CHAPTER - IV

METHODOLOGY OF THE STUDY
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4.1 Introduction

Methodology occupies a very prominent place in any type of research. It is the procedure or technique used by the investigator in conducting an investigation. Selection of research method depends upon the nature of the study and objectives to be realized.

The present study aims at finding out the effectiveness of Teacher-Controlled Video Assisted Instruction in the achievement in Biology among VIII Standard students has been an experimental design. Experimental method helps to find out whether one method of teaching is more effective than the other or not. Hence experimental method was found appropriate for the study and was adopted to compare the effectiveness of Teacher Controlled Video Assisted Instruction (TCVAI) with the Traditional Method (TM) of teaching. As the nature of the study is experimental, experimental method with pre test posttest randomized group design is used.

The present chapter is devoted to the description of the method and procedure adopted in the study.
4.2 Objectives of the study

The objectives of the study are:

1. to develop and validate the Teacher Controlled Video Assisted Instruction package (software) in Biology for VIII standard students.

2. to construct and validate Achievement Tests in Biology for Standard VIII students.

3. to find out the effect of the Teacher Controlled Video Assisted Instruction on the achievement in Biology among VIII standard students.

4. to find out the effect of Traditional Method on the achievement in biology among VIII Standard students.

5. to find out the effect of Teacher Controlled Video Assisted Instruction on the achievement among VIII standard students in the area of knowledge, comprehension and application objectives.

6. to compare the effectiveness between Teacher Controlled Video Assisted Instruction and Traditional Method on the achievement in Biology among VIII standard students.

7. to find out the effect of Teacher Controlled Video Assisted Instruction on the achievement among VIII standard students in Biology keeping their intelligence as a co-variance.
8. to find out the effect of Teacher Controlled Video Assisted Instruction on achievement among VIII standard students in Biology keeping their socioeconomic status as a co-variance.

9. to find out the effect of Teacher Controlled Video Assisted Instruction on the achievement among VIII standard students in Biology keeping sex as a co-variance.

10. to find out the correlation among the pre test and post test scores in total as well as learning objectives 'Knowledge', 'Comprehension' and 'Application' of TM and TCVAI.

4.3 Hypotheses

Hypotheses provide a network of statements relating the impact of an independent variable or a set of independent variables on some outcome variable or dependent variable(s) (Ingersoll, 1984)

In the proposed study following null-hypotheses are formulated for testing.

1. There is no significant difference between the achievement in Biology among VIII standard students when they are subjected to Teacher Controlled Video Assisted Instruction and Traditional Method.

2. There is no significant difference between the total achievement in Biology of VIII Standard students in the area of Knowledge, Comprehension and Application objectives when they are subjected to Teacher Controlled Video Assisted Instruction and Traditional Method.
3. There is no significant difference between the total achievement in Biology among VIII standard students when they are subjected to Teacher Controlled Video Assisted Instruction keeping intelligence as co-variance.

4. There is no significant difference between the total achievement of VIII standard students in Biology when they are subjected to Teacher Controlled Video Assisted Instruction keeping their Socio economic status is kept as co-variance.

5. There is no significant difference between the total achievements of VIII standard students in Biology when they are subjected to Teacher Controlled Video Assisted Instruction keeping sex as co-variance.

6. There is no correlation among the pre-test and post test scores in total as well as learning objectives of Traditional Methods and TCVAI

4.4 Methodology

The major aim of the present study was to study the effectiveness of Teacher Controlled Video Assisted Instruction (TCVAI) on the achievement in biology among VIII standard students. Experimental method helps to find out whether the TCVAI is more effective in comparison with Traditional Method (TM) of teaching. Hence experimental method was found appropriate for the study and
was adopted to compare the effectiveness of TCVAI with the Traditional Method of Teaching.

Following points contribute to the justification of the proposed method for the present study:

1. In the present study, cause and effect relationship was established by manipulating and control over independent variables like teaching methods, intelligence and socio-economic status, the changes that took place in the form of dependent variables were observed by the results of the Achievement Test (AT).

