<td>2. JIGSAW</td>
<td>2. Self-Concept</td>
<td>2. Grade level</td>
<td>2. Administrative (only seventh class was taught)</td>
</tr>
<tr>
<td>3. TRADITIONAL</td>
<td></td>
<td>3. Teacher</td>
<td>3. The three groups were taught by the same teacher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Subject to be taught</td>
<td>4. Administrative same units of Mathematics in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>three groups were taught</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Duration of Treatment</td>
<td>5. The three groups were taught for 60 days of 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>minutes period each</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Pupils’ Socio-Economic Status</td>
<td>6. No need</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Pupils’ Intelligence</td>
<td>7. No Need</td>
</tr>
</tbody>
</table>

Specific events and factors like anxiety, home environment adjustment, parents’ education, fatigue, mental health, gender, race, caste, social maturity and the like could have only a marginal effect upon the experiment, so these factors were not taken into account.
3.2 SAMPLE

In the present study, all the students studying at VII grade in Karnal is the population. Since the population, being usually too large, a smaller is chosen as representative of the population which is known as sample. A sample is a carefully chosen group of people such that the results from the sample can be said to represent the results expected from the total population. The sample is the representative selected for a study whose characteristics exemplify the larger group of population from which they were selected. It is necessary in choosing a sample that it should reflect the characteristics which define the population from which it is selected. So, a sample is a miniature picture of the entire group from which it has been taken.

Sampling is a technique by which a relatively small number of individuals or measures of individuals, objects or events are selected and analyzed in order to find out something about the entire population from which it is selected. Sampling technique reduces the expenditure, saves time and energy, permits measurement of greater scope and produces greater precision and accuracy.

In the present study, the sample comprised 90 students studying in three sections of the VII class of S.B.S. Senior Secondary School, Karnal. Each of the three sections/groups contained 30 students. One section formed the control group and the other two sections formed the experimental groups.

Table 3.4
Sample of the Study

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Groups</th>
<th>Total no. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Experimental group (EI)</td>
<td>30</td>
</tr>
<tr>
<td>2.</td>
<td>Experimental group (EII)</td>
<td>30</td>
</tr>
<tr>
<td>3.</td>
<td>Control group (C)</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>
No doubt, the sample is small for results of the study to be generalized, an experimental study is normally more suitable on a small sample. Investigations conducted through experimental design use small samples only. The Fourth Survey of Research in Education (1991) justified the use of small samples in experimental researches to facilitate deeper inquest of the problem to be studied and available methodological provisions. Experimental studies of this nature are largely worked on small samples only.

Whicker, Bol and Nunnery (1997) took just 15 students in the treatment group and 16 students in the comparison group making a total sample of 31 students while McManus and Gettinger (1994) experimented with only 38 third graders for their study in cooperative learning. Mulryan (1994) took 48 students for her study. Gillies (2002) took 88 students of Grade 5 for his study in cooperative learning.

Experimental studies (Johnson & Johnson, (1981); Schmuck & Schmuck (1983); Sharan and Sharan (1976); Slavin (1983,1989); Suyanto (1998) indicated that the use of cooperative small-group teaching methods at the elementary school level can result in positive cognitive and non-cognitive outcomes for students, including the improvement of students achievement and the improvement of interpersonal relations.

Students in cooperative learning groups showed increase in number of friends, liking of others (Slavin, 1980 and Nederhood, 1986), Increase in interactive behaviours (Nowak, 1996, McManus and Gettinger, 1996) and increase in group effectiveness and interpersonal interactions (Earley, 1997). Peer orientation significantly more motivates to learn (Hancock, 2004).

In the recent times, cooperative small-group instruction has been recommended as a possible means of enhancing students’ higher order thinking skills and problem solving ability, especially in the area of social studies (Noddings, 1989; Taylor, 1989).
3.3 PROCEDURE FOLLOWED

Procedure of the experiment comprised two main stages, that is, selection of the sample and conducting the experiment.

Stage 1: Selection of the Sample

The sample of the study comprised of 90 students of class VII (30 in control group and 30 each in two experimental groups) studying in S.B.S. Senior Secondary School, Railway Road, Karnal.

