CHAPTER-IV

DESCRIPTION OF TOOLS

For the present study following tools were selected and developed:

4.1 Standardized Tests

4.1.1 G.C. Ahuja Group Test of Intelligence (GGTI) by Dr. G.C. Ahuja (2005)

4.1.2 Socio-Economic Status Scale –Urban and Rural (SESS-UR) by Prof. A.K. Kalia and Mr. Sudhir Sahu (2012)

4.1.3 Science Attitude Scale (SAS) by Avinash Grewal (1990)

4.2 Self-Developed Tools

4.2.1 Multimedia Instructional Package (MMIP)

4.2.2 Life Science Achievement Test (LSAT)

4.2.3 Multimedia Instructional Package Opinionnaire for Teachers (MMIPO T)

4.2.4 Multimedia Instructional Package Opinionnaire for Students (MMIPOS)

4.1 STANDARDIZED TESTS

4.1.1 Group Test of Intelligence (GGTI) by G. C. Ahuja (2005)

Intelligence level of the subjects was assessed using G. C Ahuja Group Test of Intelligence developed by Dr. G. C Ahuja.

i. Purpose of group test of intelligence:

Purpose of group test of intelligence is to assess the general mental ability of subjects of age 13 to 17 years studying in English medium secondary schools. The test was developed by Dr. G. C Ahuja in a manner to reduce, as much as possible, the influence of cultural climate and educational level.
ii. Format of the test (Test booklet and the Answer sheet):

There are 135 items in the test booklet which are distributed in eight sub-tests as shown in the table-4.1.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Sub-test</th>
<th>No. of Items</th>
<th>Time Limit (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Following Directions</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>Classification</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>Analogies</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>Arithmetic Reasoning</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>Vocabulary</td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>VI</td>
<td>Comprehension</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>VII</td>
<td>Series</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>VIII</td>
<td>Best Answer</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>135</td>
<td>32</td>
</tr>
</tbody>
</table>

In addition to 135 test items 24 practice examples are also there in the test booklet. The answer sheet is of six pages. At the space meant for each subset, the first column is for practice examples. The subject has to mark the practices examples there only. The test problems are to be marked in second and third columns adjacent to that of first column. Total testing time for all the eight subsets is 32 minutes.

iii. Reliability & Validity of GGTI:

a. Reliability: Reliability of G. C Ahuja Group Test of Intelligence (GGTI) Scale estimated by two methods:
   - The Test-retest method: The retesting was undertaken after an interval of six months on a sample of 599 pupils (309 boys and 290 girls). The
reliability coefficient by this method was found to be \(0.84 \pm 0.021\) which represents a high correlation.

- **The Split-half method:** To apply this method a sample of 518 pupils (303 boys and 215 girls) was taken from four randomly selected English medium Secondary schools. The scores of all these subjects were split into two parts each. One containing odd and the other containing even items. The coefficient of correlation between scores on odd and even items was found to be \(0.974 \pm 0.003\), which is a very high correlation and hence is very dependable.

**b. Validity:** The practical or empirical validity of the test was studied by following methods:

- **Scholastic Marks:** The coefficient of correlation between annual examination results of 90 students (59 boys and 39 girls) studying in class XI from two randomly selected English medium schools was found to be \(0.53 \pm 0.075\).

- **Teacher’s Judgement:** For every individual student, teacher’s judgement were obtained from four different teachers on a seven point scale. The coefficient of correlation between the test scores and the sum of the four ratings was found to be \(0.60 \pm 0.040\).

- **With other tests:** Coefficient of correlation between the test scores of Dr. G H Nafde’s Non Verbal Test of Intelligence and the present test was found to be \(0.50 \pm 0.044\).

**iv. Scoring of GGTI:**

Scoring was done with the help of stencils provided with scale. Stencils were so adjusted that the page numbers were visible through the holes of the scoring stencil. Then the correctly marked answers were visible through the holes. Correctly marked answers were counted and written in the left margin against each sub-test of that page. If more than one alternatives were marked by the subject, it was to be considered wrong. The scores from different pages of answer sheet were transferred in a table on the front page and added, then according to norms of the scale manual, table 5 and table 6 were used to get intelligence level.
4.1.2 Socio-Economic Status Scale- Urban and Rural (SESS-UR) by Prof. A. K. Kalia and Sudhir Sahu (2012)

i. Description of Scale

This scale of socio-economic status is designed to measure social position of a person in urban and rural areas with 40 items in all. It is a verbal scale. This scale has been developed both in English and Hindi languages for urban/rural household. It is easy to be administered and acknowledge the social position of an individual in the society. Scoring process of S.E.S. scale is easy and objective. To get the total S.E.S. scores, the researcher is required to count the S.E.S. Scores of the answers options mentioned in the square box, which has been ticked (✓) by the respondent. In this way it saves time, money and labor.

ii. Administration of the Scale

This scale comprised of 40 items of five different areas/dimensions of socio-economic status viz. (i) socio-cultural component (ii) economic component (iii) possession of goods and services (iv) Health component (v) Educational Component. There is no limit for filling this scale. But it takes approximately 20-25 minutes for completing it. While administering S.E.S. scale following precautions should be kept in mind:

- A proper seating arrangement should be made for the respondents in a peaceful environment.
- A minimum facility of writing material should be arranged for respondents.
- All instructions mentioned in the test booklet should be loudly read out by the test administrator.
- Respondents should be instructed to give their responses only on consumable test booklet.
- Test administrator should motivate the respondents for free and frank responses by establishing proper rapport with them.
- All doubts should be clarified before the start of the test.
- Before collecting the response sheets, the test administrator should ensure that all the test items have been answered by the respondents.
iii. Reliability of S.E.S. Scale

Reliability of the scale has been measured by split-half and test-retest method. Results given in table-4.2 indicate that the scale is highly reliable.

