Chapter – IV
Method of the Study
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METHOD OF THE STUDY

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 the study which covers:

4.1 Tools used
4.2 The sample
4.3 Design of the study
4.4 The procedure
4.5 The statistical techniques used for the analysis of data
4.6 Precautions observed
4.7 Constraints and difficulties faced during the experiment

4.1 TOOLS USED
For the present investigation following tools were used:
1. Raven’s Advanced Progressive Matrices (APM).
2. Development of the Criterion Test (Developed by the investigator).
3. Development of the Achievement Test (Developed by the investigator).
4. Development of the Formative Tests (Developed by the investigator).
5. Development of instructional material for Teacher Directed Instruction (Developed by the investigator).
6. Scale to measure Attitude Towards Peer Tutoring (Developed by the investigator).
7. Learning Environment Inventory (LEI) by Walberg and Anderson.

4.2 SAMPLE
In a research project, researchers usually come across unmanageable population, wherein large numbers are involved, so it is difficult to study the whole population. It is often desirable in order to reduce expenditure, time and energy, to produce greater precision and accuracy, a sample from a population should be taken. Sampling is the process by which a relatively small number of
individuals or objects are selected and organized in order to find out something about the entire population from which it is selected. Sampling procedures provide generalizations on the basis of relatively small proportion of population.

In the present study, APM was administered to 200 students of class IX from the Kalapani Higher Secondary School of Dhubri District in Assam in August, 2002, as per the instructions given in the manual. Time limit for the test was 40 minutes. Separate answer sheets were provided to the students. Scoring was done with the help of the scoring key. The raw scores obtained were used as such in the study.

The intelligence scores of the students on APM were arranged in an ascending order. The 27 percent higher and 27 percent lower scoring subjects were selected and the middle group was dropped. Each one of the selected groups was randomly allocated to the two sub-groups. One sub-group from the high scoring and another from the low, was allotted to experimental group and similar matching group to control group. So, the final sample comprised of 108 students. The study followed purposive cum random sampling procedure. It was purposive because Kalapani Higher Secondary School of Dhubri District in Assam, which was easily approachable, was selected. It was random because IX class students, selected for experimentation were randomly allocated to the two groups viz., one experimental and another control group. Each group consisted of randomly allocated high and low intelligence level students. The two groups were as similar as the availability permitted. Their average age was 13 years.

In this district of Assam approximately 90% of the population is of Muslims. So, in class IX 95% of the students were from Muslim families. There were 122 boys and 78 girls out of 200 and 87 boys and 21 girls out of 108. The students belonged to lower and middle socio-economic status. The sample distribution with respect to the number of students in each sub-sample is present in Table 4.1.
Table 4.1
Sample Distribution

<table>
<thead>
<tr>
<th></th>
<th>T₁ (Experimental Group)</th>
<th>T₂ (Control Group)</th>
</tr>
</thead>
</table>
| I₁ (High Intelligence) | Mean = 26.81     
n = 27            
S.D. = .83      | Mean = 26.33    
n = 27            
S.D. = 1.29    |
| I₂ (Low Intelligence)  | Mean = 17.59     
n = 27            
S.D. = 2.39     | Mean = 17.18    
n = 27            
S.D. = 2.64    |

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 investigators conducting such studies through experimental designs have used small samples. Talegaonkar (1984) had taken 34 class IX students for his study. Panda (1986) included 86 students in his sample while Chitrive (1983) had taken three intact sections of class IX for his study with 35 students in each section as his sample. Baveja (1988) took 63 students in her experimental group and 36 students in control group making a total sample of 99 students. Jamini (1991) had worked on two sections of chemistry classes in a school. Passi and Sansanwal while reviewing Research in Teaching in Buch’s 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.

4.3 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).

Accordingly, 2x2x2 factorial design combined with ANOVA (Campbell and Stanely, 1963) was employed. The factorial design was used as it permits to evaluate the combined effect of two or more experimental variables when used simultaneously.

