CHAPTER - V

METHOD OF THE STUDY
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In the preceding chapters, the theoretical rationale of the problem and the tools along with their development were discussed. The present chapter has been developed to discuss the method of study which covers:

5.1 Design of the Study
5.2 The Sample
5.3 The Tools used
5.4 The Procedure
5.5 The Statistical techniques used for the analysis of data
5.6 Precautions observed
5.7 Constraints and difficulties faced during the experiment.

5.1 DESIGN OF THE STUDY

Educational research is described as experimental when the researcher has firstly, specified a set of researchable hypotheses and secondly, has established a systematic program of data gathering under precisely defined conditions in an effort to test these hypotheses. The hypotheses provide a network of statements relating the impact of an independent variable or a set of independent variables on some outcome variable or dependent variable(s) (Ingersoll, 1982).
Weiner (1977) has rightly remarked that 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 aspect. Statistical methods can greatly increase the efficiency of an experiment and also strengthen the conclusions so obtained (Montgomery, 1984).

The good experimental design should provide some explanation with respect to all the objectives of the experiment (Winer, 1971) and be kept as simple as possible (Montgomery, 1984).

The three basic principles of experimental design are replication, randomization and blocking (Montgomery, 1984). The term replication means repetition of an experiment under identical conditions (Montgomery, 1984; Lee, 1975). In practice, what is called a replication would usually depart considerably from this ideal. Oftentimes the term refers to a repetition of the basic experimental layout within what we consider one experiment. [In the present study we have used S(A(B)|xC) design with 28 subjects per condition, all to be run at the same location under same arrangements, we can think of a experiment as 28 replications of S(A(B)|xC). If we have AxB with ten subjects per conditions, all to be run at the same location under the same arrangements, we can think of the experiment as ten replications of AxB with one subject per condition; we speak of ten replicates (Lee, 1975). In the present study we have used design S(A(B)|xC with 28 subjects per
condition, each of 28 may be called a replicate, though all are part of one experiment.

In a factorial design AxBxC with repeated measure on C, the within well variation is subdivided into two parts.

\[ SS_{\text{sub. w. groups}} = SS_{\text{error (between)}} \]
\[ SS_{\text{cxssubj. w. groups}} = SS_{\text{error (within)}} \]

Winer (1971)

The total deviation of scores from the grand mean is partitioned into a between subjects and a within-subjects component. The between subjects component again represents the difference between a subject’s mean and grand mean. Such a difference is due to membership in one of the two groups (factors A and B), the effect of interaction between them (AxB), and the subject’s variability within the group (swg). Similarly, the within subjects component represents the difference between a child’s score and mean and is due to the level of the repeated measure factor that yielded the score (factor C), the interaction between the factor C and one of the group membership (A x C), the interaction between that factor and second group membership (BxC), the interaction between that factor and joint group membership (AxBxC), and the particular effect of the repeated measures factor on that individual (CxSwg).

In terms of empirical model

\[ SS_T = SS_A + SS_B + SS_{AxB} + SS_{swg} + SS_C + SS_{AxC} + SS_{BxC} + SS_{AxBxC} + SS_{CxsSwg} \]

(Girden, 1992).
Blocking is a means to reduce and control experimental error variance to achieve more precision.

Blocking stratifies experimental units into homogenous group or like units. A successful choice of blocking criteria results in less variation among the units within the blocks than that among units from different blocks (Kuehl, 2001).

It controls the effects of patterns of variation among experimental units (Mead, 1990). In this study, in both the treatments, the subjects are grouped on the basis of two types of cognitive styles – field-independence and field-dependence.

Randomization is the random assignment of treatments to experimental units (Kuehl, 2001) as the means to obtain valid estimates of experimental error variance (Fisher, 1935). Our analysis of data from experiments assumes the observations constitute a random sample from a normally distributed population. However whether experimental units a random sample is questionable when they are carefully selected, controlled and monitored in experiments. Thus the random allocation of the treatments to experimental units simulates the effect of independence and permits us to proceed as if the observations are independent and normally distributed. In the present study also, the two schools are randomly assigned treatments viz., one school is kept in cooperative learning settings and other school is taught by conventional method.
Different kinds of variables used in the study are as under:

**Treatment Variables**

As the impact of cooperative learning on criterion variables has to be studied, the instructional treatment or teaching strategy in the form of teacher-directed instruction followed by cooperative learning settings for the experimental group and traditional instruction for control group used as treatment variables.

