CHAPTER-III

DESIGN AND PROCEDURE

Methodology of research depicts the general pattern for organizing the procedure for gathering data for investigation. This chapter presents the description of the design employed, variables involved, setting the population, sample, tool used, procedure followed for data collection, statistical techniques, precautions and constraints.

3.1 DESIGN OF THE STUDY

The present study is experimental in nature. The objective of the present study is to see the effect of IT-Enabled Instructional Package (ITEIP) and Gender (Independent Variables) on achievement in Science (Dependent Variable) among class X students. In this study, the investigator has employed Pre-test Post-test Control Group Design. Instructional treatment was studied at two levels namely experimental group (E) which was taught Science (Biology) through IT-Enabled Instructional Package (ITEIP), and control group (C) which was taught through conventional method. The design comprised of three phases has been given in Table3.1.

Table-3.1
Design of the Study

<table>
<thead>
<tr>
<th>Treatment Phases</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test Phase</td>
<td>Measurement of 1. Intelligence 2. SES 3. Achievement in Science(Biology)</td>
<td>Measurement of 1. Intelligence 2. SES 3. Achievement in Science (Biology)</td>
</tr>
<tr>
<td>Treatment Phase</td>
<td>Teaching Science through IT-Enabled Instructional Package (ITEIP) for 6 weeks</td>
<td>Teaching Science through Conventional Method for 6 weeks</td>
</tr>
<tr>
<td>Post-test phase</td>
<td>Measurement of Achievement in Science(Biology)</td>
<td>Measurement of Achievement in Science(Biology)</td>
</tr>
</tbody>
</table>
I. Pre Phase

In this phase, students were administered to intelligence test and socio-economic status. After that all the students of two groups (E, and C) were administered achievement test in Science developed by the investigator herself.

II. Treatment Phase

In this phase, all the students of experimental group were taught Science (Biology) through IT-Enabled Instructional Package (ITEIP) and students of control group were taught through conventional method for six weeks. In the present study, the independent variable instructional treatment was varied at two levels as shown in Fig. 3.1 below:

![Instructional Treatment]

Fig. 3.1: Instructional treatment and its levels

III. Post Phase

In this phase, all the students of all the two groups were again administered through achievement test in Science to know the impact of IT-Enabled Instructional Package ITEIP on their achievement. A comparison was made to study the effect of instructional treatment on scholastic achievement in Science of tenth grade students in relation to gender.

3.2 VARIABLES INVOLVED

In the experimental research, the effect of independent variable on dependent variable has been studied. Independent variables are the cause while dependent ones are the effects. Besides, there are some intervening variables also. All these three kinds of variables, identified for the study have been mentioned below:
Dependent Variable
The dependent variable or the criterion variable used in the current study was Achievement in Science (Biology).

Independent Variables
For the present study, the independent variables were IT-Enabled Instructional Package (ITEIP) and Gender.

Intervening Variables
Different intervening variables in the present study are type of school (English medium private schools affiliated to CBSE Board), grade of class (X), subject to be taught (Science), intelligence of students (moderate intelligence) and socio-economic status (middle SES level) of students, which were controlled up to greatest extent to equate the sample or to form the matched group.

3.3 POPULATION
A population is any group of individuals that have one or more characteristics in common that are of interest to the investigator. It may be all the individuals of a particular type or a restricted part of that group. The population of the study comprised of Class X students studying in English medium private schools (affiliated to CBSE Board) located at Gohana city of Sonipat District.

3.4 SAMPLE
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 known as sample. The sample for the present study was selected through Multistage Random Sampling Technique. At first stage of the sampling, the investigator has obtained the list of private schools affiliated to CBSE board located in Gohana city. After this, by using lottery method two English medium private schools namely Bal Bharti Vidyapeeth Sr. Sec. School & Satyanand Public School were selected for the purpose of the present study. Each school was having three sections of X class. At second stage, two sections of X class {Sec-A (38), Sec-B (42)} of Bal Bharti Vidyapeeth Sr. Sec. School and two Sections {Sec-A (39), Sec-B (41)} of Satyanand
Public School were taken. In this way 160 students have been selected. The sample (160) was equated on the basis of socio-economic status (middle level) i.e. students belonging to middle level (63 to 54) and their intelligence (moderate) i.e. students of moderate intelligence ($87 \leq IQ \leq 112$) were taken. At the end, 140 students (70 from each school) were taken as the final sample of the study. Remaining 20 students of very high & low intelligence and socioeconomic status were not considered for the present study. However they were made sit along with other students in the class so that their feelings may not get hurt. By keeping in view the feelings of the parents and students, one school was treated as Experimental group (Bal Bharti Vidyapeeth Senior Secondary School) and the other school was treated as Control group (Satyanand Public School). The detailed description of the sample is given below in Table 3.2.

<table>
<thead>
<tr>
<th>Group</th>
<th>Name of School</th>
<th>Class</th>
<th>No. of Students Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Bal Bharti Vidyapeeth Sr. Secondary School, Gohana</td>
<td>X</td>
<td>70 35 from Sec. A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35 from Sec. B</td>
</tr>
<tr>
<td>Control</td>
<td>Satyanand Public School, Gohana</td>
<td>X</td>
<td>70 35 from Sec. A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35 from Sec. B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Total Sample</strong> 140</td>
</tr>
</tbody>
</table>

### 3.5 TOOLS USED

Following tools were used for the purpose of collecting data related to different variables covered in the study:

**A. Standardized Tests**

1. General Intelligence test (GIT) by Mohsin (1990) to measure the intelligence of students.
2. Socio-Economic Status Scale developed by Kalia and Sahoo (2010).

**B. Self Developed Tools**

1. Opinionnaire for Effectiveness of IT-Enabled Instructional Package (ITEIP)
2. Achievement Test in Science (Biology) to measure the achievement of students in Science.
3. IT-Enabled Instructional Package in Science (Biology).
A. STANDARDIZED TESTS USED

1. General Intelligence Test (GIT)

General Intelligence Test (GIT) by S. M. Mohsin (1990) was used to determine the intelligence level of students (Appendix-A). It is verbal intelligence test made for students of age group 9-15 years. It consists of 156 items under 6 sub-tests. These items pertain to logical reasoning, analogies, similarities, odd-one out and language ability. The time limit for this test is 40 minutes.

Reliability

The reliability of the test by split-half method is .68 and by test-retest method is .89.

Validity

The validity of this scale was determined by finding correlation of scores with those on the following standardized tests. With a view to ascertaining validity co-efficient of the general intelligence test along with the Menjel’s general intelligence test is .54 and Terman’s arithmetic reasoning test is .63, Raven’s matrices is .65.