2. It tested the hypothesis by identifying functional relationship between dependent and independent variables.

3. In the investigation the questions can be best answered by obtaining data under deliberately created conditions. The only way to hold all variables constant except the dependent variable is to use two identical groups in the experiment. Here one group receives teacher controlled video assisted instruction, and another group receives traditional instruction without the assistance of video. Any difference in the dependent variable could be attributed only to the manipulation of the independent variables.

In experiments certain conditions or variables are kept constant for the treatments. These conditions are termed as fixed conditions. This study treated the following fixed conditions.
a. Age - The researcher considered only the students in the age group of 12 - 14 years

b. Grade - Students of only standard VIII were considered for all treatments

c. Content - Learning materials on three areas in Biology 'Pollution' 'The Cell' 'The Excretory System' (based on the Biology syllabus of std VIII, General Education Department, Government of Kerala) were presented before the samples.

d. Place of providing instruction - All the students were provided instruction in the classrooms of the same school selected for instruction.

e. Teacher providing instruction - The students selected as sample were provided instruction by the same teacher using the same lesson plans with the assistance of video material and without it.

4.5 Experimental design

Educational research is described as 'Experimental' when the researcher has firstly specified the finite set of researchable hypotheses and secondly has established a systematic programme for gathering data, under precisely defined controlled conditions in an effort to test the hypotheses.

To conduct an experiment, the investigator has to follow an experimental design, i.e. the blue print of the procedure that enables the investigator to test the hypotheses. Equivalent group design would
have been the most suitable design for the study. Since the matched pairs may belong to different schools, it is administratively difficult for the investigator to arrange equivalent groups for the purpose of experimentation in Indian conditions.

Hence, intact groups that are normally non-equated were selected for the experimentation. The non-equivalent classroom groups were statistically equated. Therefore an equated group pre test – posttest design was selected for the present research.

The experiment involved two groups: a group for experimental treatment and another one, a control group. The instructional strategy whose effectiveness to be tested was administered to the experimental group and the control group is the untreated group viz the group taught in the traditional method. Here, the experimental group is subjected to Teacher Controlled Video Assisted Instruction and the Control group is subjected to the Traditional Method of Instruction.

4.6 Variables

Variables are the conditions considered for the study. In the present study the prepared video programmes were to be tested experimentally for its effectiveness by comparing with that of traditional method of teaching Biology on select topics in STD VIII. Two types of variables – independent variable and dependant variables, were used in the study.

"Independent variables are those variables the investigator chooses to study in order to assess their possible effects on other
variables. The variable that the independent variable in presumed to effect is called the dependent variable (Fraenkel and Wallon, 1993).

In experimental studies, the condition or the strategy that is varied is called the independent variable and effect of strategy is the dependent variable.

4.6.1 Independent variables

In the present study following Independent variables were involved.

1. Sex: the demographic variable that cannot be altered is considered and hence boys and girls were included in the study.

2. Level of intelligence: an attribute variable that cannot be altered and three levels – i.e. high average and low were considered in the study.

3. Socio economic status (SES): SES being an attribute variables that is not alterable for the purpose three levels of it – i.e. high, average and low level of SES were considered.

4. Instructional method: It was a treatment variable. Present study involved two instructional methods -
   a. Teacher Controlled Video Assisted Instruction.
   b. Traditional Method of instruction.

4.6.2 Dependent variables

Dependant variables are the measured changes in the student’s performance attributable to the influence of independent
variables. The achievement of the students in the form of achievement test scores is the dependent variable. The dependent variables in the present study attempted to measure what an individual had learnt after getting the Teacher Controlled Video Assisted Instruction.

The co variables that are likely to affect achievement are intelligence, sex, age, socio economic status, management of the school and locality. The variable, age, is equated because the sample belongs to Std VIII students. The co variables that affect the experiment are intelligence, socio economic status and sex. The difference in achievement that would have been caused by these co variables was made lowest by adopting statistical techniques.

4.7 Sample

The video material on three areas in Biology, 'Pollution' 'The Cell' 'The Excretory System' , based on the Biology syllabus of std VIII, Government of Kerala was prepared in English . The population of the study constituted all the Std VIII students of all English medium schools of Kerala following the syllabus prescribed by the General Education Department, Government of Kerala.

The initial task was to select a school that could exhibit the characteristics of being part of the population and could get adequate number of students for experimentation.