**Dependent Variables**

The dependent variables were attitudes towards mathematics, achievement and retention in mathematics and social skills. The students were scored on these variables before and after the treatment in all the two groups. Attitudes towards cooperative learning was also studied as a dependent variable.

**Organismic Variables**

In research, frequent use is made of response inferred organismic variables (Edwards, 1968) which means a classification based upon prior observation of responses. Cognitive style was the organismic variable in the present study, upon which classification of groups was made. Cognitive style was controlled by equating the number of field-independent and field-dependent subjects in each group.

**Situational variables**

Situational variables like teacher, time, duration of treatment, institutional variation, conditions of instruction, use of teaching aids, subjects to be taught, sample size were controlled
Method of the Study

Administratively and through selection of sample, equating the time regarding the groups through equal treatments and like-wise.

**Table 5.1**

**Variables of the Study**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Variables Controlled</th>
<th>Controls employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional treatment</td>
<td>Difference scores on scale of attitudes towards mathematics</td>
<td>Class to be taught</td>
<td>Administrative (only class VII was taught)</td>
</tr>
<tr>
<td>Cognitive style</td>
<td>Gain scores on achievement</td>
<td>Subject to be taught</td>
<td>Only mathematics was taught</td>
</tr>
<tr>
<td>Category of Objectives</td>
<td>Retention scores in achievement</td>
<td>Teacher variations</td>
<td>Same teacher taught both the groups</td>
</tr>
<tr>
<td></td>
<td>Scores on scale of attitudes towards cooperative learning</td>
<td>Size of the sample</td>
<td>Equal number of students were taken in a group</td>
</tr>
<tr>
<td></td>
<td>Difference scores on social skills</td>
<td>Average age of the sample</td>
<td>The average age of the pupils was 12 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All the groups were taught for 62 days and 45 minutes each.</td>
</tr>
</tbody>
</table>

The first 2x2 factorial design was analysed with the help of ANOVA for difference scores on scale of attitudes towards
Method of the Study

mathematics. Here instructional treatments and types of cognitive style were independent variables and difference scores on scale of attitudes towards mathematics was the dependent variables. The variables of instructional treatment was studied at two levels viz., experimental group ($T_1$) which was taught by teacher directed instruction followed by cooperative learning settings and control group ($T_2$) which was taught by traditional instruction. The variable of cognitive style was studied at two levels, viz., field-independent ($C_1$) and field-dependent ($C_2$). The schematic layout of the design has been presented in Fig. 5.1.

**Fig. 5.1. Schematic layout of 2x2 ANOVA for difference scores scale of attitudes towards mathematics**

\[
\begin{align*}
\text{Difference scores on scale of attitudes towards mathematics} \\
\downarrow \\
T_1 \\
\downarrow \\
C_1 \\
\downarrow \\
C_2 \\
\downarrow \\
T_2 \\
\downarrow \\
C_1 \\
\downarrow \\
C_1 \\
\end{align*}
\]

$T_1$ = Experimental Group
$T_2$ = Control Group
$C_1$ = Field-independent
$C_2$ = Field-dependent

The second 2x2x3 factorial design with repeated measures ANOVA was employed for analysis of mean gain scores on achievement. The variable of instructional treatment was studied at two levels namely experimental group ($T_1$) which was taught
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namely experimental by teacher directed instruction followed by cooperative learning settings and control group (T2) which was taught by traditional instruction. The variable of cognitive style was studied at was levels viz., field-independent (C1) and field-dependent (C2). The third variable of categories of objectives was studied at knowledge (O1) category, comprehension (O2) category and application (O3) category.

The schematic layout of the design has been presented in the Fig. 5.2.

**Fig. 5.2 : Schematic layout of 2x2x3 factorial design for mean gain on achievement scores**

Gain in achievement scores

<table>
<thead>
<tr>
<th>T1</th>
<th>C1</th>
<th>O1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T2</th>
<th>C2</th>
<th>O2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>O3</th>
</tr>
</thead>
</table>

T1 = Experimental Group
T2 = Control group
C1 = Field Independent
C2 = Field dependent
O1 = Knowledge category of objectives
O2 = Comprehension category of objectives
O3 = Application category of objectives
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The categories of objectives was repeated variable in the above 2x2x3 design. The factorial design was used as it permits to evaluate the combined effect of two or more experimental variables when used simultaneously. The design of the investigation is termed repeated measures, because the same individuals are measured on three occasions corresponding to each treatment level. It also is referred to as a randomized block design with each individual designated as a “block” (Girden, 1992) but there is no randomization in repeated measures (Kuehl, 2001) because the same individuals are measured on a number of occasions corresponding to each treatment level.