Table: 4.2
Split-Half and Test-Retest Reliability of Socio-Economic Status Scale

<table>
<thead>
<tr>
<th>English Version</th>
<th>Hindi Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split-half Method</td>
<td>Test-Retest Method</td>
</tr>
<tr>
<td>.68</td>
<td>.86</td>
</tr>
</tbody>
</table>

iv. Validity of S.E.S. Scale

All the 40 items of SESS have been evaluated by the various experts. The investigator has established content validity while preparing the preliminary draft of SESS. Expert opinion of teacher educators and language specialists with regard to relevance of each items was ought. For this, a copy of final draft of SESS was given to nine experts who have been directly or indirectly involved in research. The expert opinion came out to be favorable in terms of the relevance of each item in the scale. The criterion validity was measured by correlating it with SESS by Prof. Rajbir Singh, Dr. Radhey Shyam and Dr. S. Kumar (2006) and it came out to be 0.85 which is highly significant.

All 40 items (including caste and academic stream) were analyzed to measure internal consistency of the SESS through Pearson’s product moment, Kendall’s tau correlation and spearman’s rho correlation method. Coefficient of correlation is highly significant in not of the dimensions except only in one dimension i.e. health component due to presence of some items with negative scores.

v. Scoring of Socio-Economic Scale

The scoring of S.E.S. scale is easy and objective. To find out the total score in S.E.S., the examiner should add the scores where the respondent has put a check (✓) as his/her response. A separate scoring key has been developed to facilitate the scoring of SESS. Total scores for SESS are obtained after adding scores from
information given by the respondent to part A and responses given to all the items (1-40) of part-B of the test booklet.

4.1.3 **Science Attitude Scale (SAS) by Avinash Grewal (1990)**

i. **Description of Scale**

   This scale was developed by Avinash Grewal. The scale consisted of 20 items distributed among 10 positive items and 10 negative items. The students are required to indicate degree of favorableness to items on a 5-point scale; ‘strongly agree’, ‘agree’, ‘undecided’, ‘disagree’ and ‘strongly disagree’.

   The SAS is a dependable tool for measuring student’s attitude towards Science. It appears to be useful for teachers of Science, guidance workers and research scholars. It can be used by the curriculum specialists to measure the outcomes of teaching Science. The students of Psychology and Education can also use it to study the development of their attitude towards attitudes.

ii. **Reliability of SAS:**

   The reliability of the Science Attitude Scale (SAS) was estimated by the split-half (0.86) and test-retest (0.75) methods which was found to be quite satisfactory. This compares favorably with reliability (0.765) found by Sood (1975) for his scale of attitude towards Science and scientists. Reliability of the scale was further checked by two methods of scoring by administering the scale to a small sample of 50 subjects with instructions to check the statements in accordance with the usual Thrustone’s instructions and the Science subjects were then asked to check for each item on one of the five alternatives in accordance with the usual Likert instructions. The coefficient of correlation found between the scores on two scales was 0.94.

iii. **Validity of SAS:**

   The SAS appears to have content validity and the method of selecting items supports his supposition. In addition, differences in mean scores were found among the selected groups of known preference for Science i.e. Arts (Mean = 46.41) and Science (Mean = 50.58) students which is highly significant (t=6.62) at 1% level.

iv. **Scoring:**

   Each of the ten positive items (S. Nos. 2, 4, 6, 8, 10, 12, 14, 16, 18, 20) of the scale are assigned a weight ranging from 4 (Strongly Agree) to Zero (Strongly Disagree).
Disagree). In the case of ten negative items (S. Nos. 1, 3, 5, 7, 9, 11, 13, 15, 17, 19) the scale scoring is reversed ranging from (Strongly Agree) to 4 (Strongly Disagree). The attitude score of a subject is the sum total of scores on all the twenty items of the scale. For each student a total score on the scale can be obtained by summating his scores for the individual items. Thus a maximum of 80 scores can be obtained by a subject.

v. **Time for administration:**

The SAS is a self-reporting inventory consisting of 20-items designed to assess the attitude of individuals towards Science. There is no time limit but normally it takes about 5 minutes to explain the test and the subjects require about 15 minutes for giving responses to the items of the scale.

4.2 **SELF-DEVELOPED TOOLS**

4.2.1 **Life Science Achievement Test for Class- X (LSAT-X)**

A test is designed to measure the knowledge gained, after a period of training or teaching. An achievement test is intended to measure the outcomes of learning in relation to the objectives of learning the subject. Achievement testing refers to the assessment of the outcomes of formal instruction in cognitive domain (Dwyer, 1982). It can also be thought of as a sample of indicator of a student’s knowledge taken at a particular point of time (Ebel, 1972). So the test consists of items based on objectives. The individual is expected to answer the test usually within a prescribed time. The total score of an individual in an achievement test gives an index of his/her ability. It aids both the teacher and the students in assessing learning readiness, monitoring learning process, diagnosing learning difficulties and evaluating learning outcomes (Gronlund, 1977).

Life Science Achievement Test (LSAT) was developed by the investigator with the help of the supervisor to measure the achievement of students in Life Science. As achievement tests are Criterion Referenced Test (CRT), so the steps suggested by Hambleton and Rogers (1991) were followed with slight amendments. The detailed plan of the preparation of the Life Science Achievement Test (LSAT) is as follows:
1. Preliminary Considerations or Planning of the Achievement Test:
   i. **Purpose:** The purpose of the test was specified as ‘To prepare a test for the evaluation of learning outcomes in selected topic of Life Science for class X according to CBSE board curriculum.’
   
   ii. **Specifying Content:** The content of the test was taken from the Science text book of class X prescribed by C.B.S.E. Two topics of Life Science, viz., Life Processes and Control &Coordination were taken into consideration for the preparation of the achievement test.
   
   iii. **Specifying Objectives:** Objectives were defined in behavioral terms focusing on Knowledge, Understanding, Application, HOTS (Higher Order Thinking Skills), PBQ (Practical Based Questions) and VBQ (Value Based Question) from the selected topics of Science textbook for class X related to Life Science prescribed by C.B.S.E.
   
   iv. **Deciding Item Format:** The format of the items was kept identical; i.e. Multiple Choice Questions.
   