Administration

This test can be administered individually as well as in group. Before distributing the test booklet, investigator should develop rapport with students and give some instructions to them. Students should be told about the purpose of the test. The investigator should tell the subjects that the booklet contains very entertaining questions, which they have never faced ever before. These questions have not been taken from their books. And they need no preparation for answering them. This test is different from class test. There are three or four alternative answers for each question and a, b, c, d are written along with these alternative answers. They have to decide which answer is correct and put a tick mark on that answer. After giving the instructions to students test booklets should be distributed to the students. The students should be asked to write identifying data on the top of booklet. Then all the necessary instructions should be given to students in accordance with the instructions given in manual for sub-test 1 to help the students to understand them properly. After finishing the sub-test 1, investigator should explain instructions for 2nd sub-test and ask to complete it. All the remaining sub-tests should be completed in the same way. Time limits should be strictly adhered to.
Scoring
There are six scoring keys for each sub-test. The total weightage of each item can be counted and recorded as raw scores. The raw scores can be converted into normalized IQ scores by following the method of finding IQ. The method is that 100 is to be added to the difference between the score obtained by a person and the norm for the classificatory group (age or class) in which he falls. The obtained value is the IQ for the person. Thus IQ = Obtained Score - Norm (Age or class) + 100. For example a testee aged 13 years obtained the score of 79. The norm for his age is 93. His IQ = 79 - 93 + 100 = 86. He excels 25% of the testees of his age. The IQ may be interpreted qualitatively by referring to the following grades and description.

<table>
<thead>
<tr>
<th>Grade</th>
<th>IQ</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 20%</td>
<td>129 or above</td>
<td>Very Superior</td>
</tr>
<tr>
<td>Next 20%</td>
<td>113 to 128</td>
<td>Superior</td>
</tr>
<tr>
<td>Middle 40%</td>
<td>87 to 112</td>
<td>Average</td>
</tr>
<tr>
<td>Next 29%</td>
<td>69 to 87</td>
<td>Inferior</td>
</tr>
<tr>
<td>Bottom 10%</td>
<td>68 or under</td>
<td>Very Inferior</td>
</tr>
</tbody>
</table>

2. Socio-Economic Status Scale
Socio-Economic Status Scale developed by Kalia and Sahu (2010) was used (Appendix-B). This scale is constructed for urban population. This scale was preferred by the investigator because all the essential variables which determine the socio-economic status in a modern society were included in the scale and it was the latest scale according to the prevailing circumstances. Also the directions were simple & clear and the scoring of the test was easy.

Reliability
Co-efficient of reliability was calculated by test-retest method and split-half method. The reliability co-efficient, using split-half method was found to be 0.71 for Hindi
version and 0.68 for English version. The reliability co-efficient, using test-retest method was found to be 0.89 for Hindi version and 0.86 for English version.

**Validity**

To assess the validity of the scale, manifold criteria were set. Content validity was found on the basis of examination by the experts and was ranked as sufficiently high. The face validity of the test was also found to be high on the basis of same criterion as was adopted for content validity. Criterion validity was found on the basis of simultaneous administration of the present scale with the socio-economic status scale by Rajbir Singh, Radhey Shyam and Satish Kumar and correlation between the two was calculated. Both the scales correlated significantly to the tune of \( r=0.85 \).

**Administration**

The administration of the scale was quite easy. The printed scale was given to the students and the purpose the instrument was explained. The students were made to sit in such an arrangement so that they may not discuss anything with their peers. They were told that the information given by them will be kept secret and will be used for research purpose only. They were asked to put a tick (\( \checkmark \)) against the statement which fit them. There was no time limit for completing the scale.

**Scoring**

The scoring of the scale was done (as per manual) by counting the numbers given in the ticked columns and then added for both A and B part. It consisted of raw score which was directly used and the students of middle SES (63 to 54) have been taken in the present study for analysis.

**B. SELF DEVELOPED TOOLS**

1. **Opinionnaire for Effectiveness of IT-Enabled Instructional Package**

   Opinionnaire for effectiveness of IT-Enabled Instructional Package (ITEIP) has been developed by investigator herself (Appendix -C). The prime aim of conducting this research venture is to assess the usability of the developed IT-Enabled Instructional Package in Science. Usability can be defined as “a measure of the ease with which a system can be learnt or used, its effectiveness and efficiency, and attitude of its users towards it.” Based upon this definition, the usability of Package could be measured by
how easily and effectively a specific user can use this Package, given particular kind of support, to carry out a fixed set of tasks, in a defined set of environments. The aim of usability testing is to identify problem area, and the extracting of information concerning problems, difficulties, weaknesses, and areas for improvement. IT-Enabled Instructional Package should be enjoyable to use and aesthetically pleasing to users. Elements including cueing, color, graphical images, animation, and sound in the interactive multimedia can motivate the users and increase satisfaction. The investigator has developed the IT-Enabled Instructional Package in science for class X and this opinionnaire is made to obtain the information regarding effectiveness of the Package. It is consisted of the three sections according to different weight age given to each:

**Presentation of Content** contains ten statements, second section i.e **Utility for Students** contains 15 statements and third section **Utility for Teachers** contains 10 statements. The method of assessment of each parameter is based on three points scale i.e. A: stands for Agree; DA: stands for Disagree; UD: stands for Undecided.

**Planning of the Scale**

Planning stage of framing scale focuses on the areas to be covered by the scale which may also include the listing of items and the objectives of the scale. This stage was very important because it threw light on the core areas of the multimedia teaching package. The scale under reference was planned for the subject experts and technical experts with the objective of seeking their opinion on the statements of the IT-Enabled Instructional Package in Science for class X. The planning stage aims at:

- Determining the purpose of the Scale;
- Identifying and defining the intended teachers' opinion;
- Preparing the scale specifications; and
- Constructing relevant items for the scale.

For constructing scale, the objectives were outlined from IT-Enabled Instructional Package of selected units of Science text book of class X.

**Preparation of Scale and first try-out**

45 statements were framed to elicit the views of teachers on a three point rating scale. The preliminary draft of Scale was framed and given to science teachers, computer
teachers and experts from Education Dept. After showing the IT-Enabled Instructional Package (ITEIP) individually, they were requested to give their opinion about the language and appropriateness of items based on the ITEIP. Only those items were selected which were having 80% unanimity. 35 statements constituted the scale after first try-out.

Validity

The scale was given to seven subject experts and technical experts and they made a few suggestions which were incorporated; it was widely accepted by the subject experts and technical experts whose responses further established the validity of the scale.