Random Sampling technique was applied and HSS, Thirumala was selected for experimentation because it is a co educational institution having sufficient number of students for experimentation and the same teacher teaches them. So a group of
217 students of Std VIII (boys & girls) of this school was initially selected as sample for the study. The group belonged to the age group of 12-14 years. To fulfill the objectives of study, the sample was divided into two equal groups. For more valid and reliable findings the matched group experimental technique was used and the groups were made equivalent on the basis of the intelligence and socio economic status of the students. Kerala University Group Test of Intelligence (Verbal) by Dr. Nair and Socio economic Status scales by Dr. Nair were administered on the entire sample; the mean and standard deviation were calculated and group-matching technique was applied. In the process some students from the entire group who were not able to participate till the end of the treatment were dropped out. Finally 140 students (70 boys and 70 girls) were selected as sample. Number of students selected at different stages of sampling are presented in table 4.1
Table 4.1
Number of students at different stages of sampling

<table>
<thead>
<tr>
<th>Sampling State</th>
<th>No. of students</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial stage</td>
<td>109</td>
<td>108</td>
<td>217</td>
<td></td>
</tr>
<tr>
<td>Final stage - Group matched on mean IQ scores</td>
<td>70</td>
<td>70</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>Groups matched on mean SES scores</td>
<td>70</td>
<td>70</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>

Out of the two equivalent groups one group of students was randomly selected for receiving teacher controlled instruction using video material and the other group for receiving instruction in the traditional manner. Details of the subjects selected at final stage of sampling are presented in table 4.2.
Table 4.2
Details of final sample selected for experimentation

<table>
<thead>
<tr>
<th>Sex of sample</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Mean age (in years)</td>
</tr>
<tr>
<td>Boys</td>
<td>35</td>
<td>12.5</td>
</tr>
<tr>
<td>Girls</td>
<td>35</td>
<td>12.5</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>12.5</td>
</tr>
</tbody>
</table>

In order to fulfill the objectives, students were also grouped on the basis of intelligence and SES. Students were classified three groups high, average and low intelligence levels, on the basis of quartile deviation of their intelligence score i.e. high intelligence score above the third quartile, low intelligence score below the first quartile and the average between these limits. Table 4.3 shows the mean and standard deviation of scores of high average and low intelligence groups of experimental group and control group.

Table 4.3
Means and SDs of intelligence scores of Experimental group and Control group

<table>
<thead>
<tr>
<th>Intelligence group</th>
<th>Experimental group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>Low</td>
<td>12</td>
<td>49.16</td>
</tr>
<tr>
<td>Average</td>
<td>45</td>
<td>58.66</td>
</tr>
<tr>
<td>High</td>
<td>13</td>
<td>74.153</td>
</tr>
</tbody>
</table>
Similarly on the basis of quartile deviation of SES scores, the students were grouped as low average and high SES levels. Table-4.4 shows the mean and standard deviation of the two groups.

**Table 4.4**

Means and SDs of SES scores of experimental groups and control group

<table>
<thead>
<tr>
<th>SES group</th>
<th>Experimental group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>Low</td>
<td>23</td>
<td>15.956</td>
</tr>
<tr>
<td>Average</td>
<td>37</td>
<td>22.000</td>
</tr>
<tr>
<td>High</td>
<td>10</td>
<td>26.900</td>
</tr>
</tbody>
</table>

4.8 **Tools used for Experiment and Data Collection**

In order to achieve the objectives of the study, the following tools were developed and standardized by the investigator himself with technical assistance were used in the study.

Video materials on

- Pollution.
- The Cell.
- The Excretory System.

Achievement tests were developed on the above three units and standardized by the investigator himself.

Following materials and tools were also used for the experiment and collection of data:
The research design broadly covers the following phases

1. Development of video instructional materials and Achievement Tests on select topics in Biology from StdVIII syllabus.
2. Validation and evaluation of the materials.
3. Selection of the sample.
4. Experimentation.

Educational technology provides the necessary conceptual framework to produce the educational video programmes. Research methodology and methods of teaching Biology offers suitable methodology and this could be subjected for sound statistical treatment.

