CHAPTER-III

DESIGN OF THE STUDY

The alarming problem that follows the task of defining the research problem is the preparation of the design of the research project, popularly known as the “research design”. Decision regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design. ‘A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure’. In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blue print for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data.

1Winer (1971) has compared the design of an experiment to an Architect’s plan for the structure of a building. The designer of experiments performs a role similar to that of the Architect. According to Mayer (1980), ‘The design is the general structure of the experiment, not its specific content’. According to Lindquist (1956), ‘Research design is the plan, structure and strategy of investigation conceived so as to obtain to research question and to control variance’.

Research design is needed because it facilitates the smooth seafaring of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of efforts, time and money. Just as for better, economical and attractive construction of a house, we need a blue print well thought out and prepared by an expert Architect, similarly

1 www.inflibnet.ac.in/bitstream/10603/7257/7/07_chapter_3.pdf ·
we need a research design or a plan in advance of data collection and analysis for our research project. Research design stand for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and the availability of staff, time and money. Preparation of the research design should be done with great care as any error in it may upset the entire project. Research design, in fact has a great bearing on the reliability of the result arrived at and as such constitutes the firm foundation of the entire structure of the research work.

The main objective of the present study is to establish the interactional effects and the main effect of Information & Communication Technology (ICT) and Traditional Method (T.M.) on the academic achievement of students with regard to their Intelligence and Socio-Economic Status (S.E.S.).

The present chapter deals with the design, description of the method and procedure adopted in this study. The steps followed by the researcher are discussed in brief as below:

1. Methods of the study
2. Population & sample
3. Variables (Dependent/Independent)
4. Tools used
5. Research Design
6. Procedure of Experimentation
7. The Statistical Techniques used

**III.1 METHODS OF THE STUDY :-**

Selection of research method depends upon the nature of the study and objectives to be achieved. The present study has been designed to compare
the effectiveness of two methods i.e. Traditional Method and of Information & Communication Technology in Science teaching. The nature of the study is experimental; therefore, experimental method has been followed in the present Study. The following points contribute to the justification of the proposed method of the study.

(a) In the study the cause and effect relationship has been established by manipulating control variables over the independent variables like Intelligence, Teaching Methods and S.E.S. (Socio-Economic Status). The changes which took place in the form of dependent variable are observed by giving achievement test at three Delayed Intervals.

(b) It tests the hypotheses by identifying functional relationship between/among dependent and independent variables.

(c) Experiment is the type of investigation where question can best be answered by obtaining data under deliberately created conditions. The only way to hold all variable constant except the dependent variable is to use two identical groups in the experiments, if the experimental group receives treatment i.e. of Information & Communication Technology and control group do not have any difference in the dependent variable. The findings of the study can be attributed only by the manipulation of independent variable(s).

(d) This method uses two identical groups for experiment. Biases were removed by selecting individuals at random from same population, using stratified random sampling technique.

(e) In the experiments certain conditions or variables are kept constant for all treatments; these conditions are termed as ‘controlled conditions or controlled variables’. The following four are considered as controlled variables in this study:
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>:</td>
<td>The students in the age group of 16-20 years were chosen for the</td>
</tr>
<tr>
<td></td>
<td>:</td>
<td>study.</td>
</tr>
<tr>
<td>(II).</td>
<td>Grade</td>
<td>: Students of only XII grade have been chosen for treatment of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the data.</td>
</tr>
<tr>
<td>(III).</td>
<td>Place of Instruction</td>
<td>: All the students were provided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>treatment (either by Traditional Method or ICT) in the similar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>classroom conditions of the school selected for experimentation.</td>
</tr>
<tr>
<td>(IV).</td>
<td>Content</td>
<td>: The same instructional material on the concept of Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“SOURCES OF ENERGY” was used for experimental and controlled</td>
</tr>
<tr>
<td></td>
<td></td>
<td>group students.</td>
</tr>
</tbody>
</table>
III.2 POPULATION :-

As the learning material (P.L.M. on Sources of Energy) was prepared in Science for class XII students, the population of the study constituted all the class – XII students (English medium) of Senior Secondary Schools of Bareilly District. The researcher administered two tools namely Intelligence Test developed by Dr. P. Shrinivasan –72, and Dr. Beena Shah S.E.S. test on randomly selected 20 student to see whether these students are well versed with Hindi and do not feel any difficulty in attempting these tests. None of the selected students expressed any problem in understanding the questions of these two tests.