Administration

After the acceptance of final draft, the Scale was filled up by the10 subject experts for various educational institutions from North India providing the required information in different columns. They had to tick the right column where their opinion was sought. They also had to tick the one of three columns (agree/disagree/undecided) as per their choice. The subject experts were requested to provide clear and concise information which in turn help to understand the effectiveness of Multimedia Teaching Package in Mathematics.

Scoring

All the items of the scale are positively worded. Items are given a score of ‘1’, ‘0’, and ‘None’ for ‘Agree’, ‘Disagree’ and ‘Undecided’ respectively. The sum of these values gives the effectiveness of developed multimedia teaching package in mathematics. The total score varies from 0 to 35 showing least effective to highest effectiveness of IT-Enabled Instructional Package. At the end of the scale, a column for remarks was made for further suggestions.

2. Achievement Test in Science (Biology)

According to Ebel (1979) achievement test refers to a sample of indicator of students knowledge taken at a particular point of time. It can also be thought as the assessment of the outcomes of formal instruction in cognitive domain (Dwyer 1972). It helps both the teacher and students in accessing learning readiness, monitoring learning progress, diagnosis learning difficulties and evaluating learning outcomes. To achieve the
objectives of the present study, an achievement test in Biology was constructed by the investigator from four chapters of Biology discipline of X grade Science syllabus. It was employed to assess the previous knowledge of the students in the content to be taught and to measure the final achievement of the students, after teaching the contents. Different steps followed in developing the test are written below:

**Planning of the test:** Planning stage of the test tries to answer what content area is to be covered by the test? What types of items are to be included in the test and what are the objectives that are going to be tested? Stanley and Hopkins (1979), observed that the planning stage of a test should include the nature of test and test items and the statement of conditions under which it will be administered. The achievement test was planned with the objectives of measuring achievement in Science (Biology) of X grade students on selected topics. According to ‘Grounlund’ (1988) the planning of achievement test takes into account of:

a) Determining the purpose of test.

b) Identification and defining the intended learning outcomes.

c) Preparing the test specifications.

d) Constructing relevant test items.

**Objectives of the Test:** For the purpose of constructing achievement test, objectives were defined in behavioral term from selected units of biology. Textbook of class X prescribed by CBSE Since the major concern here was to test the academic achievement, according to it was decided to test the poor major areas of cognitive domain i.e. knowledge, understanding, application and skill. After determining objectives, the learning outcomes were stated as observable terminal performance. In test specifications were developed covering the objectives and subject matter selected to be taught during the experiment.

**Content of the Test for Biology:** To decide the weightage to be given to different content areas, objectives and different form of questions, expert opinion of the concerned science teacher was taken into consideration. For the purpose of constructing Achievement Test, objectives were defined in behavioral terms from selected units of Science textbook of class X prescribed by CBSE board. Since the major concern here
was to test the academic achievement, accordingly, it was decided to test the three areas of cognitive domain, i.e., knowledge, understanding, application and skill. Keeping in view the objectives, content and type of items a blue print was prepared as shown in given table 3.4. The weightage given to the different instructional objectives and content is given in the table 3.5 and also shown through pie charts in Fig.3.2 and 3.3.

Table 3.4
Blue print of the Achievement test in Science (Biology) for X Class

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition</td>
<td>MCQ</td>
<td>True / false</td>
<td>Fills in the blanks</td>
<td>MCQ</td>
</tr>
<tr>
<td>Nutrition</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Respiration</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Transportation</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Excretion</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>5</td>
<td>6</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 3.5
Weightage to Instructional Objectives /Learning Outcomes & Content/topics

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Unit</th>
<th>Instructional Objectives</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knowledge</td>
<td>Understanding</td>
<td>Application</td>
</tr>
<tr>
<td>1.</td>
<td>Nutrition</td>
<td>12</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Respiration</td>
<td>10</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Transportation</td>
<td>8</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Excretion</td>
<td>6</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>36</td>
<td>40</td>
<td>19</td>
</tr>
</tbody>
</table>

Note: MCQ = Multiple Choice Questions
Preparation of the Test

• Preparation of the test items: 110 objective type items fill in the blanks and true/false with wide range of difficulties were constructed from four units of Biology in science syllabus prescribed by CBSE for class X grade. Item were prepared in conforming to blue print. While constructing items it was ensured that no objective remained untested and language of test items was understandable and unambiguous and instructions were clear. The test items were arranged in order of difficulty. The test item were arranged properly and assembled into the test. Easy items was given a place in the beginning and difficult items towards the end. The preliminary draft of achievement test was
given to ten expert in education, which include expert in measurement of evaluation experienced science teacher and teacher educators. They were requested to give their opinion about the language and appropriateness of the items. Only those items were selected which were having 80% unanimity. Items that were having difficult language were modified to simple language finally 70 items were constituted the achievement test.

- **Preparation of direction to test item:** Appropriate directions to test items were prepared. The directions were clear and concise, so that the students understand them easily. Test has objective type, true/false and fills in the blanks types questions. Clear instructions were given at the beginning of each section.

- **Preparation of direction for administrations:** A clear and detailed direction as to how the test is to be administered were provided.

- **Preparation of direction for scoring:** To facilitate the objectively in scoring, scoring keys were prepared.

**Preliminary tryout:** After preparing the test items and scoring key, preliminary draft was administered on a sample of 30 students to find out the ambiguity and adequacy of language. It also helped to detect the omissions or mistake if any, to examine whether the directions to items were actually being followed by students and to examine whether the time allowed was sufficient or not. The problem faced by the students was noted and as a result of preliminary tryout 15 questions are modified.

**Tryout:** The purpose of final tryout was to provide data for determining the discriminating value of item. This also helped to determine the number of item to be included in the final form of the test. The number of the subject in the final tryout was raised to 185. In the preliminary tryout the number of teachers was kept low because the clearing of instructions and the language was to be judged. In the final tryout the number of subjects has to be increased because the investigator had to use the data for item analysis. The achievement test was administered to X class students individually who have already studied the content. No time limit was fixed for tryout the test. In average students took 90 minutes to answer all the questions. Try out stage is given in (Appendix-D)
Scoring: After the final tryout the answer sheet were rechecked as per the scoring keys and scoring directions already prepared by researcher one mark was designed to each correct answer and zero to incorrect answer. Scoring key is given in (Appendix-D-1.)

Item Analysis: The following steps were followed for the item analysis.

1. All the 185 sheets were arranged in the descending order from highest score scripts at the top to the lowest scores ones at the bottom.