Information from factorial design experiment is more complete than that obtained from a series of single factor experiments in the sense that evaluation of interaction effects can be made. Also the population to which inference can be made is more inclusive than the corresponding population for a single factor experiment (Winer, 1971).

ANOVA was preferred to increase the precision of analysis of the experimental data which utilized both the pre-test and post-test scores. The present study employed two replications of 2x2x2 factorial design with three fixed variables of which the measures on one variable were repeated for mean gain on achievement scores and the retention scores.

Also, sixteen replications of 2x2 factorial design were employed for analyzing mean gain scores on learning environment inventory (LEI).

The model was a fixed one because all the levels of the variables in each of the designs were determined on a logical basis and were not selected by sampling (Guilford and Fruchter, 1978). Computational procedure was followed according to the technique given by Winer (1971). When a factorial design
follows a fixed model in the technique of ANOVA, the error term is always the "within treatment mean squares" (Edwards, 1971).

There were different sets of dependent variables. The first 2x2x2 factorial design was computed by ANOVA for the mean gain on achievement scores. Here instructional treatment, intelligence and category of objectives were independent variables. Gain on achievement scores was the dependent variable which was calculated as the difference in post-test and pre-test scores for each subject.

The variable of Instructional treatment was studied at two levels namely experimental group (T₁) which was taught by teacher directed instruction followed by peer tutoring and control group (T₂) which was taught by traditional instruction. The variable of intelligence was studied at two levels viz., high intelligence (I₁) and low intelligence (I₂) levels. The third variable of categories of objectives was studied at knowledge (O₁) category and comprehension (O₂) category.

The schematic layout of the design has been presented in the Fig.4.1.

**Fig.4.1: Schematic layout of 2x2x2 factorial design for mean gain on achievement scores**

\[
\begin{align*}
\text{Performance Gain} & \downarrow \\
\text{T₁} & \text{T₂} \\
\text{I₁} & \text{I₂} & \text{I₁} & \text{I₂} \\
\text{O₁} & \text{O₂} & \text{O₁} & \text{O₂}
\end{align*}
\]

\[T₁ = \text{Experimental group}\]
\[T₂ = \text{Control group}\]
\[I₁ = \text{High Intelligence}\]
\[I₂ = \text{Low Intelligence}\]
\[O₁ = \text{Knowledge category of objectives}\]
\[O₂ = \text{Comprehension category of objectives}\]
The second 2x2x2 factorial design was for retention scores. The schematic layout of the design has been presented in Fig. 4.2. Here, the variable of instructional treatment was studied at two levels, namely experimental group (T₁) and control group (T₂). The variable of intelligence was studied at two levels viz. high intelligence (I₁) and low intelligence (I₂). The variable of categories of objectives was studied at two levels, viz. knowledge category (O₁) and comprehension category (O₂).

The schematic layout of the design has been presented in the Fig.4.2.

**Fig. 4.2: Schematic layout of 2x2x2 factorial design for retention scores**

![Schematic layout of 2x2x2 factorial design for retention scores]

- T₁ = Experimental group
- T₂ = Control group
- I₁ = High Intelligence
- I₂ = Low Intelligence
- O₁ = Knowledge category of objectives
- O₂ = Comprehension category of objectives

The third 2x2 factorial design was analyzed with the help of ANOVA for gain scores on learning environment inventory. Here instructional treatment and levels of intelligence were the independent variables and gain scores on learning environment inventory was the dependent variable. The variable of instructional treatment was studied at two levels viz., experimental (T₁) and control group (T₂). The variable of intelligence was studied at two levels, viz., high intelligence (I₁) and low intelligence (I₂) levels. The schematic layout of the design has been presented in Fig.4.3.
Different kinds of variables used in the study are as under:

Treatment Variables
As the impact of Teacher Directed Instruction followed by peer tutoring on criterion variables has to be studied, the instructional treatment or teaching strategy in the form of teacher directed instruction followed by peer tutoring and traditional instruction were used as treatment variables. For instruction, the two treatment groups used in the study are experimental and control groups.