To start the study the foremost work was to select the institutions which exhibit the characteristics of being part of the population and can supply adequate number of subjects for experimentation. The selection of schools was based on the criteria that schools should be recognized by C.B.S.E. (English Medium Sections), must have the provision of subject-wise teachers and fall within the surrounding area of ten kilometers from the place of study. Only the six Senior Secondary Schools (Table No.-T.III.1) could fulfill our criteria for selection. The students were selected from these schools as shown in the map of Bareilly District given on next page
Map Showing Location of Cities of Bareilly District from Where Sample has been Selected
Total No. of Students Selected for Sample: = 320

**TABLE NO. – III.1**
 Selection of Students of Class XIIth From Each of the School

<table>
<thead>
<tr>
<th>S. No</th>
<th>Name of the School</th>
<th>No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kendriya Vidyalaya NO.1 JLA</td>
<td>60</td>
</tr>
<tr>
<td>2.</td>
<td>Bishop Conrad Senior Secondary School</td>
<td>60</td>
</tr>
<tr>
<td>3.</td>
<td>St. Mary’s School</td>
<td>60</td>
</tr>
<tr>
<td>4.</td>
<td>Maharishi VidhyaMandir</td>
<td>60</td>
</tr>
<tr>
<td>5.</td>
<td>Bedi International School</td>
<td>60</td>
</tr>
<tr>
<td>6.</td>
<td>BBL Public School</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>360</strong></td>
</tr>
</tbody>
</table>

3.3. **PROCEDURE OF THE STUDY**:–

The procedure adopted in the present study can broadly be classified into two parts.

(a). **FIRST PART** :- Selection of students from the population.

(b). **SECOND PART** :- Conduct of experiment for the study.

3.3(a). **FIRST PART** :-
In this part of procedure, P. Srinivasan Group Test of Verbal-Intelligence Test was administered on all 360 students from six Senior Secondary Schools of Bareilly District, constituting our population. The following distribution was obtained:

(i) No. of students of High Intelligence = 137
(ii) No. of students of Low Intelligence = 124
(iii) No. of students of Average Intelligence = 261

The 99 students of Average Intelligence were excluded, as they were not required in the study. The remaining 261 students were then Science & Art group wise subjected to Dr. Beena Shah S.E.S. test. The result came out as under:

(A) High Intelligence group (137):

(A₁) No. of students having Low Socio-Economic Status (scoring 53 and below) = 64

(A₂) No. of students having High Socio-Economic Status (scoring 78 and above) = 36

(B) Low Intelligence group (124):

(B₁) No. of students having Low S.E.S. = 56

(B₂) No. of students having High S.E.S. = 62

Sixty students from each of the above groups (A₁), (A₂), (B₁) and (B₂) were than randomly selected, to make the total of subjects for our study 120 in number. Each of these four groups of 60 students each was further randomly distributed (by tossing coin) into two parts of 15 students each. This made the total number of groups for our experiment 8. One group of 15 students from each group was included in the experimental group for learning through the ICT Programmed
Instruction package and the other group was considered as control group. The 4 groups of 120 students each consisting the experimental and control group can be classified as below.

\( (C_1) \) Highly Intelligent and High S.E.S. students.

\( (C_2) \) Highly Intelligent and Low S.E.S. students.

\( (C_3) \) Low Intelligent and High S.E.S. students.

\( (C_4) \) Low Intelligent and Low S.E.S. students.

3.4 (b). SECOND PART :-

The researcher brought all the randomly selected students from the six Institutions. Bedi International School, Bareilly the researcher wrote personal letters of request to the parents of randomly selected students for allowing their wards for the experiment Bedi International School, Bareilly. Teacher/parents/guardians of subjects studying in other Schools co-operated with the researcher by allowing their wards to come at the School and to participate in the experiment.

**VARIABLES :-**

The following two types of the variables were used in this study:

(A). Independent Variable

(B). Dependent Variable

(A). **INDEPENDENT VARIABLES :-**

Independent variables are the conditions that experimenter manipulates or controls. The present study has following independent variables-
(1) **Level of Intelligence** :- Being attributed variables it cannot be altered and thus considered two level of intelligence i.e. High level of intelligence and Low level of intelligence.

(2) **Method of Instruction** :- It is a treatment variable and thus two methods of instructions i.e. Information & Communication Technology and Traditional Method were taken. Here, Traditional Method means question-answer method and other practices which are commonly used in normal class-room teaching in Indian schools.

(3) **Socio-Economic Status** :- It is an attribute variable therefore cannot be altered. For the present study two levels of Socio-Economic Status i.e. High Level and Low Level were taken.