2. The 50 upper scripts with highest scores were selected and labeled as "upper group". The 50 scripts with lowest scores were labeled as "lower group" and the middle group of the scripts was set aside. The top 27% of 185 students (50 answer sheets) and bottom 27% were taken into the consideration for computing internal discrimination index and difficulty value. The middle 46% of the total no. of answer sheets were kept aside.

Difficulty Value

After the formation of two groups, the number of correct responses to an item in each group was marked and tabulated. The difficulty in answering of an item is indicated by the total number of students, who answered it correctly. The larger will be the total number, the easier will be the item. Item difficulty was estimated by determining the percentage of students, who answered the item correctly. The percentage was converted into proportions. The average of the proportions of correct responses on each item in the two end groups was taken to be an estimate of the difficulty value of that particular item. This point of view is supported by Guilford (1954). Formula for computing the difficulty value ‘dv’ of each item was:

\[ dv = \frac{P_U + P_L}{2} \]

Where

- \(dv\) = difficulty value of the items.
- \(P_U\) = proportions of correct responses to the items from the upper group.
- \(P_L\) = proportions of correct responses to the items from the lower group.

Internal Consistency Discrimination Index (rb)

The relationship between the total scores derived from a test and item scores are referred to as internal consistency discrimination index (rb) of an item. This was found
by reading the bi-serial coefficient of correlation between item and total score from the J.C. Flanagan's abac (Appendix-D-2). Flanagan's abac was designed for use, when the sample has been restricted to the highest and lowest 27% of the total score distribution and middle 46% of the examinees of the total score have been eliminated. The proportion of examinees passing the item in the upper criterion group was read on the ordinate and the corresponding proportion from the lower criterion group was read on the abscissa. The value of the coefficient rb was read at the intersection of perpendiculars at these values. When the difficulty values and the internal consistency discrimination indices of each item had been determined, as stated above, items for final draft were selected. The list of the items showing ‘dv’ and ‘rb’ are given in Appendix-D-3.

Item Selection for Final Draft

Final selection of the items was made on the basis of difficulty value and discrimination index of each item. Lindman (1971) emphasized that easy items should be introduced in a test in order to encourage the students of low ability and some difficult items should be included to challenge the abler students. However, in the interest of constructing a measuring instrument of maximum quality and utility, items were selected whose difficulty value lies in the range .30 to .79. The investigator selected most of the items of medium difficulty and a few of higher and lower difficulty values were also included. Garrett (1967) regarded those items satisfactory which are having validity indices of 0.20 or more. Thorndike (1955) considered an item with a validity co-efficient as high as 0.25 as an outstanding 'valid' item. Grounlund (1988) states, “Zero discrimination power (0.00) is obtained, when an equal number of students in each group answer correctly. Negative Discrimination power is obtained, when more students in lower group answer correctly than the students in the upper group. Both types of items should be removed from norm-referenced tests. The distribution of the items finally selected according to dv and rb has been given in Table 3.6.
Table 3.6
The Distribution of Difficulty Value (dv) and Internal Consistency Discrimination Index (rb) of All the Items

<table>
<thead>
<tr>
<th>Difficulty Value (dv)</th>
<th>F</th>
<th>Discrimination Indices (rb)</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>.00-.09</td>
<td>01</td>
<td>.00-.09</td>
<td>8</td>
</tr>
<tr>
<td>.10-.19</td>
<td>05</td>
<td>.10-.19</td>
<td>32</td>
</tr>
<tr>
<td>.20-.29</td>
<td>03</td>
<td>.20-.29</td>
<td>06</td>
</tr>
<tr>
<td>.30-.39</td>
<td>10</td>
<td>.30-.39</td>
<td>16</td>
</tr>
<tr>
<td>.40-.49</td>
<td>23</td>
<td>.40-.49</td>
<td>21</td>
</tr>
<tr>
<td>.50-.59</td>
<td>15</td>
<td>.50-.59</td>
<td>10</td>
</tr>
<tr>
<td>.60-.69</td>
<td>16</td>
<td>.60-.69</td>
<td>08</td>
</tr>
<tr>
<td>.70-.79</td>
<td>20</td>
<td>.70-.79</td>
<td>08</td>
</tr>
<tr>
<td>.80-.89</td>
<td>14</td>
<td>.80-.89</td>
<td>01</td>
</tr>
<tr>
<td>.90-.99</td>
<td>03</td>
<td>.90-.99</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td></td>
<td>110</td>
</tr>
</tbody>
</table>

Ebel’s (1979) criteria and guidelines for categorizing discriminating indices is a widely quoted set of guidelines given in Table 3.7 was used in this test analysis.

Table 3.7
Ebel’s Guidelines (Discriminating Powers)

<table>
<thead>
<tr>
<th>Discriminating powers</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.40 and above</td>
<td>The item is functioning quite satisfactorily</td>
</tr>
<tr>
<td>Between 0.30-0.39</td>
<td>Little or no revision is required</td>
</tr>
<tr>
<td>Between .20-0.29</td>
<td>The item is marginal and needs revision</td>
</tr>
<tr>
<td>&lt;.19</td>
<td>The item should be eliminated or completely revised</td>
</tr>
</tbody>
</table>

Based on the Ebel’s guidelines in the above table, the 60 test items were categorized as shown in the Table 3.8 and Table 3.9.
Table 3.8
Distribution of Discrimination Powers of the all Items of Achievement Test

<table>
<thead>
<tr>
<th>Discriminating Power</th>
<th>Frequency</th>
<th>Item Numbers</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>.40 and above</td>
<td>48</td>
<td>2,4,7,8,10,15,16,19,21,22,23,36,38,41,43,44,48,51,53,61,62,64,66,67,70,72,73,74,76,77,79,81,82,83,84,85,86,87,88,89,90,91,96,99,100,104,106,108</td>
<td>Very Good Items</td>
</tr>
<tr>
<td>.30-.39</td>
<td>16</td>
<td>9,14,17,25,29,30,34,42,46,52,71,92,97,102,103,105</td>
<td>Reasonably Good</td>
</tr>
<tr>
<td>.20-.29</td>
<td>06</td>
<td>26,27,35,49,57,60</td>
<td>Needs Improvement</td>
</tr>
<tr>
<td>&lt; .19</td>
<td>40</td>
<td>1,3,5,6,11,12,13,18,20,24,28,31,32,33,37,39,40,45,47,50,54,55,56,58,59,63,65,68,69,75,78,80,93,94,95,98,101,107,109,110</td>
<td>Very Poor Items</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.9
Bi-variate Scatter Diagram for Achievement Test in Science (Biology) between Difficulty Value (dv) and Discrimination Index (rb)