Selection of Experimental Groups: For the experimental groups EI and EII, which were subjected to STAD and Jigsaw methods of cooperative learning, a total of 30 students each studying in VIIth standard ‘A1’ and ‘A2’ sections were chosen respectively from S.B.S. Senior Secondary School, Railway Road, Karnal.

Selection of Control Group: The Control Group comprised of 30 students studying in VIIth standard ‘A’ section was chosen from the same school in Karnal. This group of students was taught in usual common place, traditional method of instruction, without any novel input.

Stage 2: Conducting the Experiment

- The experiment was conducted in three phases as given below:
  - Phase I: Administration of Pre-test
  - Phase II: Conducting the Instructional Programme; and
  - Phase III: Administration of Post-test.

Phase I: Administration of Pre-test

At the initial stage of the experiment, the investigator interacted with the sample subjects to establish rapport with them. Before involving them in the Instructional Programme, they were oriented about objectives and methodology of the treatment to be followed viz. STAD and Jigsaw methods under cooperative learning and traditional method. This phase involved administration of four pre-tests, i.e., Socio-economic Status Scale, Intelligence, Achievement test and Self-Concept Inventory, to all students of the experimental groups and control group. Separate
response sheets were provided, which were scored as with help of their respective scoring keys. In the administration of these tests class teacher provided full cooperation to the investigator. Instructions pertaining to the tests were explained verbally in clear terms to the students before administering tests properly. The administration of these tests was carried out as per norms and instructions contained in their manuals.

**Phase II: Conducting the Instructional Programme**

To obtain the effect of independent variables, the instructional treatment was given in the form of teacher-directed instruction followed by cooperative learning settings.

The instructional treatment was given for about 55 days which included 25 lessons, 25 worksheets and 13 formative tests to the experimental groups, EI and EII, which were taught through STAD and Jigsaw respectively, whereas the control group was taught through traditional method. According to the learning settings requirement, same lesson plans and worksheets were used along with direct instructional strategy for all groups whether in the control or experimental settings. Students were encouraged to learn through the novel methods of instruction and were motivated to participate in the experiment by explaining the objectives of the study. The steps of instructional treatment were explained by the investigator to both experimental groups according to their respective co-operative learning settings.

The investigator received due orientation in using teacher-directed instruction followed in cooperative learning settings for experimental treatment involved in the study after discussions with the guide and experts at the Department of Education, M. D. University, Rohtak.

**Steps of instructional treatment**

The students of the experimental groups were acquainted with the following steps of Students- Teams Achievement Divisions (STAD):
Student Teams Achievement Divisions (STAD)

Teach

Team Study

Test

Team Recognition

Figure 3.1
1. **Teach:**
The unit (say unit -1) was presented as per teacher-directed instruction. Identical content was delivered to all the three groups. To impart instruction under Students-Teams Achievement Divisions (STAD) method of cooperative learning, first step was taken as ‘Teach’ session.

2. **Team Study:**
Students work on worksheets in their teams to master the study material. Team study included following steps:

(a) Ranking of Students: Students were ranked on their previous test scores in the descending order in respect of each of the four groups. For the very first lesson, students were ranked on the basis of their scores in the final examination of VI class.

(b) Formation of the Groups: Students were assigned to the teams of four members each. The ranked list was divided into quarters (dividing by 4) and extra students were placed in the middle quarters. In this way, four quarters were formed, as given below:

1st Quarter

1. Shivam
2. Aishwarya
3. Apurya
4. Sumati
5. Madhu
6. Harshita

4th Quarter:

1. Harvinder Singh
5. Ujjawal
6. Vishal
7. Chirag
8. Mandeep

2nd Quarter:

1. Prayas
2. Japjot Singh

3rd Quarter:

1. Rohit Cobra
2. Anterpreet
3. Manisha 3. Puneet
5. Saurabh Rai 5. Radhika
7. Sahil Kajal 7. Prince
8. Vaishali

3rd Quarter:
1. Ravi Meena
2. Gautam
3. Kajal

One student was selected from each quarter to make a group (team) of four, by ensuring that the teams/groups were well balanced along sex and ability. Likewise, in the first group, two students (top-most student in each group) from first two quarters and two lower-most students from the third and fourth quarter. Extra students became the fifth member of the first and second group respectively.