(4) **Delayed Intervals** :- There are subsequent parallel achievement tests of equal difficulty levels were given after a definite interval of time (next day, after 15 days and after 30 days) to compare retaining power of student by different methods of teaching.

**(B). DEPENDENT VARIABLES :-**

Dependent variables are the measured changes in the pupil’s performance attributable to the influence of independent variables. The following dependent variables has been taken in the study-
**Achievement Scores** :- Achievement scores are those scores which are obtained by the students after getting instructions through the two teaching methods (ICT and Traditional Method).

**3.4.TOOLS TO BE USED** :-

After selecting the sample, the next step was to select suitable tools in order to achieve the objectives of the study. Various considerations such as time at the disposal of researcher, financial resources, availability of suitable tools according to Indian conditions were involved before final choice could be made about the selection of tools. The researcher selected two standardized tools namely Intelligence Test developed by Dr. P. Shrinivasan, and Dr. Beena Shah Socio-Economic Status (S.E.S.). Apart from it, the researcher prepared one ICT Programming in Science on “Sources of Energy” as well as one Achievement Tests of equal difficulty level. The descriptions of all the measuring tools are given below.

**(A).INTELLIGENCE TEST** :-

To ascertain the variable as High and Low Intelligence groups in the present experimental study an Intelligence test was administered on the selected students. The sample was taken by the stratified random sampling method. A Group Test of Intelligence Test developed by Dr. P. Shrinivasan was used in this study.

**Scoring** :-

There are 60 problems. Every problem has four alternative answers. Out of these four alternative answers one answer is correct while other three are incorrect. Allot one mark for correct answer and zero for the incorrect answer. Sum up all the marks and convert these raw scores into mental age. Then compute the I.Q. and interpreter in terms of category.
Description of the Scale :-

The need of a group test of mental ability decided to prepare such a test as could be given to a group of student in an average school. In this test there are only 60 items and maximum time for solving it is only 30 minutes.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Constituent</th>
<th>Total Time Allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Classification</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Analogy</td>
<td>30 min.</td>
</tr>
<tr>
<td>3.</td>
<td>Assigning artificial values to arithmetical sign</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Reasoning ability</td>
<td></td>
</tr>
</tbody>
</table>

Reliability :- The reliability of the test was found to be +0.78 to 86

Validity :- The validity of the test was found by correlating with the common criteria school examination marks. Ranged from +0.69 to +0.76.

( B) SOCIO-ECONOMIC STATUS:-To ascertain the High and Low Socio-Economic Status (S.E.S.) in the present experimental study a Socio-Economic Status (S.E.S.) test, developed by Dr. Beena Shah has been used (APPENDIX – II). A brief introduction of this test is given below.

Description of the Scale :-

The present scale of ‘Socio-Economic Status’ has been developed for literate people. At preliminary state fifteen areas of Socio-Economic Status were selected with the careful study of the relevant literature and from some popular tests in the
field. The final form emerged for the purpose of scaling. This form of the scale can be understood easily with the help of the following classification

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Area</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Caste*</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Occupation</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>Education</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Income</td>
<td>8</td>
</tr>
<tr>
<td>5.</td>
<td>Possession</td>
<td>6</td>
</tr>
<tr>
<td>6.</td>
<td>Social Participation</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total Area</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Total Items</strong></td>
<td><strong>29</strong></td>
</tr>
</tbody>
</table>

*Caste is one of the areas of ‘Social Status’ and is meant only for ascribed status. In achieved social status caste is not an area.

The subjects are asked to give response for father, mother and himself (case) separately in the scale.

**Administration :-**

It is a self-administering scale. It gives better results with individual testing rather than with group testing. In group situation the tester also can get quite appropriates results only after establishing good rapport with the tastes. The tester should discuss here the desire purpose; and should explain the description and instructions of the test. The instructions should be read loudly by the tester, while subjects read them silently along with him. There is no time limit for the tastes to record the responses in this scale ordinarily an individual takes about 10 to 15 minutes to record his responses.
Scoring :- The scoring of the scale is very easy. It is done with the help of printed scoring key. The score of an individual on the scale is the sum of scores of all areas’ items. Referred manual table 1,2,3, 4, and 5 for analysis of different types of status or the desired status of the study.