<table>
<thead>
<tr>
<th>dv</th>
<th>rb</th>
<th>.00-.09</th>
<th>.10-.19</th>
<th>.20-.29</th>
<th>.30-.39</th>
<th>.40-.49</th>
<th>.50-.59</th>
<th>.60-.69</th>
<th>.70-.79</th>
<th>.80-.89</th>
<th>.90-.99</th>
</tr>
</thead>
<tbody>
<tr>
<td>.00-.09</td>
<td></td>
<td>69</td>
<td>39,75</td>
<td>68</td>
<td></td>
<td></td>
<td>3,31,37</td>
<td>59</td>
<td>6</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>.10-.19</td>
<td>47,80,95</td>
<td>11</td>
<td>95</td>
<td>12</td>
<td>78,28,40,45,50,56</td>
<td>54,55</td>
<td>24,63,93,101,109</td>
<td>13,58</td>
<td>1,20,33,65,94,98,110</td>
<td>18,107</td>
<td></td>
</tr>
<tr>
<td>.20-.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35,49,57</td>
<td>26,27,31</td>
<td>32,60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.30-.39</td>
<td>71</td>
<td>102</td>
<td>46,105</td>
<td>9,30,42</td>
<td>25,92,97</td>
<td>17,29,34,52</td>
<td>14,103</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.40-.49</td>
<td>44</td>
<td>66,70</td>
<td>23,104,106</td>
<td>19,96</td>
<td>15,99</td>
<td>10,16,22,41,61,62,64,91,108</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.50-.59</td>
<td>72,74</td>
<td>48,67</td>
<td>36,38,53</td>
<td>8</td>
<td>43,76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.60-.69</td>
<td>73</td>
<td>77,81,84</td>
<td>7,88</td>
<td>21,100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.70-.79</td>
<td>85,86</td>
<td>82,87,89,90</td>
<td>51,83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.80-.89</td>
<td></td>
<td></td>
<td>79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.90-.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It is revealed from Table-3.9 and 3.10 that 48 items have discriminating power .40 or above, hence these were selected in the final draft, 22 items have D.P. range from .20 to .39. These were revised, modified and included in the final draft. The remaining 40 items having discriminating power below .19 were rejected. Test items having discriminating power from .20-.39 were modified in the light of clarity of language, complexity of content and difficulty level of items. The language was made more simple and understandable. Vague items were made more specific. Directions for attempting the items were made clearer.

**Reliability**

The investigator has used split-half methodology for estimation of reliability. The items in a test have been split into two tests that are equivalent in content and difficulty. It has been done by splitting among odd and even numbered items. Investigator has found 0.90 as the calculated value of Reliability coefficient, which means 90% of the variance of test scores is true-score variance, and only 10% error variance. So, we can say that achievement test is fairly reliable as per general guidelines for interpreting test reliability given below in Table 3.10.

**Table 3.10**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Reliability coefficient value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0.90 and up</td>
<td>Excellent</td>
</tr>
<tr>
<td>2.</td>
<td>0.80 – 0.89</td>
<td>Good</td>
</tr>
<tr>
<td>3.</td>
<td>0.70 – 0.79</td>
<td>Adequate</td>
</tr>
<tr>
<td>4.</td>
<td>below 0.70</td>
<td>May have limited applicability</td>
</tr>
</tbody>
</table>

**Validity**

The purpose of the present investigation and the nature of the test items restricted the use of very exhaustive statistical techniques to validate the test. The test was validated against the criterion of **Content Validity**. The Content Validity is concerned with the adequacy of sampling of a specified universe of content. To determine Content Validity the test items and a list of outcomes were given to the panel consisting of five experts in subject matter and three experts in test items. The panel was asked to identify which test
item corresponded to which outcomes. The experts agreed with the researcher on the assignment of test items to objectives 95% of time. The percentage was taken as evidence of Content Validity.

**Final Form of Test**

After the selection of items for final test, items were rearranged. On the cover page of the test, directions were printed. The scoring key for the final test was also prepared and has been given along with the final form of the Science (Biology) Achievement Test, which contained 70 items (Appendix-D-4 and D-5). The time limit for the final test was 70 minutes. Number of items retained in the final draft of Achievement Test according to different cognitive levels of objectives have been given in Table 3.11 and have also been depicted in the form of pie chart given below in Fig 3.4.

**Table 3.11**

*Number of Items Retained in the Final Draft of Achievement Test*

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Unit</th>
<th>Instructional Objectives</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knowledge</td>
<td>Understanding</td>
<td>Application</td>
</tr>
<tr>
<td>1.</td>
<td>Nutrition</td>
<td>8</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Respiration</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Transportation</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Excretion</td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
<td>26</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>35.7%</td>
<td>37.14%</td>
<td>15.71%</td>
</tr>
</tbody>
</table>
3. IT-ENABLED INSTRUCTIONAL PACKAGE (ITEIP) IN SCIENCE

Investigator had gone through three different phases during development IT-Enabled Instructional Package and these were Selection of Subject Matter, Analysis of Subject Matter and Development of IT-Enabled Instructional Package (ITEIP).

![Fig.3.5: Phases of Development of IT-Enabled Instructional Package](image)

Different Phases of development of multimedia instructional material are presented in the Fig. 3.5. Each of these phases had a number of stages that were organized in sequence.
1. **Selection of Subject Matter**

The subject matter of class X Science as prescribed by CBSE syllabus was selected to develop the package. From whole syllabus of class X Science, the investigator selected four main units of Biology i.e. **Nutrition, Respiration, Transportation and Excretion** for the development of IT-Enabled Instructional Package as presented in Fig.3.6. Due to time constraint, it was very difficult to develop the package for whole science syllabus so investigator select only four units of Biology. The purpose of selecting this content was that the instructional objectives with the three domains i.e. knowledge, understanding, application and skill could be covered in these topics in a simple, logical and systematic manner.

![Fig.3.6: Selected Units of Science for the Development of ITEIP](image_url)

2. **Analysis of Subject-matter**

After selection of the subject matter, the investigator had analysed it in the form of sub-units and chapters, so that it should become simple, motivational and highly informative. The content was divided into 12 sub-units, so that each unit may be covered in the pre-determined duration. Care was taken to place each sub-unit in a logical and psychological sequence. Students were likely to learn more if the material is presented in a simple & correct sequence. So, the investigator further divided the sub-
units into chapters. Chapter-wise content specification has been given in Table-3.12. Planning for learning sequence was done in a logical order.