The video material produced has to be subjected for verification of the effectiveness, efficiency and suitability of the material in relation to the instructional objectives to be achieved. Hence testing of the material is required during the development or during use in the field and suitable methods was employed. Both developmental testing and field-testing are described by the term ‘validation’. Some authors have tried to make discrimination between the verification of the results of instruction (validation) and the verification of the benefits of long or short-term treatment (Boong (1980) Kirkpatrick (1977) Whitelaw (1972)). But Romiszowski (1986) do not think this distinction is
particularly useful or accurate because the basic idea is the same - to measure the value of the treatment and recommends using the term evaluation in both the cases and suggests thus:

"Materials validation, which includes the checking of the content for treatment given to the content by an instructional designer or experienced teacher, in order to verify that the language is well chosen for the intended population, the examples and explanations are relevant to their interests and prior learning, the visual and graphic presentations really communicate what they should and the materials really do to relate to the learning objectives that give rise to the material development project; material evaluation, which includes both developmental testing and field testing stages."^9

4.9.1 Development and Field-testing

4.9.1.a Organization, Execution and Interpretation

Developmental testing is done to correct any defects or weakness in the materials being developed at the earliest possible opportunity before the materials are brought to the final form. This testing will lead to two types of revision:

1. A revision of structure and content of the video programmes being tested in the light of the comments or difficulties of the students.

2. A revision of the author's view of the target population, in term of the Entry Level Behaviour (ELB) that will influence their acceptance and understanding of the material.
4.9.1.b Developmental testing

A schedule of developmental testing of video material using 5 students to test up three draft revisions was planned as given in table-4.5:

Table 4.5
Testing sessions of draft video programmes

<table>
<thead>
<tr>
<th>Units</th>
<th>Testing sessions (realistically programmed in time)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Draft 1 Student 5</td>
</tr>
<tr>
<td>I</td>
<td>Draft 1 Student 5</td>
</tr>
<tr>
<td>II</td>
<td>Draft 1 Student 5</td>
</tr>
<tr>
<td>III</td>
<td>Draft 1 Student 5</td>
</tr>
</tbody>
</table>

Hence a series of testing sessions were programmed at specified intervals of time to find out the weakness of the materials.

During the first session the researcher tested out the first version of the unit on pollution. This was then revised in the light of the data collected and the next unit was drafted. At the second session, the same student that was used to test the first draft of unit I now studied and commented on the first draft of unit II ‘The cell’. The new version of unit I was tested again on a new student. This was repeated for four tests of each unit. This helped to have the unit better adapted to the target population. Close observation of the students and personal discussion on the matter and learning difficulty encountered were assessed through clinical approaches.
The effectiveness of the individual frames, their sequence in the overall programme and the commentaries were evaluated in near simulated condition so that in the final product, these frames were edited together in a given sequence by or simply linked by 'voice over' commentaries. Accordingly the materials were redrafted for better ways of presentation or explanation to overcome the difficulties encountered. Care was taken to have a cordial atmosphere to see that the students feel free for expressing their ideas or feelings in a joint venture for a better product. The test sessions were carried out at predetermined intervals. New material development was always done between any two sessions so that the revision of earlier units and viewing of the first draft of the next unit was concluded within the interval. The field-testing was done under simulated conditions using 30 students of std VIII. The basic objective of the developmental testing sessions was to get to know the target population better, and to catch the big problems in the materials at the earliest possible opportunity.

4.9.1.c Field Testing

Field-testing was done on a group of 30 students of StdVIII with the objective of how the video programmes functions in reality on the target group as has been planned. Here the intention was to get a quantitative data i.e. in measuring exactly what the students have learned as a result of using the materials that were designed. Hence a larger group of students were needed for field-testing. In order to yield useful results pre and posttests were applied to learning sessions and also to ensure that the results are due to the material and method of it
use and not any other extraneous events. So it became necessary to use two forms in the entry test:

i. A pre requisite test, to check that all essential prior learning has indeed taken place.

ii. A Pre-test on the objectives to be mastered in the test session, to check that the material to be presented is not yet known.

Only students who scored nearly 100 per cent on the pre requisite test and very low scores on the pre-tests were selected for field-testing (Romiszowski, 1986).