2. **Planning of Design of Blue Print:** A blue print provides a bird’s eye view of the whole test. It helps in giving due weightage to objectives, scope of content and types of content etc. For planning and preparation of the blue print opinion of teachers and teacher educators in the field of Science was taken into consideration. Following steps were taken:
   
   i. **Preparation of Objective wise Weightage Table:** Very first a weightage table was prepared based on various types of objectives as given in table-4.3.

   **Table: 4.3**
   
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Objectives</th>
<th>Marks</th>
<th>% of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Knowledge</td>
<td>25</td>
<td>25 %</td>
</tr>
<tr>
<td>2.</td>
<td>Understanding</td>
<td>35</td>
<td>35 %</td>
</tr>
<tr>
<td>3.</td>
<td>Application</td>
<td>15</td>
<td>15 %</td>
</tr>
<tr>
<td>4.</td>
<td>HOTS</td>
<td>15</td>
<td>15 %</td>
</tr>
<tr>
<td>5.</td>
<td>VBQ</td>
<td>4</td>
<td>4 %</td>
</tr>
<tr>
<td>6.</td>
<td>PBQ</td>
<td>6</td>
<td>6 %</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100</td>
<td>100 %</td>
</tr>
</tbody>
</table>
ii. **Preparation of Content wise Weightage Table:** Next a content wise weightage table was prepared as given in table-4.4.

*Table: 4.4*

**Content wise Weightage Table**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Units and sub-units</th>
<th>Marks</th>
<th>% of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Life Processes</td>
<td>60</td>
<td>60 %</td>
</tr>
<tr>
<td>2.</td>
<td>Control and Coordination</td>
<td>40</td>
<td>40 %</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>100</td>
<td>100 %</td>
</tr>
</tbody>
</table>

iii. **Preparation of Type of Items wise Weightage Table:** Only multiple choice questions were included in the LSAT so the type of item wise weightage table is given in the table-4.5.

*Table: 4.5*

**Type of Items wise Weightage Table**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Format of Items</th>
<th>Marks per Question</th>
<th>Number of Questions</th>
<th>Total Marks</th>
<th>% of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Multiple Choice Questions</td>
<td>1</td>
<td>100</td>
<td>100</td>
<td>100 %</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>

3. **Preparation of Blue Print:**

For the preparation of blue print planned design was brought into action.

The final draft of the blue print of LSAT is given in table-4.6.
Table: 4.6
Final Draft of Blue- Print of LSAT

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Topics</th>
<th>Sub Topics</th>
<th>Objectives</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>K</td>
<td>U</td>
</tr>
<tr>
<td>1.</td>
<td>Life Processes</td>
<td>Nutrition</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiration</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transportation</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excretion</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>Control and</td>
<td>C &amp; C in</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td>Plants</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C &amp; C in</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
<td>35</td>
</tr>
</tbody>
</table>

*All the questions carry one mark each.

4. **Construction of Test Items:**

Test items were prepared in accordance with broad parameters set in the blueprint. Investigator had framed about double the items (i.e. 175), as required (i.e. 100) as some of them were be modified or rejected during try out stage.

5. **Preparation of Scoring Key:**

Scoring key was prepared to bring objectivity in the evaluation. Since only multiple Choice questions with one mark each have been included in the test, hence the researcher had prepared scoring key for the test.

6. **Try Out of the Test:**

The tryout of the LSAT was done in two phases according to the scheme given in fig. 4.1.
Fig. 4.1 Scheme of try-out of LSAT

a) **Initial try out:** The initial try out was conducted in two phases. The test was given to subject experts and individual students.

i. **Expert Try Out:** After arranging the prepared test items into required format, LSAT (Life Science Achievement Test) was given to 10 experts (TGT/PGTs Science, English and teacher educators with Science and English as pedagogical specialization).

ii. **Individual Try Out:** Simultaneously the LSAT was given to 10 students of class X to find out defects in the language and ambiguous items so that language of the test items can be modified and the ambiguous items can be removed.

Keeping in view the suggestions of subject experts and analyzing the responses of students during individual try out 7 items were removed and some items were modified. The modified LSAT had total 168 items.

b) **Group try out:** Now the modified LSAT with 168 total test items was given to a group of 50 students, belonging to different schools, who were different in terms of their level of achievement in Science. Necessary instructions were given to the students. The students were required to put a tick mark on the correct option on the LSAT booklet only. There was no time limit for the test and time taken by each student was noted.
down. Each correct response of the question was given one mark and wrong answer was given zero. Total score of each student was recorded by adding the correct responses. This group try out was the base for item analysis. Using the score of the LSAT, difficulty index and discriminating power were calculated for item analysis.

7. Item Analysis:

The scores of the group try out were used for the item analysis. The analysis of students’ responses to objective test items is a powerful tool for test item improvement and accumulating a bank of high quality test items. It is a process of determining the qualities like ‘Discrimination’ and ‘Difficulty’ of the individual items of the test.

The investigator followed following steps for Item analysis:

i. Scores obtained by different students were arranged in ascending order.

ii. 27% of highest scoring and 27 % of lowest scoring students of the total group were identified.

iii. Item difficulty index and discriminating power was calculated as per the formula given in table-4.7.

Table: 4.7

<table>
<thead>
<tr>
<th>Difficulty Index</th>
<th>Discrimination Power</th>
</tr>
</thead>
</table>
| **According to Garret (1959):** “The proportion of the group which can solve an item correctly is the standard method for determining difficulty”.