A commonly used between-groups design employs one or more treatment/control groups that are pre-tested, exposed to treatment/control procedures and post tested. As intact groups were tested and initial equivalency could not be assumed, statistical procedures ordinarily applies to pre and post treatment data have to be evaluated more cautiously (Girden, 1992). One of the technique is to analyze pre-and post-treatment difference or gain scores (Grieve, 1981; Huck and McLean, 1975). Achievement scores are the sum of items at knowledge, comprehension and application categories of objectives.

The third 2x2x3 factorial design was employed for analysing retention scores in mathematics. The variable of instructional treatment was studied at two levels, namely experimental group ($T_1$) and control group ($T_2$). The variable of cognitive style was studied at two levels viz., field-independent ($C_1$) and field-dependent ($C_2$). The variable of categories of objectives was studied at three levels, viz. knowledge category ($O_1$), comprehension category ($O_2$) and application category ($O_3$).
The schematic layout of the design has been presented in Fig. 5.3.

**Fig. 5.3 Schematic layout of 2x2x3 factorial design for retention scores in mathematics.**

```
T1                    T2
  ↓                  ↓
  C1    C2             C1    C2
- O1    - O1           - O1    - O1
- O2    - O2           - O2    - O2
- O3    - O3           - O3    - O3
```

T1 = Experimental Group
T2 = Control Group
C1 = Field-independent
C2 = Field-dependent
O1 = Knowledge category of objectives
O2 = Comprehension category of objectives
O3 = Application category of objectives

The fourth 2x2 factorial design was analyzed with the help of ANOVA for difference scores on social skills questionnaire. Here instructional treatments and types of cognitive style were independent variables and gain scores on social skills questionnaire was the dependent variable. The variable of instructional treatment was studied at two levels viz., experimental group (T1) and control group (T2). The variable of
cognitive style was studied at two levels, viz. field-independent (C1) and field-dependent (C2). The schematic layout of the design has been presented in Fig. 5.4.

**Fig. 5.4 : Schematic layout of 2x2 ANOVA for difference scores on social-skills questionnaire**

\[\text{Difference Scores In Social Skills}\]

\[T_1 \quad T_2\]

\[C_1 \quad C_2\]

\[C_1 \quad C_2\]

T₁ = Experimental Group  
T₂ = Control Group  
C₁ = Field-independent  
C₂ = Field-dependent

### 5.2 SAMPLE

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

In all types of researches, there are some inferences regarding a well specified and identifiable group known as population and the selected number of persons or objects is
known as sample. Sample is the representative proportion of the population.

Firstly, the schools were selected based on the Principals' permission and cooperation. So, the two schools whose principals agreed to help in the investigation were:

- Government Model Senior Secondary School, Sector 10-A, Chandigarh.

As per the requirement of the present investigation students had to be classified on the basis of cognitive style.

So, Group Embedded Figures Test (GEFT) was administered to 100 students of class VII from Government Model Senior Secondary School, Sector 19-C and 100 students of class VII from Government Model Senior Secondary School, Sector 10-A, Chandigarh on 1st July, 2004, as per instructions given in the manual. Time limit for the test was 40 minutes. Scoring was done with the help of scoring key. The raw scores obtained were used as such in the study.

The students who scored 13 or above were kept in field independent group. The students who scored 8 or below were kept in field-dependent group, whereas students who scored between 9 and 12 were dropped.

Thus, on the basis of the scores obtained by the students the Group Embedded Figures Test, the students were divided into two groups of field-independent and field-dependent students. Next, the field-independent and field-dependent students were randomly allocated to experimental and control group.
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The sample description may be explained as follow:

**Fig 5.5. Schematic layout of sample distribution**

Initial Number of Students = 200

- Field Independent n=56
- Field Dependent n=56

- Experimental Group n=28
- Control Group n=28

The sample was selected irrespective of gender as Chandigarh reflects the modern outlook of its residents. Boys and girls are treated equally at all places whether it is home or educational institutions and provided with similar facilities and opportunities. The average age of students was 12 years.