The Video materials produced in a form equivalent to the final form, was subjected to treatment in a session equivalent to the final instructional sessions.

At the end of the testing session a posttest was applied based on the specific objectives of each unit.

4.9.2 Treatment and Interpretation of Results

Developmental testing aimed at qualitative information for improvement whereas field-testing aimed to gather quantitative data such as test scores or percentages in favour of certain aspects of the packages tested.

Because the treatment of information collected is different, the qualitative insights collected during developmental testing do not need statistical treatment. In the case of field-testing the raw test data collected are to be statistically analyzed in order to make sense. The
interpretation of the results is based on the tendencies encountered with the group of students used for testing.

The task is of video programme development and it is operated by means of a cyclic process of testing, modifying, and resetting and finally field testing to test its effectiveness.

Use of a measure of gain in learning that the student group achieves due to the treatment is expressed as the difference between the pre test and the posttest scores.

\[
\text{Pre test score} - \text{post test score} = \text{gain}
\]

Mean gain of the group can also be calculated.

**Table 4.6**

**Schematic representation of the Research Design**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nature of experiment</td>
<td>Pre-test Post-test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equivalent Group Design</td>
</tr>
<tr>
<td>2</td>
<td>Variables</td>
<td>Independent variable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dependent variable</td>
</tr>
<tr>
<td>2</td>
<td>Variables</td>
<td>Co variable</td>
</tr>
<tr>
<td>-</td>
<td>Effect of Video</td>
<td>Achievement in Biology</td>
</tr>
<tr>
<td></td>
<td>assisted learning in Biology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>among Std VIII Students</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Socio economic status</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Intelligence</td>
</tr>
</tbody>
</table>
3. **Tools used**
   - **a. Self-made tool**
     1. Video instructional materials in Biology, Std : VIII on 3 topics - Pollution, The cell, The excretory system
     2. Achievement Test in Biology
   - **b. Standardized tool**
     1. Group test of intelligence
     2. Socio Economic Status Scale

4. a) **Sample selected for the study**
   - Experimental & Control groups

4. b) **Sample selected for Normative Validation**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Video lesson</th>
<th>Achievement test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educationists</td>
<td>5</td>
<td>Educationists 5</td>
</tr>
<tr>
<td>Teachers</td>
<td>4</td>
<td>Teachers 4</td>
</tr>
<tr>
<td>Students</td>
<td>5</td>
<td>Students 5</td>
</tr>
<tr>
<td>Group try out</td>
<td>Students 30</td>
<td>Students 30</td>
</tr>
<tr>
<td>Field try out</td>
<td>Students 70</td>
<td>Students 70</td>
</tr>
</tbody>
</table>

5. **Duration of the experiment** 3 months

6. **Statistical Techniques used**
   - Correlation, t-test

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**4.10 Development of video lessons**

**4.10.1 Selection of the topics for Video Assisted Instruction - the rationale**

While selecting a topic for developing video lessons two most critical questions suggested by Derek Rowntree (1986) to ask oneself are:

1. For this particular lesson, could video material provide worthwhile learning experience that could not be provided more cheaply using other media?
2. Can I make my own Video material or obtain suitable material made by other people?

Purushothaman S. (1997) in Adapted Version of Interactive videos for Indian classroom opines "we need an economic and cost effective combination both old and new techniques. India needs 'group' mass learning through Interactive Video". He suggests a 'human interface' in adoption as it suits the Indian conditions not only in terms of economy, but also in terms of mode of instruction and class size.

Selection of the content or topic for the video programmes not a matter of arbitrary choice. Considering the suggestions and Biology being one of the area of the researcher's field of interest, educationists, subject experts and senior teachers and students who have completed std VIII were interviewed with the objective of finding out the suitability of certain topics in biology of std VIII of the Kerala syllabus. Finally the following areas selected for preparing the video material.