**Table-2 Status categories and scores on SES scale. Stanines**

<table>
<thead>
<tr>
<th>Category</th>
<th>I</th>
<th>II-III</th>
<th>IV-VI</th>
<th>VII-VIII</th>
<th>IX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>0.91</td>
<td>14.96</td>
<td>68.34</td>
<td>14.96</td>
<td>0.91</td>
</tr>
<tr>
<td>Scores</td>
<td>21 below</td>
<td>21-51</td>
<td>51-79</td>
<td>79-109</td>
<td>109 above</td>
</tr>
</tbody>
</table>

Reliability :-

The reliability of the revised scale has been calculated by test-retest method. The reliability coefficient correlation was found 0.76 of the scale as whole.

**Table-3 Reliability coefficients and Indexes of Reliability (test-retest method)**

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>N</th>
<th>R</th>
<th>RI</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 days</td>
<td>225</td>
<td>0.92</td>
<td>0.96</td>
</tr>
<tr>
<td>30 days</td>
<td>225</td>
<td>0.89</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Validity :- The content validity of the revised scale, since areas and then item are solely based on research proven items is high and promising.
Table 4- Correlation Coefficients between total SES scores and scores on its component variables.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>0.72</td>
<td>0.82</td>
<td>0.86</td>
<td>0.83</td>
<td>0.78</td>
<td>0.69</td>
</tr>
</tbody>
</table>

(C) ICTPROGRAMME :-

In the present study ICTProgramme on “Sources of Energy” in Science of XII grade students of Science Stream has been constructed and validate by the researcher himself (APPENDIX-III). The process of construction & validation is given below-

DEVELOPMENT OF I.C.T PROGRAMME :-

PREPARING A PROGRAMMED UNIT FOR THE STUDY :-

The analysis & structuring of the material is probably the most important aspect of programmed unit. For that he has to analyze the subject matter, analysis the contents and the skills involved so as to organize the component in an efficient order. He would make a list of the prerequisites skills and information’s (which is the entering behavior). The student going to take up the programme and the moderating of transitional concepts and final instructional goals or terminal behaviour. There are different procedure to analyze different subjects and topics. The precision and clarity of such analysis varies from programmer and from subject to subject. As such programming remains and individualistic and highly
diversified skill - half art and half science. Here are some steps which must be employed for developed a programme on any subject for researcher:

1. Study of syllabus.
2. A look at the aims and objectives of the subject matter and their task analysis.
3. Defining pre-requisite skills.
4. Decision of the type of programming that is ICT or branching to be employed.
5. Writing draft frames.
6. Critical evaluation of the programme by other teachers and dividing its frames in to suitable lessons.
7. Its class room tryout.
8. Determination of its error rate.

TO DESCRIBE BEHAVIOUR:-

(WHAT THE LEARNER WILL BE DOING)

1. Identify and name over the entire behavior act.
2. Define the improvement condition under which the behaviour is to occur (give and or restriction and limitation).
3. Define the criteria of acceptable performance. So here is a statement should show at the end of programme.

THE CHILD AFTER GOING THROUGH THE PROGRAMME :-

- Classification of sources energy.
- Renewable sources of energy
- Non-Renewable.

GENERAL PRINCIPLES IN THE DEVELOPMENT OF PROGRAMME :-
The whole approach of ICT Programmed based on certain principles. Success of the programme depends greatly upon the material used in it. The principles underlying the construction of ICT programmed learning sequences are the heart of the application of learning theory to programmed teaching. Here are some of the principles concerning the development of Information technology programme.

**SPECIFICATION OF TERMINAL BEHAVIOUR:**

The behaviour which ICT programme wants the students to perform at the end of the programme and must specify the kind of stimulus material is called the terminal behaviour in the teaching.

**REINFORCEMENT:**

It is a process of providing some type of reward to subjects for responding correctly to the item in display. It is the central process for the acquisition of behaviour.

**GRADUAL PROGRESSION:**

It is an important principle for taking the students from his initial state reparatory to the terminals once. The ICT programme moves in very finely graded steps, working with simple to higher and higher levels of complexity.

**PROMPTING:**

It is concerns with making the direct context of repetition. As Skinner (1959) has pointed out important goal is to enrich the student understanding by making his permute and recombine the element of behaviour.

**EDITING & REVISION:**
An important aspect of ICT Programmed sequence is its empirical nature where the teacher or programmer from the behaviour of the learner. If a student fails to learn it is a fault of programme not his. A fault should be modified, in order to ensure that is each successive revision the students’ performance is brought closer and closer to define terminal behaviour.