The break up of total sample (School wise) given in Table 5.1

**Table 5.2 Sample Distribution**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the school</th>
<th>Field Independent</th>
<th>Field Dependent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Government Model Senior Secondary School, Sector 10-A, Chandigarh (Control Group)</td>
<td>28</td>
<td>28</td>
<td>56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>56</strong></td>
<td><strong>56</strong></td>
<td><strong>112</strong></td>
</tr>
</tbody>
</table>
No doubt, the sample is small for the result of the study to be generalized but availability of a large sample and feasibility of carrying out such an experimental study on large sample is beyond the control of the investigator. Even earlier investigations conducting such studies through experimental design have used small samples.

McManus and Gettinger (1994) had taken 38 third graders for their study in cooperative learning, Mulryan (1994) took 48 students for her study. Whicker, Bol and Nunnery (1997) took 15 students in treatment group and 16 students in comparison group making a total sample.

Gillies (2002) took 88 students of Grade 5 for his study of 31 students for their study in cooperative learning. Fourth survey of Research in Education (1991) had justified the use of small samples in such experimental researches due to deeper inquest of these studies and available methodological facilities. It is accepted that almost all studies of this nature as the present one, have worked on small samples only.

Experimental studies (Johnson & Johnson (1981); Schmuck & Schmuck (1983); Sharan & Sharan (1976); Slavin (1983, 1989) have 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. 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 mathematics (Noddings, 1989; Taylor, 1989).
**5.3 TOOLS USED**

For the present investigation following tools were used.

1. Development of attitudes towards mathematics (developed by the investigator)
2. Development of material for instructional treatment (Developed by the investigator).
3. Development of worksheets (Developed by the investigator).
4. Development of formative criterion tests (developed by the investigator)
5. Development of criterion test (developed by the investigator)
6. Development of achievement test (developed by the investigator)
7. Scale of attitudes towards cooperative learning (developed by the investigator)
8. Social skills Questionnaire-Pupil (Spence, 1995).

All the above tools have been explained in Chapter IV.

**5.4 PROCEDURE**

Procedure of the experiment comprised of two main stages, which are selection of the sample and conducting the experiment.

**Stage 1: Selection of the Sample**

The present study was conducted on 112 class VII students from the Government Model Senior Secondary School, Sector 19-C, Chandigarh and Government Model Senior Secondary School, Sector 10-A, Chandigarh. Students were selected for
experimentation after administration of Group Embedded Figures Test (GEFT) to class VII students, 100 each in both the schools (as explained under the subheading sample in the present chapter). Each group (both schools) consisted of equal number of field-independent and field-dependent students. The investigator was trained in using teacher directed instruction followed by cooperative learning settings for experimental treatment involved in the present study after meeting with the guide and some experts at the Department of Education, Panjab University, Chandigarh.

Stage 2: Conducting the Experiment

The experiment was conducted in four phases as given below:

Phase 1: Administration of Pre-test
Phase 2: Conducting the instructional program
Phase 3: Administration of the post-test
Phase 4: Administration of the retention test

Phase 1: Administration of Pre-test

The phase involved the administration of the following test to the students of the experimental group and control group i.e.

i. Criterion Test
ii. Scale of attitudes towards mathematics
iii. Social skills questionnaire (Pupil version)

Separate response sheets were provided. The answer sheets were scored with the help of scoring key. The scores indicated the previous knowledge possessed by the students, their attitudes towards mathematics and their level of social skills.
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**Phase II: Conducting the instructional program**

To find out the efficacy of the treatment variables, the instructional treatment was manipulated in the form of teacher directed instruction followed by cooperative learning settings.

The instructional treatment was given for about 62 days which included 45 lessons and 17 formative criterion tests to the experimental group whereas the control group was taught by the conventional method. Same content was taught to both the groups. Students were motivated to learn through the novel method of instruction and were encouraged to participate in the experiment by explaining the objectives. Students were explained the steps of instructional treatment. An effective cooperative learning method called Student Team-Achievement Divisions or STAD was used. (Slavin, 1994, 1995 a).

The following steps were followed how students were introduced to STAD.

(I) **Teach:** The lesson (say chapter-1) was presented by the teacher-directed instruction.