1. Pollution
2. The Cell
3. The Excretory System

The conceptual aspect of 'The Cell' and 'The Excretory System' have no scope for substantial variation. The topics are vital basis for the students of Biology. The programmes on these contents would provide sound basis for the study of biology at secondary level. The content aspect of ecology in relation to 'Pollution' is relatively a basis for the fast developing branch of environmental science.
Moreover, the topic is of creating much social importance and civic consciousness. More over,

- the topics selected for the study had a technical, insightful and logical structure.
- in ‘Pollution’ the external environment is to be treated in the classroom and this could not be otherwise be experienced in the classroom. Video is the only medium that could bring in the outer world to the classroom.
- in ‘The Cell’ and ‘The Excretory System’ viewing through the microscope is essential and screening the same on a monitor would ease the task of the teacher and the taught.
- the contents of the programmes belonged to investigator’s own field of knowledge area and during a decade of teaching the subject, the investigator experienced the need for a suitable educational technological support for the conceptual understanding in students.
- the teachers as well as the students have identified the topics selected as ‘hard spots’ in the Biology syllabus of std VIII.

4.10.2 Content Analysis

In fabricating an instructional design analysis of the concepts to be learned under the prescribed topics forms an important component. Content analysis identifies the external structure of the concepts. It helps to develop a deeper understanding of what experts believe students should learn and to examine the role that technology
can play in facilitating learning outcomes. Hence it becomes obligatory to develop a suitable analysis of the content.

4.10.2.3 POLLUTION

i. Introduction

Population has been increasing uncontrollably so also the pollution of the environment. In pursuit of increased comforts and luxury, man is exploiting and polluting the environment thereby jeopardizing his existence itself. It is the duty of every one to protect himself, his fellow beings and conserve the biosphere by eliminating pollutions from his environment. The chapter is intended to make each student realize his duty and to enable him to carry out his responsibility towards conservation of environment and to strive for a pollution free earth.

ii. Concepts principles and skills involved

- The world population has crossed 606 crores. Population in India is estimated to be more than 107 crores.

- The relationship between population growth and extend of pollution.

- The pollution in a locality can cause adverse effects on a global level.

- The waste can be classified as domestic, industrial, bio-medical, agricultural and commercial waste.

- Some waste can be recycled and others can be reduced.
ii. **Entering behaviour**

The student knows the different methods of purifying water for domestic purpose. Observed microorganisms found in water through microscope.

The student knows the different means by which water sources in the locality such as, canals, ponds and wells etc. get polluted. They are able to suggest certain measure to prevent pollution of water bodies.

i. **Terminal behaviour**

- To convince the fact that increase in population causes an increase in pollution.
- To make the students aware that local pollution can cause adverse effect on a global level.
- To understand the sources of pollution, their components and nature.
- To understand the ways in which pollution can be kept at a manageable level to save the environment.
- To get familiarized with the rules and agencies related to environmental conservation.

4.10.2.b **The cell.**

i. **Introduction**

The lesson presents the knowledge regarding the cell, which is the basic unit of living beings and findings of scientists, engaged in
the study of cells and cell organelles. A structural complexity of a
typical cell and a comparison of animal cell and plant cell is presented.

ii. Concepts, facts, skills etc. involved

- All living things are made up of cells.
- The living component of a cell is called protoplasm.
- Protoplasm is made up of the nucleus, cytoplasm and cell
  membrane.
- The Nuclear control the activities of the cell.
- Cytoplasm is a jelly like fluid in which the activities of the cell
  takes place.
- Cell membrane forms the boundary of cytoplasm.
- In lower organisms the same cell carries all the life activities.
- In multicellular organisms the body functions are carried out
  by specialized group of cells. But the basic structure is
  almost the same.
- Election microscopic structure of the cell.

iii. Entering behaviour

- The student knows that the cells are the basic unit of the
  living body.
- Cells contain protoplasm.
- Protoplasm is made up of nucleus and cytoplasm.
iv. Terminal behaviour

- To enable the student to have an understanding about, the events that lead to the discovery of the cell.
- To understand the basic structure of a typical cell.
- To know the cell organelles and their functions.
- To understand the structural differences between plant cell and animal cell.