PERFORMANCE ASSESSMENT:-

2 The empirical nature of development of programme has demanded that the programme be accompanied by carefully prepared assessment test. These tests serve two purposes. First, they present quite specially a sample of terminal behaviour which the programme was designed to teach. Secondly, they show, on the basis of previous programme try out, what the expected achievement level of the programme should be.

DEVELOPMENT OF THE PROGRAMME:-

In this chapter, the various stages of ICT programme construction have been discussed as preparation of the ICT programme, writing of the frames of the programme and evaluation of the programme. In the present study, the researcher has developed Information Technology programme in the Science. The Information Technology Programme has developed on “Source of energy” in Science at Senior Secondary Level Hence, the various stages of programme

https://www2.ed.gov/pubs/OR/ConsumerGuides/perfasse.html
construction have been discussed. Preparation of the programme and its various steps, Writing of the programme and various steps. Evaluation of the programme and its various steps

**CONTENT ANALYSIS :-**

After having selected the topics, it becomes obligatory for the programmer to develop a suitable content analysis. The following analysis of the content, as shown in Table No.-T.III.2, on the “Source of energy” was made.

**TABLE NO – III.2**

**ANALYSIS OF THE CONTENT**

<table>
<thead>
<tr>
<th>SUB-TOPIC</th>
<th>ELEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Energy</td>
<td>Meaning, Sources of energy, characteristics of good fuel.</td>
</tr>
<tr>
<td>2. Classification of sources of energy</td>
<td>Renewable, Non-Renewable</td>
</tr>
<tr>
<td>3. Renewable Sources of Energy</td>
<td>(i) Solar energy, (ii) Wind Energy, (iii) water energy (hydro-energy), (iv) geothermal energy, (v) ocean energy, (vi) biomass energy</td>
</tr>
</tbody>
</table>
4. Non-Renewable Sources of Energy

(i) Coal
(ii) Oil
(iii) Natural gas

Advantages or Disadvantages of Non-renewable sources of energy

5 Conventional sources of energy

Meaning, Sources of energy, characteristics.

6. Geothermal Energy, Nuclear Energy, Nuclear Fusion reaction, Nuclear Fission reaction, Nuclear Fission reaction:

Meaning, Merits and Limitation

Advantages or Disadvantages

3.5 Sample of the Study

The researcher selected the institution from Bareilly Districts – Bedi International School. The sample was selected as two groups science and Art or cluster sampling. The total numbers of students for the programme in ICT and T.M. Were 120 and the total numbers Science and Art group. The schedule for field testing of the programme has been given in Table No – III.3:-

Table No. – T. III.3

Schedule for Field Testing of the Programme

<table>
<thead>
<tr>
<th>NAME OF THE INSTITUTION</th>
<th>TREATMENT</th>
<th>DATE</th>
<th>DAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table No. –III.3 depicts that on the first day of the experiment, the researcher gave an orientation talk to the students in selected institution and the experiment was also started the same day and continued for five days. On six day of the experiment, the achievement test was administered both the stream of Science and Art in this institution to find out the teaching programme.

The response sheets and the criterion test were collected from the students and scoring was done with the help of a key already prepared by the researcher. After scoring, for types of analysis have been attempted after field testing-

(D). ACHIEVEMENT TEST :-
In the present study one achievement tests in Science on the topic of “Source of energy” of XII grade students selected for three delayed intervals (Next Day, After 15 Days, After 30 Days), have been developed and standardized by the researcher. With the help of these achievement tests (APPINDEX-III) achievement scores in Science were taken.

**Construction and Standardization of Achievement Tests :-**

Achievement of an individual is one of the aspects for which evaluation procedures have been developed. Achievement tests attempt to measure what an individual has learnt i.e. his or her present level of performance. They are helpful in determining individual or group status in academic learning, placing, advancing or retaining of students at particular grade level.

Constructing and Standardizing of achievement test is treated as a hardest job because there are well established steps of test development which are to be followed. Standardization is highly sophisticated process requiring technical competency of highly quality, deep understanding of subject matter etc.

In the present research, the following steps for standardizing the one achievement tests were followed:

1. Planning of test.
2. Writing of test items.
3. Testing the tests
4. Preparing the final draft.
5. Establishing the test parameters (Reliability, Validity and Norms).
The planning of the standardized test were carried out in two steps as given below-

(a) Designing of the test

(b) Preparation of blue print

Here the researcher considered the purpose of the test and the student population for whom it was meant. The researcher also took in to account what has been taught and how. It was decided by the researcher to have multiple choice items as these were more convenient to analyses statistically and more over, they ensured hundred percent objectivity as well as easiness of scoring. These sets of decisions are called the design of the test. The purpose of preparing these achievement tests was to have three standard achievement tests of equal difficulty on the topic “Source of energy” to obtain the scores in Science at three delayed intervals (next day, after 15 days and after 30 days). This was done to eliminate the practice and learning effect and to have objective and scientific criterion variable.