The groups in the cooperative learning setting were made in the following manner:

**Table 3.5**
**Formation of Groups**

<table>
<thead>
<tr>
<th>Group A</th>
<th>Shivam, Prayas, Mandeep, Prince, Ravi Meena</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B</td>
<td>Aishwarya, Japjot Singh, Chirag, Sawan Singh, Vaishali</td>
</tr>
<tr>
<td>Group C</td>
<td>Apurva, Manisha, Vishal, Radhika</td>
</tr>
<tr>
<td>Group D</td>
<td>Sumati, Gagan Wadhawa, Ujjawal, Meenakshi</td>
</tr>
<tr>
<td>Group E</td>
<td>Madhu, Saurabh Rai, Harvinder Singh, Puneet</td>
</tr>
<tr>
<td>Group F</td>
<td>Anjalika, Megha, Kajal, Anterpreet</td>
</tr>
<tr>
<td>Group G</td>
<td>Harshita, Sahil Kajal, Gautam, Rohit Cobra</td>
</tr>
</tbody>
</table>
(a) **Working in Groups**

During team learning, students worked (40 minutes) on worksheets in their teams to master the material which was presented in the skills being taught and they assessed themselves and were assessed also by their teammates. For team study, the following steps were followed:

- Team-mates were asked to move their desks together or move to team tables.
- Two worksheets were handed over to each team (e.g. worksheet 1, that is, based on rational numbers, was given to Group/Team A).

All the team members were given the following instructions:

i. Students on each team will work in pairs. If they are working on a problem, each student, in a pair, should work the problem and then check with his or her partner. If anyone missed a question, then it is the responsibility of team-mates to explain it.

ii. If there is a disagreement among team members on them, they are to present their arguments and resolve the problem themselves. Only when they are unable to resolve the problem, they should ask the teacher for help.

iii. Students should finish studying only when they are certain that everyone in their team understands and solves each item in the worksheets.

iv. When you have questions, first ask the team-mates before asking the teacher.

v. Encourage and praise your team-mates from time to time.

vi. Do not hesitate in asking any question from your team-mates and clear your doubts.

vii. If any of your team-mate in the group indulges in gossiping then stop him sternly. If need be, tell the teacher.

viii. Have patience in explaining the concept or skill to a weaker student.
ix. After explaining the skill or concept to one of your team-mates, then check it whether he is able to do the similar question or not. If you have a team-mate in a group, who is weak, encourage him that he can also do well and can reach up to the levels of others.

While students were working in teams, the teacher moved through the class, praised teams that were working well, encouraged the teams, and sat with each time to hear and see how members are doing. The teacher checked the worksheets side by side and corrected their mistakes, if any.

The next day in a same way they solved worksheet 2 after Lesson-2 was delivered. In all, students were given 25 lessons covering five units together with a worksheet associated with each lesson.

3. Test

Students took tests say formative test-1, which measures their understanding of the content of Chapter-1, Rational Numbers. Identical formative tests were given to both the treatment groups. Adequate time was given to the students to complete the test in the classroom. They were not allowed to work together. Each test organized parallel to the worksheet. The number of formative tests was constructed on the basis of the length of the chapter. Care was taken that the tests should be able to do justice with each topic.

4. Scoring

Students’ tests were scored by the teacher. Team scoring was based on the improvement of individual team members who were awarded points based on their test scores compared to their base scores. Similar pattern was followed to calculate base scores of each team respectively either it belonged to STAD or Jigsaw.