4.10.2.c The Excretory system

i. Introduction

Excretion is a life process performed by all living things. In vertebrates a pair of kidneys are the major excretory organs. Nephrons are the basic excretory structures of the kidney. In man, lungs, liver and skin also perform excretion.

i. Content

- Significance of excretion.
- Kidneys and associated structures. Cortex and medulla.
- Structure of a Nephron.
- Filtration of waste materials between the glomerulus and Bowman’s capsule.
- Reabsorption of water and dissolved molecules from the nephric filtrate.
- Removal of urine.
- Excretion through lungs, liver and skin.
ii. **Entering Behaviour**

**Students**

- Have knowledge about the life activities
- Have knowledge about the complexity of body organization
- Know that waste products are accumulated in the body as a result of life activities.
- Each organism has a mechanism to remove the metabolic waste products.
- In man excretion is chiefly done by kidney and associated structures - ureters, Urinary bladder and urethra.
- Knowledge of the location, shape, size, color and structure of the kidney

iii. **Terminal Behaviour**

**The student**

- understands the significance of excretion.
- identifies that excretion is carried out by the kidneys and associated structures - ureters, urinary bladder and urethra.
- kidney is composed of two regions - cortex and medulla.
- the functional unit of kidney is nephron.
- glomerulus is a branch of capillaries seen inside the Bowman's capsule.
• filtration of waste materials from the blood takes place between the glomerulus and Bowman's capsule.

• water and the dissolved molecules of useful substances are reabsorbed from the nephric filtrate when it passes through collecting tubule.

• urine collected inside the collecting tubule is drained through the ureters and stored in the urinary bladder and pass out through the urethra.

• develop the ability and skill to identify and label the parts of a nephron.

4.11 Designing Media for Instruction

Instructional design is meant to ensure effectiveness and efficiency of method and materials used for instruction.

Instructional design refers to application of well-defined procedural steps for designing instruction and instructional resource materials.

Inputs from theories of learning, fundamentals of attention, perception, communication, memory and student motivation etc are to be suitably incorporated in the instructional design. Heimich, Molenda and Russel present a procedural guide - the ASSURE model for planning and delivering instruction that incorporates media. It involves six steps:

• Analyze the students
• State objectives
- Select methods and materials
- Utilize media and materials
- Require student participation
- Evaluate/Revise.

In designing media based materials, the student, the mode in which instruction is proposed to be delivered, availability of time, infrastructure- both in terms of hardware, software, cost effectiveness, technical expertise, equipments and facilities are to be taken into account.

4.11.1 Principle of media design: the process of developing software

a. The content design

The content that the users can experience be presented in a variety of ways. To maximize the effectiveness of the presentation a design can be structured based on pedagogical principles and experience. The structure the author imposes on the information shapes the environment in which the user can explore. The user could theoretically move from a unit of information to other unit of information in a linked manner. The structure is determined based on the purpose of the software product and the possible logical connections in the content.

b. Sequential design

The most basic way to present information is a linear sequential design. Here each element leads directly to the next in
logical sequence with no other options for the user. Educational videotapes use this organizational structure.

Linear sequential design is simple and easy to the user, as the user is not demanded to operate a complicated navigation system. Content can be communicated logically, informatively and interestingly or attractively. The sequential structure is helpful to a user who is just a beginner in using multimedia PC.

c. Graphic Design

The purpose of careful graphic design is to make the displayed information as informative, easy to understand to remember. Teaching experience and creative talent counts more.

d. Text presentation and writing style

Principles of using text are to emphasize clear communication, legibility and motivation. Present text in chunks surrounded by space for greater legibility. Factors affecting attention and perceptions should be taken care of in presentation. Small blocks of text are best suited than continuous screens of text. The text on the screen should be easy to read and special embellishments (special fonts, bold type, size etc) should be limited to situations in which it is important to draw the attention of the users and to something unique and specific.

Following are the general guidelines were observed.

- Text messages should be concise.
- Text should be easy to read.
• Consider presenting text in several different forms within the same screen display.

e. Navigation

Navigation is concerned with the practical mechanisms by which the potential user will interact with the information provided. The user must have some idea about the product i.e how the material is organized and how to control the use i.e where the user is within the total body of information and how to get from one location to another. The goal is to allow the user to learn the material and think and not to think what must be done to interact with it.

4.11.2 Connection between the teacher, learning environment and student - a model

In the present model, technology and the teacher presents information to student. This information will be concepts or ideas the students to master or experience. But it is presented to the eyes and ears as well as body kinesthetic. The student has to use a Multimedia PC for the learning task. Technology is used as a tool for manipulating the instruction. The experiences resulting from this manipulation as well as the interactions with the teacher and what the student think about and learn from.