The preparation of blue print refers to the final stage of planning of a test. Here the distribution of items has to be evolved so that these decisions are fully selected and can be easily implemented. The researcher decided the number of items to be prepared and the method of scoring. These decisions have helped the researcher for writing items. In other words it can be guide for writing items. The researcher, thus, finally selected 50 items through review scrutiny before they are selected for a preliminary tryout. The prepared preliminary draft was submitted to a small group of students (N=10) in order to verify the relevance of the test items. Finally the preliminary drafts of the one achievement tests were prepared.
III.6. RESEARCH DESIGN :-

Researcher design is the strategy of investigation conceived so as to obtain answer to research questions. The implicit purpose of all research designs is to impose controlled restrictions on observations of natural phenomenon. Practically speaking design is the general structure of the experiment and not its specific content. Researcher has to plan the design carefully for experiment so that the experiment on completion on fulfils the principles and objectives, its analysis where in, is a measurement for optimal statistical efficiency. The present study is a true experimental design as it includes the following steps.

III.6(A). Selection of Factors :-

A factor is a variable that the experimenter defines and controls so that its effect can be evaluated in the experiment. The term factor is used interchangeably with term treatment or experimental variable. It is also referred to as an independent variable which is manipulated by experimenter.

In the present study the instruction through Programmed Instruction constituted the experimental variable. The controlled variable was to provide instructions through Traditional Teaching Methods.

III.6(B). Selection of Criterion Measure:-

A choice of levels from among the large number in a design is a major decision on the part of experimenter. Present study had two criterion measures.

(a) **Criteria of Intelligence** :-

For identifying the students in two categories belonging to High and Low Intelligence, the researcher calculated \( Q_1 \) and \( Q_3 \) of the Intelligence scores of the
students. The calculation of $Q_1$ and $Q_3$ is given on next page in Table N: T.III4

**TABLE NO-III.4 Showing $Q_1$ & $Q_3$ of Intelligence Scores** (N=360)

<table>
<thead>
<tr>
<th>Class-Intervals (C.I.)</th>
<th>Frequency (f)</th>
<th>Cumulative-Frequency (Cf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>11-20</td>
<td>124</td>
<td>143</td>
</tr>
<tr>
<td>21-30</td>
<td>137</td>
<td>280</td>
</tr>
<tr>
<td>31-40</td>
<td>62</td>
<td>342</td>
</tr>
<tr>
<td>41-50</td>
<td>14</td>
<td>356</td>
</tr>
<tr>
<td>51-60</td>
<td>4</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td>360</td>
<td></td>
</tr>
</tbody>
</table>
The student who obtained 16 and below score out of 60 were put under the category of Low Intelligence (L.I.) and the student who obtained 30 or above score were put under the category of High Intelligence (H.I.). Thus, 124 students and 137 students were identified respectively under the category of High and Low Intelligence group.

**TABLE NO. –III 4 Showing Q₁ & Q₃ of S.E.S. Scores (N=261)**

<table>
<thead>
<tr>
<th>Class-Intervals (C.I.)</th>
<th>Frequency (f)</th>
<th>Cumulative-Frequency (Cf)</th>
</tr>
</thead>
</table>

**Calculation for Q₁**

For Q₁:

\[
Q₁ = l₁ + \frac{f}{N/4 - C} \times (N/4 - C)
\]

<table>
<thead>
<tr>
<th>l₁</th>
<th>l₂</th>
<th>f</th>
<th>N/4</th>
<th>C</th>
<th>Q₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.5</td>
<td>30.5</td>
<td>124</td>
<td>90</td>
<td>19</td>
<td>16.23</td>
</tr>
</tbody>
</table>

\[
Q₁ = 10.5 + \frac{124}{(90 - 19)} \times (71) = 10.5 + \frac{124}{710} \times 710 = 10.5 + 124 = 16.23
\]

**Calculation for Q₃**

For Q₃:

\[
Q₃ = l₁ + \frac{f}{3N/4 - C} \times (3N/4 - C)
\]