The difficulty index of an item can be defined as the percentage of the group who answered the items correctly. |

\[
\text{Item Difficulty Index} = \frac{RH + RL}{NH + NL} \times 100
\]

Discrimination power of an item can be defined as a measure of the extent to which that item distinguishes or discriminates between the students who performed well in overall test and who do not performed well. |

\[
\text{Discrimination Power} = \frac{RH - RL}{NH or NL} \times 100
\]
Where

RH = Number of students in the higher group who answered the items correctly
RL = Number of students in the lower group who answered the items correctly
NH = Number of students in the higher group
NL = Number of students in the lower group

Table: 4.8
Interpretation of Difficulty Index

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Difficulty Index</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Below 20 %</td>
<td>Difficult</td>
</tr>
<tr>
<td>2.</td>
<td>20 % to 50 %</td>
<td>Good</td>
</tr>
<tr>
<td>3.</td>
<td>50 % to 80 %</td>
<td>Best</td>
</tr>
<tr>
<td>4.</td>
<td>80 % to 100 %</td>
<td>Very Easy</td>
</tr>
</tbody>
</table>

The difficulty index of each item was calculated, interpreted according to table-4.8; and categorized as shown in the table-4.9.
### Table: 4.9
Analyzed items in terms of Difficulty Index

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Difficulty Index</th>
<th>Item No.</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Below 20 %</td>
<td>15,42,45,69,86,94,126,168.</td>
<td>Difficult</td>
</tr>
<tr>
<td>3.</td>
<td>50 % to 80 %</td>
<td>1,3,4,5,7,9,11,12,13,16,17,18,19,21,23,24,25,28,29,31,32,35,36,38,40,46,48,50,52,55,59,60,61,63,64,65,66,67,70,72,75,77,78,80,84,85,87,89,90,92,100,105,106,107,108,109,110,112,114,115,116,117,120,122,123,124,125,128,129,131,134,135,136,137,140,141,144,146,148,149,152,154,157,159,162,163,166</td>
<td>Best</td>
</tr>
<tr>
<td>4.</td>
<td>80 % to 100 %</td>
<td>14,30,88,130,139,145,155.</td>
<td>Very Easy</td>
</tr>
</tbody>
</table>

### Table: 4.10
Interpretation of Discriminating Power

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Discriminating Power</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Below 30 %</td>
<td>Poor Items to be Rejected</td>
</tr>
<tr>
<td>2.</td>
<td>30 % to 60 %</td>
<td>Reasonably Good</td>
</tr>
<tr>
<td>3.</td>
<td>60 % to 80 %</td>
<td>Good Discriminator</td>
</tr>
<tr>
<td>4.</td>
<td>80 % to 100 %</td>
<td>Best Discriminator</td>
</tr>
</tbody>
</table>
The discriminating power of each item was calculated, interpreted according to table-4.10; and categorized as shown in the table-4.11.

**Table: 4.11**

**Analyzed items in terms of discriminating power**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Discriminating Power</th>
<th>Item No.</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>30 % to 60 %</td>
<td>2,8,9,14,15,18,19,21,25,31,32,33,40,41,44,46,48,51,52,53,55,56,57,58,59,62,63,65,71,74,77,78,79,81,82,83,85,89,90,91,92,93,96,97,98,101,102,103,107,108,115,116,118,119,120,122,124,125,130,135,138,139,142,143,146,151,153,154,155,165.</td>
<td>Reasonably Good</td>
</tr>
<tr>
<td>3.</td>
<td>60 % to 80 %</td>
<td>1,3,4,6,7,12,13,16,23,28,29,34,35,37,38,39,43,47,60,61,64,67,68,70,72,76,80,84,87,99,100,106,109,110,112,113,117,121,123,127,128,132,136,137,140,141,144,148,150,158,159,161,163,164,166.</td>
<td>Good Discriminator</td>
</tr>
<tr>
<td>4.</td>
<td>80 % to 100 %</td>
<td>10,17,22,24,49,66,73,95,111,114,129,133,134,147,149,152,156,157,162.</td>
<td>Best Discriminator</td>
</tr>
</tbody>
</table>

After item analysis total 100 items were selected according to the blue print of the LSAT. Taking into consideration the time taken to complete the test by each student, the total time was estimated for the completion of 100 items. It
was one hour. With general instructions, the final draft of LSAT was prepared. A scoring key was also prepared as per the previous format.

8. **Standardization of Achievement Test:**

The LSAT was further standardized by experimental validation of the test that included establishing reliability and validity. The investigator personally visited various schools in Delhi and sought the permission and cooperation of Heads of the schools in administering the final draft of LSAT on class X Science students. Finally, the test was conducted on the 260, X class students of five schools affiliated to CBSE on different dates. The information about the test was communicated to the students earlier itself so as to prepare themselves for the achievement test. Clear instructions were given to the students to respond to the LSAT in time. The test procedure was strictly followed and answer sheets were collected on time. One mark for each correct answer and zero for each wrong answer was awarded. The item wise scores and total scores were recorded in the SPSS for item analysis and reliability of the test.

The standardization process of the test includes two major processes, ensuring validity and establishing reliability, which are given below:

i. **Validity:** A test has content validity if it measures knowledge of the content domain of which it was designed to measure knowledge. Content validity concerns, primarily, the adequacy with which the test items adequately and representatively sample the content area to be measured. The content validity of the LSAT was established by taking opinion of experts in the field of Science (TGT/PGT) and teacher educators with specialization of pedagogy of Science.

ii. **Reliability:** According to Anastasi & Urbina (2002), "Reliability refers to the consistency of scores obtained by the same persons when they are reexamined with the same test on different occasions, or with different sets of equivalent items, or under other variable examining conditions."

The reliability of the LSAT was established through two methods:

a) Test-Retest Reliability

b) Internal Consistency Reliability

i. Split Half Reliability
ii. Spearman and Brown Formula

- Spearman and Brown Formula
- Rulon/Guttman’s Formula

ii. Cronbach’s Alpha (α)

a) Test-Retest Method: For test- retest reliability extermination sample of 100 students of X class was taken. The time gap between test and retest was three weeks. The Pearson’s product movement coefficient of correlation between the test and retest scores was found to be 0.867 (significant at 0.01 level).

b) Internal Consistency Reliability

i. Split Half Method: In the Split-Half reliability method, the LSAT was administered on 260 students of class X. The scores obtained were arranged into two equivalent halves keeping scores of all even items in one half and all odd items in another. The correlation coefficient between scores of these half-test was found through Spearman-Brown formula and Guttman formula.