(II) **Team-Study:** It included the following of steps:

(a) **Ranking of Students**

The students were ranked on their previous test scores from top to bottom. For the first lesson, students were ranked on the basis of their score of their 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 student was placed the middle of the quarter. In this way we got four quarters as given below.
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Ist quarter
1. Chitranshi
2. Ritu Sharma
3. Ashish
4. Kavita
5. Sukhmani
6. Suman
7. Sukhpreet
8. Ritesh
9. Preeti Rana
10. Dimple
11. Divya
12. Suraj
13. Pardeep
14. Poonam

IInd quarter
15. Priyanka
16. Mandeep
17. Ankush
18. Sushma Devnath
19. Kavita Pannu
20. Jatinder
21. Robin
22. Jaspreet
23. Rekha
24. Komal Verma
25. Vikas Kandel
26. Dushyant Rana
27. Dinesh
28. Parveen
29. Sahil Nayar

III quarter
30. Sushma
31. Mandeep Singh
32. Ravi Aggarwal
33. Suresh Kumar
34. Ritu
35. Kavita Rani
36. Kiran
37. Sulbha
38. Anu
One student was selected from each quarter to make a group of four. Like in the first group, two students from first two quarters and two lower most students from the third and fourth quarter. Extra student became fifth member of the first group.
The groups were made in the following manner.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chitranshi</td>
<td>Ritu sharma</td>
<td>Ashish</td>
<td>Kavita</td>
<td>Sukhman</td>
</tr>
<tr>
<td></td>
<td>Priyanka</td>
<td>Mandeep</td>
<td>Ankush</td>
<td>Sushma Devnath</td>
<td>Kavita Pannu</td>
</tr>
<tr>
<td></td>
<td>Anish</td>
<td>Mohit</td>
<td>Parmod Yadav</td>
<td>Vishal</td>
<td>Lokesh Joshi</td>
</tr>
<tr>
<td></td>
<td>Nikhil</td>
<td>Ankush Arora</td>
<td>Jatin</td>
<td>Yogesh Mathur</td>
<td>Radhika Rana</td>
</tr>
<tr>
<td></td>
<td>Sahil Nayyar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Suman</td>
<td>Sukhpreet</td>
<td>Ritesh</td>
<td>Preeti Rana</td>
<td>Dimple</td>
</tr>
<tr>
<td></td>
<td>Jatinder</td>
<td>Robin</td>
<td>Jaspreet</td>
<td>1 Rekha</td>
<td>Komal verma</td>
</tr>
<tr>
<td></td>
<td>Harpreet</td>
<td>Chaitanaya</td>
<td>Ajit Pal Singh</td>
<td>Jagmeet</td>
<td>Abhishek</td>
</tr>
<tr>
<td></td>
<td>Anu</td>
<td>Sulbha</td>
<td>Kiran</td>
<td>Kavita Rani</td>
<td>Ritu</td>
</tr>
<tr>
<td>K</td>
<td>Divya</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vikas Kandal</td>
<td>Suraj</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shivani Sharma</td>
<td>Dushyant Rana</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suresh Kumar</td>
<td>Pankaj</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ravi Aggarwal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(c) Working in group

During team study students worked (45 minutes) on worksheets in their teams to master the material which was presented in the skill being taught and assessed themselves and their teammates.

For team study following steps were followed:

- Teammates were asked to move their desks together.
- Worksheets were handed over to each student (say worksheet 1 based on Rational Numbers). All team members were given following instructions:
  
  (I) Each student in a group of foursome should the problem and the check with his or her partners. If anyone missed a question then it is the responsibility of teammates 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 solve each item in the worksheet.

  (IV) When you have questions, first ask a teammate before asking the teacher.

  (V) Encourage and praise your teammates from time to time.

  (VI) Don’t hesitate in asking any question from your teammates and clear your doubts.

  (VII) If any of your teammate indulge the group 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 teammate then check it whether he is able to do the similar question or not.

(X) If you have a teammate in a group who is weak, encourage him that he can also do well and can reach upto the level of others.

While students are working in teams, the teacher circulated through the class, praised teams that are working well, encouraged the teams, and sat with each team 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 45 lessons covering ten chapters. Worksheet was associated with each lesson.