Dependent Variables
The dependent variables were achievement and retention in science and LEI. The students were scored on these variables before and after the treatment in all the two groups. Attitude towards peer tutoring 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. Intelligence was the organismic variable in the present study, upon which classification of groups was made. Intelligence was controlled by equating the number of high and low intelligence subjects in each group.
Situational Variables

Situational variables like teacher, time, duration of treatment, institutional variations, conditions of instruction, use of teaching aids, subjects to be taught, sample size and the like were controlled administratively and through selection of the sample, equating the time regarding the groups through equal treatments and like-wise.

Table 4.2
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>Gain scores on achievement</td>
<td>Class to be taught</td>
<td>Administrative (only IX class was taught)</td>
</tr>
<tr>
<td>Intelligence</td>
<td>Retention scores</td>
<td>Subject to be taught</td>
<td>Only science as a subject was taught</td>
</tr>
<tr>
<td>Category of objectives</td>
<td>Gain scores on LEI</td>
<td>Teacher variations</td>
<td>Same teacher taught both the groups</td>
</tr>
<tr>
<td></td>
<td>Scores on scale to measure attitude towards peer tutoring</td>
<td>Size of sample</td>
<td>Equal number of students were taken in a group</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average age of the sample</td>
<td>All the sections included pupils of the average age group 13 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Situational variables</td>
<td>Period of treatment</td>
<td>All the groups were taught for 27 periods of 40 minutes each</td>
</tr>
<tr>
<td></td>
<td>Duration of treatment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.4 PROCEDURE

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

Stage I: Selection of the Sample

The present study was conducted on 108 class IX students from the Kalapani Higher Secondary School, District Dhubri in Assam. Class IX students were selected for experimentation after administration of APM to 200 class IX students (as explained under the sub-heading sample in the present chapter). Each group consisted of randomly allocated high and low intelligence level students.
The investigator was trained in using teacher directed instruction followed by peer tutoring for experimental treatment involved in the present study after meeting with the guide and some experts at the Department of Education, Panjab University, Chandigarh and Gauhati University, Guwahati.

Stage 2: Conducting the experiment

The experiment was conducted in four phases as given below:

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

Phase I: Administration of the pre-test

This phase involved the administration of the following tests to the students of the experimental group and control group i.e.

- Criterion test
- Learning environment inventory

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 and their perceptions about learning environment of their classroom.

Phase II: Conducting the instructional program

To find out the efficacy of the independent variables, the instructional treatment was manipulated in the form of teacher directed instruction followed by peer tutoring.

The instructional treatment was given for about 50 days to the two groups. Students were motivated to learn through the novel method of instruction and were encouraged to participate in the experiment by explaining its objectives.

Students of the experimental group were explained the steps of instructional treatment as follows:

- Unit 1 is taught by teacher directed instruction.
- Administration of unit test 1.
• Feedback to all students.
• Formation of peer groups followed by peer tutoring.
• Administration of unit test 1 again to determine the level of mastery of the tutors and the tutees.
• Feedback and retutoring by peers, if essential.
• Similarly, the remaining units will be taught by teacher directed instruction followed by the above mentioned activities.

Instructions to the peer tutors

The students who were selected to be peer tutors (on the basis of their mastery in the unit test) were given specific instruction such as:

The control group was taught the same topics for the same duration of time by traditional instruction.

At each tutoring session:

1. Get started with your tutees as quickly and quietly as possible:
   (a) Greet the tutees by their first names – and let them call you by your first name.
   (b) Ask about anyone who is missing; find out, in a friendly manner, what happened to anyone who is present at this session but was missing the previous week; give tutees a chance to tell you about any personal events which have happened since the previous week – accidents, punishments, birthdays, football matches, etc.
   (c) As soon as possible after establishing personal contact and rapport, ask them to describe their previous lesson – good practice for them as well as a source of information for you.