Calculation of Base Scores

For formative test (FT-1), base scores were calculated by taking 25% of the students’ scores in Mathematics (Max. Marks: 100) during final examination of class VII as their no other academic record was available. For example: Table 3.6
Table 3.6
Calculation of Base Scores

<table>
<thead>
<tr>
<th>Members of Team No. - C</th>
<th>Test -1 (Base scores)</th>
<th>FT-1</th>
<th>Improvement points</th>
<th>Total(FT-1+ Improvement Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apurva, Manisha, Vishal, Radhika</td>
<td>19</td>
<td>24</td>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>19</td>
<td>20</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>15</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>117</strong></td>
</tr>
<tr>
<td><strong>Average of Team No. - C</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>29.25</strong></td>
</tr>
</tbody>
</table>

Base scores for FT-2 were the scores of the average of FT-1. For FT-3 base scores were the average of FT-1 and FT-2. Similarly, for FT-4, base scores were the average of FT-1, FT-2 and FT-3 and so on. Scores of test A were dropped in computing base scores for the next test as these were the scores of previous class. For FT-1, there was no other alternative.

Base scores can be recalculated at any point the teacher chooses (Slavin, 1995). Improvement points are added to the scores obtained in the test. The team scores were computed by averaging the total scores of individual members.

Individual improvement scores were determined, as given below: (Slavin, 1990) in Table 3.7.

Table 3.7
Improvement points corresponding to base scores

<table>
<thead>
<tr>
<th>Quiz Scores</th>
<th>Improvement Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect score of 10 or more points above base score</td>
<td>30</td>
</tr>
<tr>
<td>5-9 points above base score</td>
<td>20</td>
</tr>
<tr>
<td>4 points below to 4 points above base score</td>
<td>10</td>
</tr>
<tr>
<td>5 or more points below base score</td>
<td>0</td>
</tr>
</tbody>
</table>
Rewards

After taking test, the team scores were announced the next day before the new lesson started. Team accomplishments were recognized by giving suitable prizes (pens, notebooks etc.) to all the members of that team who secured maximum points and by praising them in front of whole class and their class teacher and mathematics teacher.

In general, after 12 days of STAD and Jigsaw, new teams were re-assigned, i.e., after covering unit 1(Rational Numbers), 2 worksheets, 4FT’s were also given to students. For the formation of new groups, the same procedure was followed as described above for ranking of the students, total sum of scores of FT-1, 2, 3 and 4 were taken. Base scores for FT-5 were computed in the same way. By averaging all the groups were made four times. This allowed the students to work with their classmates and to keep the programme fresh.

Table 3.8

Table showing teams reassigned, time duration, content covered and FT’s taken by students

<table>
<thead>
<tr>
<th>Number of times teams reassigned</th>
<th>Duration of same groups (in days)</th>
<th>Content covered</th>
<th>No. of FT’s given</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>14</td>
<td>1. Rational Numbers</td>
<td>4( FT-1,2,3,4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Practical Geometry</td>
<td></td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>15</td>
<td>3. Perimeter and Area</td>
<td>4( FT-5,6,7,8)</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>14</td>
<td>4. Algebraic Expressions</td>
<td>3(FT-9,10,11)</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>12</td>
<td>5. Exponents and Powers</td>
<td>2(FT-12,13)</td>
</tr>
</tbody>
</table>

FT- formative test

The above Table shows how many times the teams were reassigned, for how much time period the students remained in same groups, how much content was covered in that time and how many Formative Tests were taken.
Here, formation of groups was quite different in their structure for both the experimental groups, taught through STAD and JIGSAW methods of cooperative learning.

The following steps were followed to implement and introduce jigsaw to the students:

1. Class was divided into groups of four (i.e., A, B, C, & D etc.) each. Groups were diversified in terms of gender, caste and ability etc.
2. One student was appointed as group leader.
3. Lesson was divided into four segments.
4. Predetermined part of problem on which to concentrate or to learn was assigned and chosen by each student in the group.
5. Students were given time to read over their segment to become familiar with it.
6. Arranged “experts groups” meeting and gave instructions to them.
7. Each moved to a group with others who chose the same part (Expert Groups) to master a technical part of the course. It means all the 1’s met together, all the 2’s met together etc.
8. Then they went back to their original (Home group) to teach the other three members of the group what they have learned about her or his segment.
9. If any group was facing trouble (e.g., a member was dominating or disruptive), an appropriate intervention was made accordingly.
10. The home group then tried to synthesize all the four parts and discuss their views before others.
11. Finally the group performance was evaluated and grades were assigned.