- Spearman-Brown Coefficient for LSAT was found to be 0.850.
- Guttman Split-Half Coefficient for LSAT was found to be 0.850.

ii. Cronbach’s Alpha (α): Cronbach’s Alpha is mathematically equivalent to the average of all possible split-half estimates. The Cronbach's Alpha and found to be 0.845. The LSAT appeared to have good internal consistency, α= 0.845.

9. Description of final form of Life Science Achievement Test (LSAT): The final form of LSAT consisted of 100 multiple choice questions having four options for each question. The respondents have to tick on the correct response. One mark has to be awarded for each correct and zero for each incorrect response. The maximum marks for LSAT are 100 and the time duration was fixed as 60 minutes.

4.2.2 Multimedia Instructional Package Opinionnaire for Teachers (MMIPOT)

For the present study the investigator has prepared a Multi Media Instructional Package (MMIP) for two topics of class X Science textbook. Before using this package
it was important to validate it in terms of its appropriateness for the age and mental level of the target students and usability for the teachers. A thorough literature survey was made to find out a scale or opinionnaire which can be used for validating the MMIP. But there was no such opinionnaire available in the selected topics of the present study. So, the investigator decided to prepare an opinionnaire to know the usability and effectiveness of the Multimedia Instructional Package for Teachers.

1. Development of the Opinionnaire (MMIPOT)

The development of the opinionnaire consisted of following steps:

i. An item pool consisting of 54 items was developed and arranged into following eight areas:
   i. Content Quality
   ii. Learning Objectives Alignment
   iii. Presentation Design & Multimedia Aspect
   iv. Creative And Innovative Aspect
   v. Language Aspect (Spelling & Grammar)
   vi. Interaction & Navigation Usability
   vii. Evaluation Tool
   viii. Motivation Aspect

This initial item pool was given to two language experts and two teacher educators for review. The suggestions made by the experts were incorporated and some of the items of the initial item pool were modified and a few were deleted. One more area (Usability for the teachers) was added including two items as per the suggestions of the experts. So, the revised item pool consisted of 52 total items.

ii. The item pool of 52 items was arranged into a five point rating scale: Very Good (VG), Good (G), Average (A), Poor (P) and Very Poor (VP) and given to 10 experts for the selection of appropriate items. Item analysis was conducted and item discrimination coefficient (Point biserial coefficient) was calculated through SPSS 20. Items having Corrected Item- Total Correlation greater than 0.3 were accepted, some were modified and a few items were deleted. Thus, after item analysis total 45 items were left.
iii. **First Try-out:** The final 45 items were arranged into a five point rating scale (Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree) and submitted to 10 teachers having specialization in Science, English, Education Technology, Pedagogy of Science and Education along with the MMIP. They were required to go through the prepared MMIP and mark their opinion regarding language of items, appropriateness of content of MMIP on the given five point rating scale. The responses of the experts were recorded and analyzed through SPSS 20 software. Based on the item analysis results one item was deleted from the opinionnaire and some items were modified, thus now the final opinionnaire for second try-out was having total 44 items. Based on the suggestions of the experts the MMIP was also modified.

iv. **Second Try-out:** After suggested changes opinionnaire consisting of 44 items was given to another 20 Science teachers along with the revised MMIP. Teachers’ responses taken on five point rating scale (opinionnaire) were recorded and analyzed through SPSS 20 software. None of the items was deleted and thus the final draft of the *Multimedia Media Instructional Package Opinionnaire for Teachers (MMIPOT)* was consisting of total 44 items belonging to nine different areas.

2. **Establishing Reliability and Validity of the MMIPOT:** For the standardization of the opinionnaire reliability and validity was established in the following way:

a) **Reliability of Opinionnaire:** The internal consistency reliability of the opinionnaire was established using following methods:

i. **Split Half Method:** In the Split-Half reliability method, MMIPOT was administered on 20 Science teachers who were teaching to class X students. The scores obtained were arranged into two equivalent halves keeping scores of all even items in one half and all odd items in another. The correlation coefficient between scores of these half-test was found through Spearman-Brown formula and Guttman formula.

   - Spearman-Brown Coefficient for MMIPOT was found to be 0.889.
- Guttman Split-Half Coefficient for MMIPOT was found to be 0.876.

ii. **Cronbach's Alpha (α):** Cronbach's Alpha is mathematically equivalent to the average of all possible split-half estimates. Cronbach's Alpha and found to be 0.953 which indicates a good internal consistency of the opinionnaire (MMIPOT).

b) **Validity of Opinionnaire:** The validity of the opinionnaire was well established by taking into consideration the suggestion made by various experts at different stages of development of the opinionnaire.

3. **Description of Final Form of Opinionnaire (MMIPOT)**

The final form of MMIPOT consisted of 44 items belonging to nine different areas. Area wise number of items is given in table-4.12.

**Table: 4.12**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Area</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Content Quality</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>Learning Objectives Alignment</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Presentation Design &amp; Multimedia Aspect</td>
<td>11</td>
</tr>
<tr>
<td>4.</td>
<td>Creative And Innovative Aspect</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Language Aspect (Spelling &amp; Grammar)</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Interaction &amp; Navigation Usability</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>Evaluation Tool</td>
<td>6</td>
</tr>
<tr>
<td>8.</td>
<td>Motivation Aspect</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>Usability for Teachers</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Total Items</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

4. **Scoring:** All the items of the opinionnaire are positively worded. Items were given a score of 5,4,3,2 and 1 for ‘Strongly Agree’, ‘Agree’, ‘Undecided’, ‘Disagree’ and ‘Strongly Disagree’ respectively. The sum of the values assigned
to responses categories can be used for interpreting the effectiveness of MMIP. Thus, the opinionnaire can have total score ranging from 44 to 220, showing least effective to highly effective.