2. Orient the tutees to the task for the day:
   (a) Tell the tutees precisely what they are to do.
   (b) Explain the general and specific purpose of the day’s lesson, linking it to the structure of the course as a whole and to the outside world.

3. Always try to proceed by asking questions, rather than making statements. Do not prompt your tutees with subtle clues or cues. Do not
tell them the answers to the questions, but rather lead them to answers by supplementary questions (breaking major points down into simpler ones). Try to evaluate your tutees' responses. You can learn from their mistakes. If you have an appreciation of their misconceptions, it is easier to direct them along the right path.

4. Praise your tutees when they are doing well or give correct answers.

5. Do not punish your tutees. If they give incorrect answers, just go on asking questions until they give the right answer, then repeat the right answer with them. Try to quieten them by interesting them in some aspect of the work, even if it means broadening the context.

6. If your tutees are restless or undisciplined, ask them what is the matter: do not shout at them or order them about. In case of serious indiscipline, call the teacher.

7. Do not expect too much from your tutees. Try to get the feel of an appropriate rate of learning. Try to be aware of individuals who may not be keeping up with the rest of the group and give them some individual attention. If you join a lab group, it is best to observe for a few minutes first to get a feel for the roles of individuals in the group.

8. Reinforce the tutees' learning:
   a) Tell them when they have got an answer right, and praise them.
   b) Do not punish them when they have given wrong answers; simply state the correct answer (if your supplementary questions do not elicit it) and ask them to repeat it.

In general – praise in public; correct persistent faults privately.

9. Be prepared to be flexible; there is no point in pressing on to some lesson-target if pupils have not grasped the earlier steps. Try to assess how much of the earlier work needs to be reinforced before progressing further. Show your interest both in the tutees and in the subject-matter of the lessons.

10. Try to use illustrative examples which draw on your tutees' interest – eg sports, TV programmes, pop, etc and /or examples with which they will be familiar such as incidents in the kitchen.
11. Know the subject-matter and the lesson plan. Being one step ahead will make you feel confident. However, do not be afraid to admit that you do not know an answer: pupils will respect this. Learn together.

12. Do not discriminate or show favouritism. And be aware of your tutees’ sensitivities – ethnic or social class background, gender, religious beliefs. For example, do not correct them for what you may consider to be bad language; they may resent you for judging them. Teach by example in this respect, otherwise your relationship with them may be damaged.

13. Evaluate the tutees’ knowledge frequently by asking questions. For example, if you are not being called over to help tutees, try to join a laboratory group to observe it, and ask tutees what they are doing and what they have found out.

14. Do not assume that the tutees’ secondary behaviour (such as shifting on the stools, drumming fingers, unwillingness to make eye-contact, tendency to giggle and gossip) is an indication that they dislike you; they may just be shy or somewhat embarrassed by their lack of proficiency in the subject (Some children, for example, may have difficulty in reading).

15. Towards the end of the lesson, go over the points learned.

16. Having ‘broken the ice’, ask about their interests in science. If they say it is all boring, try sympathetically to unearth the source(s) of their dislike. In all sessions, but more importantly in the first one, try to understand any difficulties the tutees may have and encourage the tutees to be frank with you. For example, girls may think science ‘is boys’ stuff’ or boys may think science is ‘just learning facts’. Gradually, and without pushing too hard, stress the interest, excitement, and importance of systematic enquiry as the basis of science.

17. Try to overcome (or disguise) any apprehension that you may have about tutoring as this will quickly be communicated to the pupils. Once you get started, you will be too involved to worry about your role in the class!

18. Smile – the fastest ice-breaker!
At all sessions

1. The teacher is in charge of the class, legally as well as morally. Always consult the teacher before going off on a new track or departing in any significant way from the syllabus.