<table>
<thead>
<tr>
<th>l₁</th>
<th>l₂</th>
<th>f</th>
<th>3N/4</th>
<th>C</th>
<th>Q₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.5</td>
<td>30.5</td>
<td>137</td>
<td>270</td>
<td>143</td>
<td>29.77</td>
</tr>
</tbody>
</table>

\[
Q₃ = 20.5 + \frac{137}{(270 - 143)} \times (127) = 20.5 + \frac{137}{1270} \times 1270 = 20.5 + 137 = 29.77
\]
| 30-34 | 14 | 14  |
| 35-39 | 32 | 46  |
| 40-44 | 35 | 81  |
| 45-49 | 39 | 120 |
| 50-54 | 25 | 145 |
| 55-59 | 50 | 195 |
| 60-64 | 26 | 221 |
| 65-69 | 19 | 240 |
| 70-74 | 12 | 252 |
| 75-79 | 09 | 261 |

### Calculation for $Q_1$:

For $Q_1$:

\[
Q_1 = 1_{1+} \quad \frac{l_2 - l_1}{f} \quad (N/4 - C)
\]

- $l_1 = 39.5$
- $l_2 = 44.5$
- $f = 35$
- $N/4 = 65.25$
- $C = 46$

\[
Q_1 = 1_{1+} \quad \frac{44.5 - 39.5}{35} \quad (65.25 - 46)
\]

\[
= 39.5 + \quad \frac{44.5 - 39.5}{35} \quad (65.25 - 46)
\]

\[
= 39.5 + \quad \frac{5}{35} \quad (19.25)
\]

\[
= 39.5 + \quad \frac{5}{35}
\]

\[
Q_1 = 42.25
\]

### Calculation for $Q_3$:

For $Q_3$:

\[
Q_3 = 1_{1+} \quad \frac{l_2 - l_1}{f} \quad (3N/4 - C)
\]

- $l_1 = 59.5$
- $l_2 = 64.5$
- $f = 26$
- $3N/4 = 195.75$
- $C = 195$

\[
Q_3 = 1_{1+} \quad \frac{64.5 - 59.5}{26} \quad (195.75 - 195)
\]

\[
= 59.5 + \quad \frac{64.5 - 59.5}{26} \quad (195.75 - 195)
\]

\[
= 59.5 + \quad \frac{5}{26}
\]

\[
Q_3 = 59.64
\]
The students who obtained 60 and above were put under the category of High Socio-Economic Status (H.S.E.S.) whereas the students who obtained 42 and below scores were placed under the category of Low Socio-Economic Status (L.S.E.S.).

3.6 ( C ). **Treatment Combinations** :-

As the objective of the present study is to test the effectiveness of method of teaching on achievement of students and also its interaction with S.E.S. and Intelligence we have employed a 2x2x2x3 mixed factorial design with repeated measures on last variable. A factorial design is the structure of research in which two or more independent variables are juxtaposed to study their independent and interactive effect on dependent variables.

There are three types of experimental design i.e. between subjects design, within subject design and mixed design in the between subject design or repeated measures design each subject is observed under all treatment conditions involved in the experiment and in mixed design, some factors are between subject and some within subjects. To achieve our aims of studying the effectiveness of instructional use of ICT program in schools as against the Traditional Method, the researcher had two groups of subjects on the basis of Intelligence.

(i) The students of high Intelligence,

(ii) The students of Low Intelligence,

To enable us to see how the two treatments responded to two levels of Intelligence. Each Intelligence group (High and Low) was further divided into two sub-groups on the basis of S.E.S. i.e.:-

(i) High Socio-Economic Status,
(ii) Low Socio-Economic Status,

At this stage our 4 combinations were-

(i) High Socio-Economic Status & High Intelligence
(ii) Low Socio-Economic Status & High Intelligence
(iii) High Socio-Economic Status & Low Intelligence
(iv) Low Socio-Economic Status & Low Intelligence

Now the subjects in each of these combinations were divided randomly into two classes. One of them instruction was given through ICT and the other group was taught the same content by the Science and Arts groups traditional method with commonly used in class-room practices.

The scholastic achievement was obtained at different Delayed Intervals by using three parallel tests. The Delayed Intervals were varied as under-

- Next day.
- After 15 days.
- After 30 days.

In the present study two levels of Intelligence, two levels of S.E.S., two Teaching Methods and three Delayed Intervals were the variables used for the study, thus we have used 2x2x2x3 mixed factorial design with repeated measures on last variable i.e. Delayed Intervals.