Table-3.12
Chapter-wise Content Specification

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiration</td>
<td>Introduction to Respiration, Types of Respiration, Respiration in Plants, Respiration in Fishes, Human Respiratory System, Activities in Respiration (Fermentation and Carbon-dioxide activity.</td>
</tr>
<tr>
<td>Transportation</td>
<td>Introduction to Transportation, Transportation in Plants, Kinds of Transportation in plants, Mechanism of Transpiration, Activity of Transpiration, Blood and Lymphatic system, Structure and working of Human Heart, Mechanism of Blood Circulation, Blood-Pressure</td>
</tr>
<tr>
<td>Excretion</td>
<td>Excretion and Osmoregulation, Excretion in Plants, Excretion in Animals (Amoeba, Earthworm), Excretion in Human beings, Function of Nephrons, Renal system, Renal Failure and Technology for Survival, Dialysis</td>
</tr>
</tbody>
</table>

3. Development of ITEIP

After collecting all the necessary material, the investigator developed the IT-Enabled Instructional Package. The job of development of package has been carried out in six steps presented in the form of flow diagram in figure 3.7.
I Selection of Appropriate Technological Tools

The investigator has planned about appropriate technological tools for each media element such as graphics, text, audio, video, animation and interactivity for each learning experience. She has selected required hardware and software for the production of each element of IT-Enabled Instructional Package. The software such as **Swish 2.0, Adobe Photoshop, Adobe Illustrator, Adobe Sound Booth, Frutiloop, Adobe After Effects and Microsoft Word 2007** have been used for the development of the Package. Swish 2.0, the main software used in the package is the successor of Swish, a tool created by Djj holdings PTY ltd using Adobe (at that time Macromedia) license to export flash files. Opposite to Adobe Flash (the tool not the format), Swish 2 uses its own defaults text animations that can be customized or applied to objects such as pictures or vector based images with some basic scripting commands rather than the complex but great action scripting from Adobe Flash. It goes beyond providing advanced draw tools and new scripting commands for creating a complete flash website. It also let you import swf, wav and mp3 files and have its own set of command to control each one, flash content can be controlled as an instance (a movie part of another movie), audio files can be started, paused, looped and stopped during the main movie timeline or stand alone. It creates professional looking animation in few minutes and its user friendly interface, easy even for first time users.
II Script Designing

The investigator had designed the script by using all the necessary elements required for the development of IT-Enabled Instructional Package i.e. Text, Graphics, Audio, Video and Animation, which are explained below:

**Text:** Text has played an important role in development of ITEIPs. The extent to which text have been used in ITEIP depends upon three major factors i.e. nature of the ITEIPs, the subject/content and treatment of the subject/content. Text has been used in ITEIPs for different purposes like Titles text, Body text, Menu and Miscellaneous text etc. The design of each particular text depends upon its appearance in the slide. For example, the title texts were bigger in size and employed brighter colours than body texts.

![Fig. 3.8: Layout of the Text](image)

Designing text involved two basic aspects of information that were-Content (content covered the matter that was being presented) and Display (display covered how that matter was being presented). The three parameters that controlled the display design of multimedia text were-Fonts, Font colours and Background. It was noticed that while the font affected the profile of the displayed texts, colours and background affected the overall appeal of the same. The textual content was consisting of topics, sub-topics, definitions, figures, diagrams examples and multiple choice questions with positive
feedback. The layout of the text used in unit-nutrition of the package is given in the figure 3.8 as shown above.

**Graphics:** Graphic in multimedia represent a collective terminology that includes still images, photographs, figures and other artwork used in ITEIP. It does not include any entities with dynamics and movements like animation and videos. Graphic used in ITEIPs were kept as simple and appealing and fittingly captured the mood of the title. They were developed in exact concurrence with other forms of media presented like texts videos so that all these elements fitted together as one seamless stream of information. The still images related to the content were collected from various resources like Internet, Text Books, and Magazines etc. The images which have been downloaded from Internet were firstly modified with the help of Adobe Photoshop and then were used in the package as per the requirement of the topic. Images which could not be assessed on the Internet were taken from various text books in scanned form. Pictures were also shoot as and when the need was felt and have been used to cover various aspects of the selected topics. Figures and diagrams used in slides were made by the investigator herself with the help of Adobe Photoshop. A period of approximately four months was spent in this process. The layout of graphics used in the package is given in the form of figure 3.9:

![Diagram showing presence and absence of starch in leaf samples with sunlight exposure](image-url)

Fig.3.9: Layout of Graphics
Audio: Audio plays a vital role in the making of an ITEIP. It is used in all the slides of package. Adobe Sound booth software was used for this purpose. It has been put in the form of natural sound, music, and narrations. The audio used in the package was recorded by the investigator herself in own voice and it needed great effort and expertise. The three major steps of audio input were: 1) Sound recording 2) Sound editing 3) Sound delivery.

- **Sound Recording:** It was done taking all the precautions like when microphone based recording was done, a place was selected with least noise disturbance from outside. After the recording got over the stop button was pressed and the sound file was saved on computer using one of the media players.

- **Sound Editing:** sound editing demanded even more expertise than the sound recording. Effective sound editing demanded a great deal of creativity and timing. After recording the whole voice over, the investigator edited the sound to enhance the quality and reduce the noise. For this purpose, good quality of instruments like head phones were used by the researcher at a quiet place which was free from noise and disturbance.

- **Sound Delivery:** After that it was cut into small fractions in the form of WAV format, so that they can be separately added with each slide. The addition of Human voice in the package has made it more interesting and fascinating. Similarly the background music and suggestive music (happy, sinister depending upon the nature of the package) given in beginning slides and practising slides made the Package more effective. About four weeks were spent in the whole process of voice over.

Videos: Video has been delivered using media player. Video proved to be an effective supplement to text and images and provided enhanced experience. In the IT-Enabled Instructional Package (Nutrition, Respiration, Transportation and Excretion) video clipping have been used to explain different topics.

Animation: Rapidly changing the image on the screen to create the illusion of motion is called animation. It was used by the investigator for showing biology concepts like process of nutrition and photosynthesis, visualizing 3D structures like human digestive system, human heart and respiratory system, also in science experiments.
(photosynthesis experiments, fermentation activity) etc. The above mentioned elements i.e. text, and graphics were lastly animated by the investigator with the help of software Swish 2.0. The level of animation was kept high and low as per the requirement of the content and level of the students. The use of animation in IT-Enabled Instructional Package was highly stimulating and brought the feeling of participation in the whole process. The viewers were completely involved and remained active. It also helped in the retention of the attention of the viewers.