2. Try to build around the teacher’s demonstrations, worksheets, etc. The teacher has to continue with the class long after the tutoring has ended: it is essential to maintain and reinforce the tutees’ confidence in the teacher.

3. Do not be afraid to ask the teacher’s advice on how to approach a problem with a particular child. The teacher will probably have a better appreciation of the child’s abilities and where extra help may be needed.

4. Take things into lessons (games/books/photos/objects) which illustrate the work being covered. Such items could be used as a focus to reinforce a specific topic.

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 administrated to both the experimental and control groups.

- Criterion test.
- Learning Environment Inventory
- Scale to measure attitude towards peer tutoring (only to students of experimental group).

Phase IV: Administration of the Retention Test

Fifteen days later, the same criterion test was again administered to the students to get a measure of retention. The time limit was 40 minutes. Again the obtained answer sheets were scored with the help of the scoring key.

The Date Schedule of the experiment has been given in Table 4.3
Table 4.3
DATE SCHEDULE OF THE EXPERIMENT

Stage 1: 1st August, 2002 – Administration of intelligence test.
Stage 2: Conducting the Experiment
Phase 1: 2nd August, 2002- Pre-test stage- Administration of criterion test and LEI
Phase: II Instructional Programme

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Units</th>
<th>Teacher Directed Instruction</th>
<th>1st Adm. Of Unit Test</th>
<th>Peer tutoring</th>
<th>2nd Adm. Of Unit test</th>
</tr>
</thead>
</table>

Control Group
Units – I – VI were taught by traditional instruction.
26th Sept, 2002 Administration of scale of Attitude towards peer tutoring.
Phase III 27th Sept, 2002- Post-test stage- Administration of criterion test and LEI.
Phase IV 12th October, 2002 – Administration of Retention test.

4.5 STATISTICAL TECHNIQUES

The following statistical techniques were employed to analyse the data obtained from the experiment to test the hypotheses.
1. Graphical representations.
2. Qualitative analysis of criterion scores.
3. Descriptive statistical techniques like mean, S.D’s of achievement scores.
4. Factorial design 2x2x2, Analysis of variance for mean gain on achievement scores.
5. Factorial design 2x2x2, Analysis of variance for retention scores.
6. Factorial design 2x2 analysis of variance for gain scores on LEI.
7. For further investigation, t-test was employed wherever F-ratios were found to be significant.

4.6 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.

- All the subjects were oriented to the tests and teacher directed instruction followed by peer tutoring as per their treatment in the beginning of the experiment.
- 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.
- All the subjects were taught by the investigator himself to avoid any variation in the teacher variable.
- The effectiveness of the experimental treatment was ensured by establishing rapport and liaison in the school, 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 even taught by any other teacher during the experiment to any of the groups viz. experimental and control group.
- During instructional treatment, attempt was made to stick to the limits of the specific Teacher Directed Instruction for treatment to the respective group and not to deviate from the steps especially made in the lesson plans of the treatment during execution.
- Care was taken not to undermine the importance of content matter during the course of treatment and it was not under played while fitting into instructional treatment.
- Separate material was provided for every student during experimentation so as to avoid any disturbance or chances of unfair observations. Thus it
was ensured that the material provided to the students for testing, treatment or during orientation was adequate to meet this demand.

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

4.7 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:

a) It is quite an effort to make teachers and principal agree to co-operate in the experiment.

b) In the experimental school, sometimes a 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 which implies his/her regular presence in the school during the days of treatment. Thus it was ensured that the sample groups were regularly attending the school excepting some unavoidable circumstances.

c) Some difficulty was also faced during the orientation of students towards their respective treatments. In the beginning the students appeared to be hesitant to come forward with responses and views but with the passage of time, the students began to take interest in teaching-learning activities.

d) The experimenter had to teach the lessons as per the syllabus and time schedule also, as they are pursuing a regular course of studies. Thus the experimental schedule had to be adjusted accordingly.

e) Specific events like anxiety, fatigue or interest and the like factors were beyond the control of the researcher.