A block diagram representing our 2x2x2x3 factorial design is given in figure as shown on the next page.
DISTRIBUTION OF SAMPLE

TOTAL SAMPLE (120)

Science (60)

ICT (30) T.M (30) ICT

HIGH I.Q (15) LOW I.Q (15) HIGH I.Q (15) LOW I.Q (15) HIGH I.Q (15) LOW I.Q (15)

NEXT DAY (D₁) 15 DAYS (D₂) 30 DAYS (D₃)

Art (60)

L.C.T (30) T.M (30)

HIGH I.Q (15) LOW I.Q (15) HIGH I.Q (15) LOW I.Q (15) HIGH I.Q (15) LOW I.Q (15)

NEXT DAY (D₁) 15 DAYS (D₂) 30 DAYS (D₃)
III.7 STATISTICAL TECHNIQUES USED :-

The present experimental study was conducted on the model of 2 x 2 x 2 x 3 factorial design for analyzing the main and instructional effects of four independent variables-Instructional Methods, Levels of Intelligence, Levels of Socio-Economic Status (S.E.S.) and Delayed Intervals.

The following statistical techniques have been used for data analysis-

(A) Mean

(B) Standard Deviation (S.D.)

(C) t-test

(D) Analysis of Variance (ANOVA)

(A).MEAN:--“The mean is the sum of the individual scores or measures divided by their number.”

$$M = \frac{\sum X}{N}$$

$$\sum X = \text{Sum of Individual Scores}$$
\[ M = \text{Mean} \]
\[ N = \text{Number of Scores} \]

**(B). Standard Deviation (S.D.) :-**

The Standard Deviation is the square root of the arithmetic average of the squared deviations of various values from their arithmetic mean. Standard Deviation (S.D.) of any series can be calculated from the following formula –

\[
\text{S.D.} = I \sqrt{\frac{\sum fd^2 - (\sum fd)^2}{N}}
\]

**SD** = Standard Deviation.

**I** = Class Interval

**\( \sum fd^2 \)** = Sum of the product the frequencies and square of deviation from assumed mean.

**\( \sum fd \)** = Sum of the product of frequencies and deviation from assumed mean.

**N** = Number of Scores.

**(C) t-Test**

In order to find out the significance of difference t-test was used. The formula for t-test is

\[
t = \frac{(M_1 - M_2)}{\sigma D}
\]

Where,

\[
\sigma D = \sqrt{\frac{\sum x_1^2 + \sum x_2^2 (1 + \frac{1}{n})}{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}
\]
\[(N_1 + N_2 - 2) \quad N_1 \quad N_2\]

- \(D\) = standard error of difference between means
- \(M_1\) = mean of one group
- \(M_2\) = mean of the other group
- \((M_1 - M_2)\) = difference between two means
- \(\sqrt{x_{12}}\) = sum of squares of the deviations from the mean for one group
- \(\sqrt{x_{22}}\) = sum of squares of the deviations from the mean for the other group
- \(N_1\) = Number of persons in one sample
- \(N_2\) = Number of persons in the other sample

(D). Analysis of Variance (ANOVA):-

Three way of analysis of variance (ANOVA) technique was used to study the main effects and interaction effects.

Analysis of Variance (ANOVA) TABLE:--

The analysis of variance table used in the present study has been provided in following table.

**THE TABLE OF ANOVA USED IN THE ANALYSIS OF DATA:**-

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>df</th>
<th>Sum of Squares (SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – Intelligence</td>
<td>A - 1</td>
<td>SS_A</td>
</tr>
<tr>
<td>Category</td>
<td>Formula</td>
<td>SS</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
<td>-----</td>
</tr>
<tr>
<td>B – Teaching Method</td>
<td>B - 1</td>
<td>SS\textsubscript{B}</td>
</tr>
<tr>
<td>C - SES</td>
<td>C - 1</td>
<td>SS\textsubscript{C}</td>
</tr>
<tr>
<td>D – Delayed Interval</td>
<td>D - 1</td>
<td>SS\textsubscript{D}</td>
</tr>
<tr>
<td>Error (b)</td>
<td>Abcd(n – 1)</td>
<td>SS error</td>
</tr>
<tr>
<td>Between subject</td>
<td>Abcd - 1</td>
<td>SS\textsubscript{bs}</td>
</tr>
<tr>
<td>Error(w)</td>
<td></td>
<td>SS error CW – SS ous(w)</td>
</tr>
<tr>
<td>Within subject</td>
<td></td>
<td>SS\textsubscript{W}</td>
</tr>
<tr>
<td>Total</td>
<td>abcd - 1</td>
<td>SS\textsubscript{1}</td>
</tr>
</tbody>
</table>

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