III Integration of Elements of IT-Enabled Instructional Package

All the necessary elements being used in script designing have been integrated for the development of ITEIP which is also shown in Fig. 3.10

![Fig. 3.10: Layout of Developed IT-Enabled Instructional Package](image)

IV Assessment of IT-Enabled Instructional Package by Experts

Special emphasis was given by investigator on this step. After making the rough format, the package was shown to the subject as well as technical experts of Central Institute of Educational Technology (CIET), NCERT, New Delhi, and Educomp smart class coordinators and subject-teachers of various schools. After getting valuable suggestions from eminent professors the investigator made necessary changes in the package before finalization. An opinionnaire was also developed by investigator to check the effectiveness of IT-Enabled Instructional Package. Views of various subject experts
regarding validity of Package were taken through this scale. The description of the tool is already given above. The percentage of assessment of this tool by subject experts was found to be above seventy percent.

V Final Shape of IT-Enabled Instructional Package

After assessment of IT-Enabled Instructional Package by experts, the investigator has given the final shape to the package by incorporating suggested changes.

3.6 PREPARATION OF LESSON PLANS

After the development of IT-Enabled Instructional Package in Science, 24 lesson plans were developed for the students of class X to teach the selected content of Science (Nutrition, Respiration, Transportation, and Excretion). Lesson plan is a detailed plan prepared by the teacher in advance for the daily teaching. It helps the teacher in systematic and effective teaching. There is no one “best way” to plan lessons. Regardless of the form or template, there are fundamental components of all lesson plans that one should learn to write, revise, and improve. During lesson planning, besides keeping in mind the abilities, interests and needs of students, logical order of the content was also taken care of. Instructional objectives were written for each unit of the package and developed in terms of the observable outcomes expected from learners (given in Appendix-E). It is to be mentioned that for teaching the experimental group students IT-Enabled Instructional Package have been used as Instructional material and for students of control group, lesson plans structured according to the conventional method were used. Appropriate learning conditions were utilized while designing lessons and provisions for desired instructional event were made. The lessons were arranged properly in sequence relating to their pre-requisites. A copy of lesson plan on unit “nutrition” is given in Appendix E-1.

In the present study, the investigator has followed Herbartian Approach which is based on Apperceptive Mass Theory of Learning. This theory is based on the notion that new experience and knowledge is assimilated to and transformed by the past experiences of an individual to form a new whole. In short it is to perceive new experience in relation to past experience. The following steps of Herbartian approach i.e. preparation;
presentation; comparison or association; generalization, application and recapitulation were being followed by the investigator while developing lesson plans in science for the present study.

**Preparation**
This step is concerned with the task of preparing the students for receiving new knowledge. In preparation, nothing new is taught to students. At this stage the investigator made sure of what the pupils already know, by putting a few questions, based on the pupils previous knowledge. In general, with the help of this step, she checked the students entering behavior before she starts teaching the lesson. This step has helped in achieving the aim of testing previous knowledge, developing interest in the minds of students and maintaining curiosity of the students.

**Presentation**
It is the key step and only through which the actual process of teaching is going to take place. The ultimate aim of the presentation was to make the concepts understandable to the students. Hence the investigator has developed the subject matter by using ITEIP so that her pupils may clearly and readily grasp it. With the help of package, appropriate examples & illustrations for demonstration and explanation of the concepts made the understanding of the students better. The interest of the students on the subject matter has been maintained continuously by the way of asking questions from time to time in this stage.

**Comparison or Association**
At this stage, the facts observed by the students have been compared with another concept by way of giving examples. With the help of package, the students were encouraged to give new suitable examples for the concept instead of the examples given in the book to make them think in an innovative manner.

**Generalization**
This step is concerned with arriving at some general ideas or drawing out the necessary conclusions by the students on the basis of the different comparisons, contracts and associated observed in the learning material present by the teacher. The investigator had
given the task of formulation to the students by keeping herself in the background for providing only necessary guidance and correction.

**Application**

In this stage, the investigator made the students to use the understood knowledge in an unfamiliar situation. Unless the knowledge of science is applied in new situations or in our day-to-day life, the study of science will become meaningless. This application of scientific principles uses to strengthen learning and make the learning permanent.

**Recapitulation**

This stage is meant for the teachers to know whether students have grasped and understood these concepts taught or not. At the end of the lesson, the investigator reviewed the lesson by asking questions from the students. For this purpose, formative evaluation has been carried out with the help of multiple choice questions (MCQ). The MCQs were asked in a healthy & positive manner with proper feedback. After this, students were given home work and practical assignments.

### 3.7 EXPERIMENTAL PROCEDURE

The subjects in the present study were 140 X class students from the two English medium private schools affiliated to CBSE board of Gohana city. For the Experimental Group, which was subjected to IT-Enabled Instructional Package, a total of 70 students were taken from Bal Bharti Vidyapeeth Sr. Secondary School, Gohana. The control group which was exposed to conventional method of instruction, was also consisted of 70 students chosen from Satyanand Public School, Gohana and hence no novel treatment was given. The investigator studied literature and books on multimedia strategies deeply and consulted various experts for the execution of multimedia learning strategies. Hence all the lessons for all groups were taught by the investigator herself.

The experiment was conducted in three phases:

- **Phase I**: Administration of the Pre-Test
- **Phase II**: Conducting the Instructional Programme
- **Phase III**: Administration of the Post-Test

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The first phase has involved pre-testing of all the students of two groups on the following scale/test: (a) Achievement Test in Science (Self-developed) (b) Socio-Economic Status Scale developed by Kalia and Sahoo (2010) (c) General Intelligence test (GIT) by Mohsin (1990). The second stage consists of Experimental treatment of Six weeks. The experimental treatment was consisted of teaching Science to class X with ITEIP to experimental group and through conventional method to control group. During the third stage i.e. post-test stage, the students were post-tested on achievement in Science just after the treatment so as to determine the effect of treatment. A detailed description of the design of the experiment has been given in the table 3.13.

**Table 3.13**  
*Description of Experimental Procedure*

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Phase</th>
<th>Duration</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
</table>
| 1.    | Pre-Test | 7 Days   | 1. Achievement Test in Science(Biology)  
2. Socio-Economic Status Scale  
3. General Intelligence test | 1. Achievement Test in Science(Biology)  
2. Socio-Economic Status Scale  
3. General Intelligence test |
| 2.    | Treatment| 6 Weeks  | Teaching Science with IT-Enabled Instructional Package  | Teaching Science through Traditional Method            |
| 3.    | Post-Test| 2 Days   | Achievement Test in Science(Biology)                   | Achievement Test in Science(Biology)                  |

1. **Pre-Test Phase**

Before the start of the experiment, subjects were contacted and rapport was established with them. They were oriented to the tests to be used with them and also with the methodology of the treatment to be followed viz. IT-Enabled Instructional Package and conventional method. In the very beginning, Intelligence test and Socio-Economic Status Scale were used to equate all the groups in terms of socio-economic status and intelligence level. After this achievement test in Science (Biology) was administered to the students of both the groups. The investigator himself with co-operation of class teachers administered all the tests. The instructions pertaining to the tests were
explained verbally in clear terms to the students before administering the test. The administration of these tests was carried out as per norms and instructions contained in their manuals. Separate response sheets were provided. The answer sheets were scored with the help of scoring key. The scores in achievement test indicated the previous knowledge possessed by the students. This all took time of Seven days.