Other than formation and working of groups, identical pattern was followed for testing, scoring and rewarding of students in the group taught by Jigsaw.

**Phase III: Administration of Post-Test**

Immediately after the instructional treatment was over, the subjects were assessed on criterion measures to know the effect of the treatment. The following tests were administered to all the experimental and control groups.

a. Achievement test in mathematics; and
b. Self-concept Inventory.

Interview was also taken regarding the perceptions of the students towards the instructional programme only for the students of experimental groups.

**SCHEDULE OF THE EXPERIMENT**

**Phase I: Pre-test Stage**

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>21\textsuperscript{st} September 2010</td>
<td>Administration of Achievement test in Mathematics</td>
</tr>
<tr>
<td>23\textsuperscript{rd} September 2010</td>
<td>Administration of Self-Concept Inventory</td>
</tr>
<tr>
<td>24\textsuperscript{th} Sept 2010</td>
<td>Administration of Intelligence Test and Socio-Economic Status Scale</td>
</tr>
</tbody>
</table>

**Phase II: Instructional programme**

**Table 3.9**

**Table showing Date Schedule of the Experiment**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the Chapter</th>
<th>Experimental Groups, STAD/ Jigsaw instructional procedure</th>
<th>No. of FT’s</th>
<th>Administration of FT’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rational Numbers</td>
<td>27\textsuperscript{st} September- 4\textsuperscript{th} October 2010</td>
<td>2</td>
<td>FT1-30\textsuperscript{th} September 2010 FT2-5\textsuperscript{th} October 2010</td>
</tr>
<tr>
<td>2.</td>
<td>Practical Geometry</td>
<td>6\textsuperscript{th} October - 15\textsuperscript{th} October 2010</td>
<td>2</td>
<td>FT3-11\textsuperscript{th} October 2010 FT4-16\textsuperscript{th} October 2010</td>
</tr>
<tr>
<td>3.</td>
<td>Perimeter and Area</td>
<td>18\textsuperscript{th} October- 3\textsuperscript{rd} November 2010</td>
<td>4</td>
<td>FT5-20\textsuperscript{th} October 2010 FT6-25\textsuperscript{th} October 2010 FT7-29\textsuperscript{th} October 2010 FT8- 4\textsuperscript{th} November 2010</td>
</tr>
<tr>
<td>4.</td>
<td>Algebraic Expressions</td>
<td>8\textsuperscript{th} November - 25\textsuperscript{th} November 2010</td>
<td>3</td>
<td>FT9-11\textsuperscript{th}November 2010 FT10-19\textsuperscript{th}November2010 FT11-26\textsuperscript{th}November2010</td>
</tr>
<tr>
<td>5.</td>
<td>Exponents and Powers</td>
<td>29\textsuperscript{nd}November- 8\textsuperscript{th}December 2010</td>
<td>2</td>
<td>FT12-3\textsuperscript{rd}December 2010 FT13-9\textsuperscript{th}December 2010</td>
</tr>
</tbody>
</table>

The above mentioned identical content/chapters were taught by traditional group learning approach in the control group.
Phase III:  Post-test stage

10th December 2010 - Achievement Test in Mathematics

13th December 2010 - Self-Concept Inventory

14th December 2010 - Interview conducted regarding students perceptions about cooperative learning methods (experimental groups).

3.4 STATISTICAL TECHNIQUES USED

The data collected was statistically analyzed to test objectives of the study by using the following techniques or statistical tools:

1. Descriptive statistics such as means and SD’s were worked out on the score of achievement, and self-concept.

2. Bartlett’s test and analysis of variance (ANOVA) were used in order to adjust pupils’ intelligence and socio-economic status.