(III) Test

Students took test (say formative criterion test - 1) that measures their understanding of the content of chapter-1 (Rational Numbers). Students were given adequate time to complete. They were not allowed to work together. Each test paralleled the worksheet. The number of formative criterion tests were 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.
Scoring

Students’ tests were scored by the teacher. Team scoring is based on the improvement of individual team members. Team members were awarded points based on their test scores compared to their base scores.

Calculation of Base scores

For formative criterion test (FCT-1), base scores were calculated by taking 25% of the student’s scores in mathematics (Max marks: 100) during final examination of class VI as their no other academic record was available. For example,

<table>
<thead>
<tr>
<th>Members of Team No. 3</th>
<th>Test-A (Base scores)</th>
<th>FCT-1</th>
<th>Improvement Points</th>
<th>Total (FCT-1+ Improvement Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashish</td>
<td>18</td>
<td>23</td>
<td>20</td>
<td>43</td>
</tr>
<tr>
<td>Ankush</td>
<td>16</td>
<td>18</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>Mohit</td>
<td>15</td>
<td>19</td>
<td>10</td>
<td>29</td>
</tr>
<tr>
<td>Jatin</td>
<td>17</td>
<td>12</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td></td>
<td></td>
<td><strong>Average of Team-3 112/4=28</strong></td>
</tr>
</tbody>
</table>

FCT- Formative Criterion Test

Base scores for FCT-2 were the scores of the average of FCT-1. For FCT-3 base scores were the average of FCT-1 and FCT-2. Similarly, for FCT-4, base scores were the average of FCT-1, FCT-2 and FCT-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 FCT-1, there was no other alternative.
Method of the Study

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 was determined as given below: (Slavin, 1990) in Table 5.3

<table>
<thead>
<tr>
<th>Quiz Score</th>
<th>Improvement Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect score or 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 score were announced the next day before the new lesson started. Team accomplishments were recognized by giving suitable prizes (pens, notebooks) to all members of that team who secured maximum points and by praising them in front of whole class and their class teacher and mathematics teacher.

After 14 days of STAD, new teams were reassigned, i.e., after covering chapters 1 (Rational Numbers), 2 (operations on Rational Numbers) and 3(Decimal Representation of Rational Numbers), 4 FCTS 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 FCT-1, 2, 3 and 4 were taken. Base scores for FCT-5 were computed in a same way.
Method of the Study

by averaging all the four FCTS as discussed before for other tests. In the whole program, new groups were made five times. This allowed the students to work with other classmates and kept the program fresh.

Table 5.4

Table showing number of times the teams reassigned, time period for the students remained in same group, chapters covered in that time and number of FCT’s taken by the students

<table>
<thead>
<tr>
<th>Number of times teams reassigned</th>
<th>Duration of same group (in days)</th>
<th>Chapters covered</th>
<th>No. of FCTS given</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>14</td>
<td>Rational Numbers, Operation on Rational Numbers, Decimal Representation of Rational Numbers</td>
<td>4 (FCT-1,2,3&amp;4)</td>
</tr>
<tr>
<td>2nd</td>
<td>17</td>
<td>Exponents, Direct and Inverse Variations, Percentage and its Applications</td>
<td>4 (FCT-5,6,7,8)</td>
</tr>
<tr>
<td>3rd</td>
<td>11</td>
<td>Algebraic expressions, Factorization of algebraic expressions</td>
<td>3 (FCT-9,10,11)</td>
</tr>
<tr>
<td>4th</td>
<td>13</td>
<td>More about triangles</td>
<td>4 (FCT-12,13,14,15)</td>
</tr>
<tr>
<td>5th</td>
<td>6</td>
<td>Surface areas and volumes</td>
<td>2 (FCT-16,17)</td>
</tr>
</tbody>
</table>

FCT – Formative Criterion Test
Method of the Study

Selection of the Sample: The sample for the present study was selected from the above two schools.

Experimental Group

Control Group
Method of the Study

Conducting the Instructional Program

Teammates moved their desks together to form a group of foursome.
Method of the Study

Students working on worksheets in their teams

Teaching Monitoring the Group Activities
Teacher intervening only when necessary.

Students taking tests individually after the instructional treatment.
Phase III : Administration of the 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 both the experimental and control groups.

- Criterion Test
- Scale to measure attitudes towards mathematics
- Social skills (Pupil version)
- Scale to measure attitudes towards cooperative learning (only to students of experimental group)
- Interview taken regarding the perceptions of students towards the instructional program (only of the students of experimental groups).