4.2.3 Multimedia Instructional Package Opinionnaire for Students (MMIPOS)

The Multimedia Instructional Package was developed to find the empirical evidence of effectiveness of learning through multimedia packages over traditional method of teaching. So, views of the students who are the target group for using the developed MMIP should also be considered for assessing its effectiveness. The investigator reviewed various literature but could not find any such tool which can fulfil the requirement. So, an opinionnaire- Multimedia Instructional Package Opinionnaire for Students (MMPIOS) was developed to assess the usability and effectiveness of MMIP for students.

1. Development of the Opinionnaire (MMIPOS)

The development of the opinionnaire consisted of following steps:

i. An item pool consisting of 45 items was created. The items of this initial pool consisted positively worded statements belonging to various aspects of the Multimedia Instructional Package (MMIP) like; content, explanation of the topic, quality of assignments, evaluation tool etc. This item pool was given to six experts belonging to various areas like; Education, ICT, English, Science and Computer Science along with a CD of MMIP. They were required to assess the suitability of the items for opinionnaire of students, their grammatical correctness etc. The suggestions made by the experts were incorporated and some of the items (5 items) which were unanimously rejected by them were deleted and some were modified according to their suggestions. Thus, the revised item pool now consisted of in all 40 items.

ii. The revised item pool of 40 items was given to two experts for review. Their suggestions were incorporated and two more items were deleted and thus remaining 38 items were arranged into five point rating scale having response categories; strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD).
iii. **First Try-out:** The opinionnaire in form of five point rating scale having 38 items was used for the first try-out. A sample of 30 students were taught through MMIP. After that they were requested to fill the opinionnaire according to their learning experience through MMIP. Their responses were carefully keyed into the computer. Through SPSS 20 software item analysis was conducted and eight items having *item total correlation* < 0.3 were rejected and some others were slightly modified. So, after first try-out 30 items were retained for second try-out.

iv. **Second Try-out:** The opinionnaire having 30 items was again tried out on a different sample of 30 students and after item analysis through SPSS-20 two more items were deleted from the scale (having *item total correlation* < 0.3).

2. **Establishing Reliability and Validity of the MMIPOS:** For the standardization of the opinionnaire reliability and validity was established in the following way:

   a. **Reliability of MMIPOS:** The internal consistency reliability of the opinionnaire was established.

      i. **Split Half Reliability:** The split half reliability coefficient of MMIPOS was found through Spearman-Brown formula and Guttman formula using SPSS 20 which are as follows:

         i. Spearman-Brown Coefficient for MMIPOS was found to be 0.919.

         ii. Guttman Split-Half Coefficient for MMIPOS was found to be 0.913.

      ii. **Cronbach's Alpha (α):** Cronbach's Alpha for MMIPOS was found to be 0.944 which indicates a good internal consistency of the opinionnaire.

   b. **Validity of MMIPOS:** The Opinionnaire was given to eight different experts in two phases for review and evaluation. There suggestions were incorporated for improving the item quality. As, validity is the fidelity of the test in terms of quality it intends to measure how valid a test is. So validity of this opinionnaire was well established by taking experts suggestions into action.
3. **Description of the Final form of Opinionnaire (MMIPOS)**

   The final form of MMIPOS consisted of 28 items arranged in five point rating scale having response categories; Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD).

4. **Scoring:**

   As, all the items were positively worded so items were given scores of 5, 4, 3, 2, 1 for Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD) respectively. Thus, the total score for the opinionnaire can vary from 28 to 140, which can be used to know the effectiveness of MMIP.

4.2.4 **Development of Multimedia Instructional Package (MMIP)**

   Development of Multimedia Instructional Package is the heart and soul of this experimental research. For the development of the MMIP steps of ADDIE model of the instructional design was followed.

   **Instructional Design:** Instructional design is a strategic planning of a course, training program or multimedia program. According to Berger and Kam (1996) “Instructional design is a process, discipline, Science and reality.” Instructional design can also be defined as “the process by which instruction is improved through the analysis of learning needs and systematic development of learning materials.” (Instructional Design, 2010). There are various Instructional Design models like ADDIE, Dick and Carry model, Kemp’s Instructional Design model and Gagne’s Nine Events of Instructions etc.

   ADDIE model is the most commonly used ID model. It was initially created by Florida State University to explain the processes involved in formulation of an Instructional System Development (ISD) program for military service training (Branson et al., 1975). ADDIE is an abbreviation of five phases- Analysis, Design, Development, Implementation and evaluation. There are many adaptations of ADDIE model of Instructional Design but it generally consists of the mentioned five cyclic phases. These phases represent an active and flexible guideline for building effective training, multimedia, e-learning tool.
Fig. 4.2 ADDIE model (Adapted from Gagne et al., 2004)

Fig.4.2 shows relationship among all five phases of ADDIE model. Solid lines illustrate the flow of process, i.e. from “analysis” to “evaluation” phase and dotted lines illustrate feedback pathways. After each phase there is provision of evaluation and revision.

**Phases of ADDIE model of Instructional Design:**

1. **Analysis Phase:** The analysis phase of ADDIE model of instructional design consists of various activities like clarification of instructional problem, establishment of instructional goals and objectives and analysis of learners’ present knowledge and skills.

2. **Design Phase:** It is kind of a blue print for the next phase i.e., development phase, so should be specific and systematic. It deals with stating instructional objectives, Creation of storyboard, lesson planning, and assessment instrument and media selection.

3. **Development Phase:** In this phase the developer creates and pulls together the content assets that were blue printed in the design phase. This phase is a process of developing instructional materials and support material including all components of multimedia. Content writing and graphics designing are done in this phase.

4. **Implementation Phase:** In this phase the designed instruction is introduced to the actual learners in effective way.