The Bartlett test statistic is designed to test for equality of variances across groups against the alternative that variances are unequal for at least two groups.

\[
T = \frac{(N - k) \ln(S_p^2) - \sum_{i=1}^{k} (n_i - 1) \ln(S_i^2)}{1 + \frac{1}{3(k - 1)} \sum_{i=1}^{k} \left( \frac{1}{n_i - 1} - \frac{1}{N - k} \right)}
\]

Where \( N = \sum_{i=1}^{k} (n_i) \) & \( S_p^2 = \frac{1}{N - k} \sum_{i=1}^{k} (n_i - 1)S_i^2 \)

In the above equation, \( S_i^2 \) is the variance of the ith group, \( N \) is the total sample size, \( n_i \) is the sample size of the ith group, \( k \) is the number of groups, and \( S_p^2 \) is the pooled variance. The pooled variance is a weighted average of the group variances.

3. ‘t’-test was employed for testing the significance of difference between the means of pupils’ achievement in mathematics, their self-concept on pre-test, post-test and gain scores. The value of ‘t’ was computed with the help of the following formula:
\[ t = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} - \frac{\sigma_2^2}{N_2}}} \]

Where
\[ M_1 \rightarrow \text{mean of first group}; \]
\[ M_2 \rightarrow \text{mean of second group}; \]
\[ \sigma_1 \rightarrow \text{variance of first group}; \]
\[ \sigma_2 \rightarrow \text{variance of second group}; \]
\[ N_1 \rightarrow \text{number of cases in first group}; \]
\[ N_2 \rightarrow \text{number of cases in second group}. \]

3.5 PRECAUTIONS OBSERVED

Following precautions were observed during the course of experiment (pre-test- treatment-post-test) for ensuring effectiveness and high precision in experimental condition which may have contributed to the results.

- No undue stress or control of any kind was imposed on the subjects at any time during the study and the experiment was conducted in a relaxed natural setting.
- Both the experimental and control groups were taught by the investigator herself to avoid any variation.
- The effectiveness of the experimental treatment was ensured by establishing rapport with students and teachers, maintaining natural setting, harmonious atmosphere, providing sufficient time for various activities in the experimentation and the like.
- It was ensured that the topics on contents had not been previously taught to the students in all the experimental group and control groups.
- During the instructional treatment, attempt was made to stick to limits of the specific teacher directed instructions in both groups and not to deviate from the steps made in the lesson plans of the treatment during execution.
• Care was taken to keep the importance of content matter during the course of treatment and it was not underplayed while fitting into the instructional treatment.

• Care was taken to maintain proper sitting arrangement in all the classrooms especially in the cooperative settings.

• Separate materials like worksheets and other tests were provided to every student during experimentation so as to avoid any indiscipline or chances of unfair observations. So it was ensured that the material provided to the students for testing or during treatment was adequate to meet this demand.

• Teaching periods of 40 minutes duration were utilized fully for treatment and time was not wasted during experimentation.

• Rewards like pens, pencils, notebooks etc. were given to high achievers immediately just after the display or announcement of team scores on the board.

• Care was taken to ensure that no one could dominate and snub others in the team-working, if any couldn’t understand the content/instruction, other members helped him/her to learn.

3.6 CONSTRAINTS AND DIFFICULTIES

It may not be improper to mention some of the difficulties faced or the constraints of the experiment that needed to be taken note of. These are:

• In the present study, the students of experimental groups had to arrange benches for every mathematics period, which was a hurdle in minimizing transition time. In further studies flexible arrangement can be provided.

• Efforts are needed to convince teachers and the principal about importance of the experiment to make them agree to cooperate in the experiment.

• In the experimental school, sometimes few subjects were not present or were irregular. It is an essential requisite for every experiment that the treatment is fully provided to every student. Therefore, subjects kept in the sample were more than the required number to ensure that the small groups regularly attended the school.
• Some difficulty was faced during the orientation of students towards cooperative learning. In the beginning, some weak students had problems in following the conditions of cooperative learning, mainly in the management of groups. But with the passage of time and encouragement given by the investigator, students were motivated to take interest in the teaching-learning activities.

• The experimenter had to adjust the time accordingly, as the students were pursuing a regular course of studies.

• The method of cooperative learning takes more time when some difficult topic is taught and some students generally lose interest in the class, some might feel fatigued or may not like solving worksheets associated with difficult topics. Such students repeatedly needed encouragement to ensure their participation from time to time.