Phase IV : Administration of the Retention Test

Twenty days later, following test was again administered to both experimental and control group.

1. Criterion Test – It was administered to get the measure of retention.

   The obtained answer sheets were scored with the help of scoring key.

   The Date wise schedule of the experiment has been given in Table 5.3.

DATE SCHEDULE OF THE EXPERIMENT

Stage 1 : 1st July, 2004 – Administration of Cognitive Style (GEFT)
Stage 2: Conducting the experiment.

Phase 1: 2nd July, 2004 – Pre-test stage
Administration of Criterion Test, Scale of attitudes towards mathematics, social skills questionnaire.

Phase II: Instructional Program

Table 5.3
Date Schedule of the Experiment

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Chapter</th>
<th>Experimental Group Teacher directed Instruction</th>
<th>No. of FCTs</th>
<th>Administration of FCTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Decimal representation of Rational Numbers</td>
<td>16th-18th July, 2004</td>
<td>1</td>
<td>FCT 4 – 19th July, 2004</td>
</tr>
<tr>
<td>5.</td>
<td>Direct and Inverse variations</td>
<td>29th July – 2nd Aug. 2004</td>
<td>1</td>
<td>FCT 7 – 3rd August, 2004</td>
</tr>
</tbody>
</table>
Control Group

The above chapters were taught by conventional group learning.

Phase III: Administration of the Post-tests

(i) Criterion test
(ii) Scale of attitudes towards mathematics
(iii) Social skills questionnaire

Dates for administering the test were:
10th September, 2004 for control group
10th September, 2004 for experimental group
11th September, 2004 (i) Administration of scale of attitudes towards cooperative learning only to experimental group.
(ii) Interview conducted regarding students’ perceptions about cooperative learning (for experimental group)

Phase IV: Administration of retention test

The criterion test was administered to students of both the experimental and control groups to determine how much they have retained with respect to the topics taught to them after 20 days of post-testing.
5.5 STATISTICAL TECHNIQUES

The following statistical techniques were employed to analyse the data obtained from the experiment to test the hypotheses.

- Graphical representations
- Qualitative analysis of criterion scores
- Descriptive statistical techniques like Means, SD's, Skewness and Kurtosis of the attitudes difference scores, achievement gain scores and social skills difference scores.
- Factorial design 2x2, analysis of variance for mean difference scores on scale of attitudes towards mathematics.
- Factorial design 2x2x3 ANOVA with repeated measures on one factor for mean gain on achievement scores.
- Factorial design 2x2x3 ANOVA with repeated measures on one factor for retention scores.
- One-way ANOVA was employed for the scores on attitudes towards cooperative learning.
- Percentages were computed to analyze the findings regarding interviews.
- Factorial design 2x2, ANOVA for difference scores on social skills questionnaire.

For further investigation, t-test was employed wherever F-ratios were found to be significant.

5.6 PRECAUTIONS OBSERVED

Following precautions were observed during the course of experiment (Pretest-treatment-Posttest) 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 of treatment had not been previously taught to the students and not during the course of experiment in both the experimental and control groups.

- During instructional treatment, attempt was made to stick to the limits of the specific Teacher Directed Instruction in both groups and not to deviate from the steps made in 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.

- Separate material 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 period of 45 minutes duration were utilized fully for treatment and time was not wasted during experimentation.

5.7 CONSTRAINTS AND DIFFICULTIES FACED DURING EXPERIMENT

It will not be improper to mention some of the difficulties faced or the constraints of the experiment for the knowledge of those who intend to conduct such researches in future. Such constraints of the experiment also need to be taken note of. These are:

- Efforts are needed to convince teachers and principal the importance of the experiment and made 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 be fully provided to every students. Therefore, subjects kept in the sample were more than the required number and it was ensured that the sample groups were regularly attending 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 the encouragement given by the investigator, students were motivated and began to
Method of the Study

take interest in teaching-learning activities and realize the importance of the treatment.

- 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 and when some difficult topic is taught some students generally lose interest in the class. Here also, some students might feel fatigue or not like solving worksheets associated with difficult topics. It is not the time to lose heart. Such students repeatedly need encouragement, Investigator also made it sure to encourage them from time to time.

- Other events like anxiety, interest and other like factors were beyond the control of the researcher.