5. **Evaluation:** In this phase we determine the effectiveness of the developed instructional material in order to check up to what extent the material meets the
learning objectives and requirements of the learners. In fact, evaluation is directly related to all of the previous four stages. Furthermore, an evaluation is made at the end of each phase which is helpful in ensuring quality of the instructional material by modifying it.

Each phase of the model is made up of various procedural steps. For example Analysis phase typically includes need analysis, learner analysis and content analysis.

**Rationale for selecting ADDIE model:**

ADDIE model is a basic model with a systematic approach. This model provides a framework to ensure that the instructional material developed is accurate and effective. According to Siemens (2002), the ADDIE model is the best and most commonly used instructional design for the development of multimedia instructional programs or packages. It follows a linear design in which one phase becomes input for the next phase. According to Morrison and Kemp (2007), “in the design of multimedia software, the process that occurs are not as easy as the original process of ADDIE model.” They clearly advocate that ADDIE model has been developed in an integrated manner with the principles of multimedia instructional design. Moreover, evaluation at the end of each phase gives this model a very effective input in terms of the quality of the final product as at each and every phase the process and product is being evaluated and modified according to the requirement to meet the quality. So, keeping in mind these advantages of the model the investigator had decided to adopt ADDIE model to develop the multimedia instructional package for the present study.

**Development of MMIP based of ADDIE model**

Following phases of ADDIE model were followed for the production of the MMIP.

1. **Analysis Phase:** The analysis phase consisted of the following steps:
   i. **Need Analysis:** In this stage need for the development of the multimedia instructional package was analyzed by reviewing various available multimedia packages related to the topics under study.
   ii. **Selection of the content:** This is the very important stage for the development of the multimedia learning package in which investigator identified the content. In schools at secondary level, affiliated to CBSE Life Science is being taught as a part of general Science curriculum. In the text book of General Science as prescribed by NCERT there are
various units of Life Science. After a thorough analysis the investigator selected two units of Life Science i.e., Life Processes and Control and Coordination.

**Rationale for selecting these two units:**

Life processes and control and coordination are two very important units of the class-X Science curriculum. In these two units very important topics like different organ systems, various life processes, structure and functioning of brain and nervous system etc. have been discussed. These topics cannot be taught only by lecture method as, for the better understanding of these complex topics good quality aids are required. The investigator interviewed many students and found that if these topics are supported with visual description, the process can help students with better understanding.

**iii. Content Analysis:** After the selection of the topic, investigator conducted a content analysis of these topics. For this, investigator read the content thoroughly from the NCERT text book of class X, many other reference books by various other publishers and online content from internet. Also, subject teachers and experts were also consulted for the modification and improvement of the content.

**iv. Learner Analysis:** This is a very important step of the very first phase of ADDIE model. In order to develop an effective multimedia package it is very necessary that we should carefully and thoroughly analyze the intended user or the learner in this case for whom the package is being developed. So, the investigator visited various schools of North Delhi area for collecting information so that learner analysis can be done and it was found that students were in between the age group of 15-16 years. Both gender i.e., male and female were included in the sample. They had a good understanding of concepts of previous class. Since, the learners were studying in an English medium school so they possessed required language skills. Students also had knowledge about basic computer operations as they were being taught computer as an additional subject.
2. Design Phase:

i. **Defining major course objectives:** Based on the above three types of analysis instructional objective were framed for the whole MMIP.

ii. **Division of Content into suitable Sections or sub-topics:** The whole content of two units was divided into lessons and time spent in each sub-topic was decided.

iii. **Sequencing:** The subtopics were sequenced according to the MMIP major objectives.

iv. **Identification of Instructional Objectives for each sub-topic:** Instructional objectives were framed for each sub-topics in form of terminal behavioural outcomes.

v. **Defining lesson content and learning activities:** For each sub-topic content and learning activities were defined.

vi. **Selecting Evaluation Criteria:** Type of evaluation and evaluation criteria was decided for each sub-topic.

vii. **Story Boarding:** It is a process of documentation of the multimedia package. It consists of detailed description and positioning of the visual elements such as text, video, graphics and animation on the screen.

3. Development Phase:

After analysis and designing phase next phase is development phase. Development phase is the most tedious phase of the development of MMIP. In this phase all the planning done in the design phase is executed i.e., the content which was written and modified based on the experts’ suggestions is developed in various form of multimedia like; pictures, video, audio, animation and text using different softwares like Microsoft Office Power Point Presentation, Adobe Flash Player etc.

Multimedia packages can be created using either Authoring softwares or Presentation Softwares. Authoring software is used to develop to generate an interactive multimedia application that can be supplied to the end users through a variety of medium e.g. through CD ROMs, DVDs, Web-pages etc. Some common authoring softwares are Adobe Flash, Adobe Dreamweaver, and Adobe Director etc. Whereas a Presentation software can be used to develop a
multimedia application which comprised solely of screens or slides with text, images, video, audio and animation. Although, the modern presentation softwares are more feature-rich as compared to the original versions of the software, they are still not at par with the capacities and features of proper multimedia authoring software. Some common presentation softwares are Microsoft PowerPoint etc.

There are many softwares available to prepare multimedia instructional packages and programs but the investigator selected Microsoft Power Point (Office 13), which is a presentation software and a part of Microsoft Office Suite. It has evolved almost to the point of being an authoring package in its own right. It can incorporate a wide variety of media, provide complex user interaction and can be further extended through the use of scripting. The new Power Point-13 has many strong features which makes it easy to use and result in good quality multimedia program.

Various components of the multimedia like text, pictures, video, audio and animation etc. were created through various means and using variety of softwares and integrated with Microsoft PowerPoint to form the final form of package. A detailed description of the development of various components of multimedia is given below:

i. **Text:** The most basic step of development of any multimedia program is inclusion of text. Text can be used to communicate information in an easiest way. Textual data can be developed by using any text editor. The investigator used Microsoft Word-2013 to create textual data.

ii. **Audio:** Sound can be defined as meaningful speech in any language. The term sound is used in analog form whereas the digital form of speech is known as audio. In the absence of presenter the information conveyed by text and images can be very well communicated to the audience by using a good quality sound. So, to supplement our text, images, video or animation we have to record supporting sound narration so that an effective multimedia can be created. For the MMIP the investigator used following ways to record sound:
The commonly used audio file formats are given in table-4.13.