2. Conducting the Instructional Programme

To find the effectiveness of the treatment variable, the instructional treatment was manipulated in the form of teacher directed instructions followed by using self-developed ITEIP to the experimental group. The instructional treatment was given for about six weeks, which included 12 sub-units, twenty four chapters and twenty four formative tests to experimental group, whereas the control group was taught through conventional method only. Same content was taught to both the groups. The treatment was conducted by the investigator herself in both groups so as to avoid teacher variable and maximum precision.

Teaching through IT-Enabled Instructional Package (ITEIP)

Students of experimental group were given an orientation lecture about IT-Enabled Instructional Package in the beginning of experiment. Students were motivated to learn through the novel method of instruction and were encouraged to participate in the experiment by explaining the objectives. The lessons were presented by the teacher through self developed ITEIP. The teacher taught the lessons on the guidelines of prepared lesson plans as explained above in section 3.6 to achieve the formulated objectives. The teacher well explained the complex concepts of science like Photosynthesis experiments (Sunlight, Chlorophyll, CO₂) specially working of Heart, Human Digestive System, Functions of Nephron, process of Respiration in human beings through videos in ITEIP. It was very easy for students to understand these concepts in a stimulating way. The complex system of animals like Amoeba, Paramecium, Fishes and Earthworm has also been well elucidated by the teacher. Proper feedback was given to students to motivate and reinforce them positively. Following the teacher instruction, students were evaluated at the end of each lesson with the help of Multiple Choice Questions (MCQ) designed appropriately accordingly to the
topic. As a result, a total of 24 lesson plans were delivered in 6 weeks to Experimental Group.

**Conventional Method of Teaching**

On the other hand, for teaching students of control group, conventional method based on whole class teaching was used. In this setting, regular instructional method - unit presentation and tests were used. For control group, same books and curriculum objectives were retained as in experimental groups. The lecture-cum-demonstration method, laboratory method and activity method frequently applied in science lessons throughout the world were used. The method includes explaining the concepts, doing the experiments, demonstration of materials like leaves, specimens, transpiration activity etc. During the application procedure, sufficiently many activities were performed in line with course objectives, and the stages of experiment were explained in detail. Meanwhile, the students under control group were given the opportunity to ask questions to clarify the parts that they could not understand. For each question the teacher provided an appropriate solution. Later, an activity was performed by the students in class as well as in laboratory according to the need of topic. While the students were trying to perform the activity, the teacher walked among the students and helped the students make their own corrections. In science drawing the diagrams with appropriate labeling is very important part. To develop drawing skill among students they are asked to draw the well labeled diagrams in their note-book first. After that blackboard test was taken to draw diagrams by the students. At the end of lesson, the students were given homework and practical assignments which were discussed the next day in class.

**3. Post-Test Phase**

Immediately after the treatment was over, the subjects were assessed on criterion measures on Science (Biology) to know the effect of treatment. The Achievement Test in Science (Biology) was administrated to both the experimental and control group. The same criterion test as taken in pre-test was taken. Both the groups of sampled students were subjected to those post-test. In this way, post-test scores were obtained on achievement test in Science of both the groups.
3.8 STATISTICAL TECHNIQUES EMPLOYED

To achieve objectives of the study, the data collected was statistically analyzed by using the following techniques:

1. Descriptive statistics such as mean and S.D. were worked out on the scores of achievement.

2. Two way Analysis of variance (ANOVA) with 2x2 factorial design was employed to study the main effects and interactional effects of independent variables (treatments and gender) on dependent variable (Science Achievement) supplemented by t-test. To test the assumption of homogeneity of variance for ANOVA, Hartley's test was employed.

3. To test the assumption of homogeneity of variance for ANOVA, Hartley’s test was employed.

3.9 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.

1. 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.

2. Both the experimental and control group were taught by the investigator herself to avoid any variation.

3. 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.

4. It was ensured that the topics on contents of treatment had not been previously taught to the class tenth students in both the experimental and control groups.

5. During instructional treatment, attempt was made to stick to limits of the specific teacher directed instructions in both groups and not to deviate from the steps made in lesson plans of the treatment during execution.

6. 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.

7. Separate sheets for achievement tests on Science (Biology) were provided to every student.
student during experimentation so as to avoid any indiscipline or chances of unfair observations.

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

3.10 CONSTRAINTS FACED DURING EXPERIMENT

During the process of data collection, the researcher faced some difficulties during experiment which are mentioned as under:

1. It was quite an effort to convince the Principal and teachers about importance of the experiment to make them agree to cooperate in the experiment. The investigator contacted the authority and briefed about the programme and its usefulness.

2. It is an essential requisite for every experiment that the treatment should be provided to every student. It was ensured that pupils of both the groups are attending school regularly.

3. Some difficulty was faced during orientation of total procedure before students. They were taking it very lightly in starting. But with passage of time and keen efforts, the investigator succeeded in maintaining the interest of students in the experimental treatment. The students were very curious to perform experiments in class with enthusiasm.

4. The experiment had to be adjusted as per the time-table of the students of class tenth. Even the time-table in-charge was contacted for making some changes in the regular time-table.

5. Difficulty was also faced in managing resources for the experimental treatment i.e. smart classroom, LCD projector, speakers etc. The researcher convinced the authority for all the technical support.

6. The multimedia method of instruction through ITEIP takes more time in setting up and winding up. So the school computer teacher was used for help.

7. Students have serious misunderstanding about biochemical concepts, even concerning the basic scientific content related to nutrition and circulatory system.

8. Students face problems in nutrition, respiration, transportation and excretion terminology, students may get confused because terms look and sound very similar.
9. Sometime students do not understand the concept due to ineffective teaching in the classroom. In Indian classroom, most of the teachers adopt lecture methods. But concepts of various life processes are not easily understood by lecture method.

10. Many teachers are not adept at using quick sketches to explain certain content, or in drawing diagram. Some do not possess a big enough knowledge-base to link scientific content with day to day life example.

Despite these constraints the researcher carried out the experiment very smoothly to study the impact of teaching through IT-Enabled Instructional Package in science on academic achievement of tenth class students.

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