Table: 4.13
Audio File Extensions

<table>
<thead>
<tr>
<th>File Extension</th>
<th>Type of File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.mid, .midi</td>
<td>Musical Instrument File</td>
<td>Contains music data.</td>
</tr>
<tr>
<td>.rm, .ram</td>
<td>Real Audio Metadata File</td>
<td>It is a combination of audio and video.</td>
</tr>
<tr>
<td>.wav</td>
<td>Wave File</td>
<td>Wave form audio file.</td>
</tr>
<tr>
<td>.wma</td>
<td>Windows Media Audio File</td>
<td>Audio file compressed with windows media compression.</td>
</tr>
<tr>
<td>.mp3, .mpga</td>
<td>MP3 Audio File</td>
<td>Compressed audio format.</td>
</tr>
</tbody>
</table>

iii. **Image**: Images are important component of a multimedia presentation. Images used in multimedia program can be photographs converted into digital form with the help of scanners or generated on computer. Computer can store images into two forms- Bitmap or Raster images and Vector graphics. A bitmap image is made up of tiny pixels whereas in vector graphics images are saved as mathematical equations. Though, both type of images look same on screen but when enlarged bitmap images look blur whereas the vector graphics remain clear. According to the need of the content the investigator searched the internet and some pictures were downloaded, some pictures were taken from the digital camera, some pictures were scanned from the books. Some pictures were edited using Adobe Photoshop. Some commonly used file formats are given in table-4.14.
### Table: 4.14
Image File Extensions

<table>
<thead>
<tr>
<th>File Extension</th>
<th>Type of File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.bmp</td>
<td>Bitmap Image</td>
<td>Uncompressed image file used to store bitmap digital images.</td>
</tr>
<tr>
<td>.gif</td>
<td>Graphical Interchange Format File</td>
<td>Common for web graphics with small images and images with text. Uses limited numbers of colors.</td>
</tr>
<tr>
<td>.png</td>
<td>Portable Network Graphic</td>
<td>Used to store graphics for web images and supports up to 32-bit colors. It is an improvement over gif.</td>
</tr>
<tr>
<td>.jpeg/.jpg</td>
<td>Joint Photographic Expert Group Image File</td>
<td>Common image format used by digital cameras. Supports up to 24-bit colors.</td>
</tr>
<tr>
<td>.psd</td>
<td>Photoshop Document</td>
<td>Image file created by Adobe Photoshop.</td>
</tr>
<tr>
<td>.tif</td>
<td>Tagged Image File Format</td>
<td>Highly flexible and platform independent format.</td>
</tr>
</tbody>
</table>

### Video:
“Video refers to the sequence of natural scenes captured using analogue or digital video capturing device which can be a digital camera, web-cam or even a mobile phone.” Video in multimedia is extremely powerful tool for communication. It is helpful in illustrating ideas and events. As, video files occupy larger space so we should use very short video clips (of less than one minute) that should be highly compressed format like MPEG. Videos for the MMIP were created and edited using Windows Movie Maker.
Table: 4.15
Video File Extensions

<table>
<thead>
<tr>
<th>File Extension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVI</td>
<td>File format developed by Microsoft for windows. It is also known as Video for Windows (VFW).</td>
</tr>
<tr>
<td>MOV, MOOV, QT</td>
<td>These files belong to Apple Quick Time Movie.</td>
</tr>
<tr>
<td>MPEG, MPG</td>
<td>MPEG files uses the MPEG-1 video compression routine. MPEG video clips can be viewed with IBM compatible PC and Unix workstations.</td>
</tr>
</tbody>
</table>

v. **Animation:** Animation has greater potential to give life to a static presentation. In animation digital images are played one after the other to create a moving effect. So, animation is created from drawn pictures whereas video is created using real time visuals. Animation can be 2-D or 3-D. In this 2-D animation videos were developed to explain certain concepts using Adobe Flash.

**Assembling all the Components of Multimedia:**

All these collected, developed and edited components of multimedia were assimilated in the selected presentation software i.e. Microsoft Power Point 20013 version. Recorded voice for narration, video and animations etc. were also embedded at appropriate place. Use of irrelevant material, sound, words etc. was as far as possible avoided in order to remove the negative effective on learning. Graphics were explained with appropriate narration so that both, visual and auditory channels can be utilized. Then the lesson wise presentation was converted into Flash file using I-spring Presenter software. The package thus prepared was reviewed and revised many times to ensure the quality of design, colour scheme and navigation quality can be ensured.

The multimedia package thus developed was tested. The package then was given to five experts for review. After the suggestions of the experts the MMIP was modified.
The MMIP thus modified was tried out on a small group of intended target group i.e. ten students of class X. The problems faced during the execution of the package were discussed and also feedback was taken from the students. Again the package was modified and reviewed by the experts.

4. **Implementation Phase:** The package developed by the investigator was tried out on a sample of 20 students. The effectiveness of the MMIP was measured in the form of mean gain which was obtained through statistical analysis. The MMIP was found to be effective in enhancing the achievement of students of class X in Life Science.

5. **Evaluation Phase:** Evaluation or validation of any developed multimedia package or program is a very essential and meticulous procedure for the total quality assurance of the developed product. As, the post-test scores of the students in implementation stage already ensured its effectiveness for the students but opinion of the experts is also necessary for the complete validation of the MMIP. So, the developed MMIP was evaluated by 30 experts using a five point evaluation scale in the name of Multimedia Instructional Package Opinionnaire for Teachers (MMIPOT) developed and standardized by the investigator herself. Analysis of the experts’ responses clearly revealed that the MMIP is of good quality and can be used for the final experiment. (Final MMIP attached – Appendix-P)