The teacher's introduction to the tool, onsite support and responses add to the new information to process. The student also acts on the learning environment. He can proceed at the pace of the tool or can manipulate it according to his pace, move backward or forward to any point of presentation or skip to any point or review any
area any number of times or make the frames still for keen observation. The students thinking behaviour takes form in the paper as responses to the stimuli presented by the teacher. This written material will become another information resources for the student to think about and discuss with the teacher or peers or a review of the tool itself.

Clicking with a mouse or pressing a designated key will help in situations where inexperienced users are many or in situations when instructions must be minimal. For reasons related to practical matters of teacher's time and resources and to the design of learning environments, these classroom application often require that students work in pairs or small groups.

4.11.3 Evaluating and revising

Understanding and fixing problems related to both the software and the content that the software was developed to present.

- Learn to test systematically all planned and unplanned actions within programmes that have been created.
- Ask naive users to try out products and carefully observe what happens.
- Test out products on different equipments that the target audience will use.
- Ask a content area expert to review the product.

This provides excellent opportunities to do the mental activity required to find connections with what they already know. The teacher assesses the result of students' learning behaviour and remediation is
done through reviewing the tool asking the teacher or peers for assistance. The assessment of learning requires the student to demonstrate understanding and the ability to apply knowledge as well recall facts.

The tool presents critical concepts and ideas to be learned in a direct manner and the student working with it are engaging in reception learning. When the content emphasizes visual elements or sounds, a combination of representational system is better suited to the content of some disciplines (Smagorinsky, 1995).

So a computer based presentation potentially using some combination of text, pictures, sound, stills and video - a multimedia product is prepared. It has even been claimed (Jonassen, 1986) that multimedia may represent a superior learning as the traditional film and VHS formats are quickly giving way to the digital format.

4.11.4 Perspectives of the present multimedia programme

Now films and compact cassettes (VHS) are giving way to discs. Hence the new technology was adopted in preparing the video programme and it could be displayed using a multimedia PC that is rapidly occupying its place in schools. Since Information Technology is one of the school subjects the students themselves can manipulate the PCs. The format presented is a blending of a linear video format and the ease in accessibility of the information using a computer. A person with a very basic knowledge of operating a multimedia PC that is commonly available in schools can learn lessons using the programme prepared. In this format, units of information such as segments of text,
segments of audio, pictures, animations and video clips are connected in a linear way. The linear multimedia programme offers a self-contained user-friendly presentation. Using a multimedia PC the user direct the software and hardware environment. Any point in the programme can be accessed within seconds or reviewed any number of times.

From the angle of a teacher having fairly good knowledge of operating a multimedia PC can produce his/her own multimedia product to assist his/her class. A computer with a fast processor, good storage capacity, audio and video capabilities, video editing software, CD writer, and a microphone can help the teacher in creating own multimedia for classroom use. A digital camera with video recording facility or a mobile phone with video capturing facility is an added advantage for capturing amateur picture/video clips useful for developing a video programme by the teacher for his/her class. So the format is student friendly and teacher friendly.

4.12 Development of Video materials

Laysaught and Williams (1968) suggested five criteria for the selection of a topic for programming. These are:

i. Programmer’s own field of interest
ii. Length
iii. Depressed level of learning
iv. Logical order of material
v. The exclusiveness of special students needs
Laysaught and Williams suggested the criteria for developing programmed learning material. The investigator has developed linear programmed learning material; validated and tested its effectiveness as a part of his earlier research and feels that the stages could be modified because video programme consists of scenes and each scene comprises of a series of shots. The concepts in lesson are broken down into a number of scenes in a sequential or linear order and thereby the sequences of concept to be developed in the lesson are prepared. Following are the steps to develop a linear video programme:

- Selection of the topic and its analysis.
- Defining entry-level behaviour.
- Defining terminal level behaviour.
- Sequencing and scripting.
- Frame-construction, shooting, video-audio synchronization.
- Video Editing.
- Testing and revision.
- Validation.

4.12.1 Video Production

The generation of a polished video product is called video production.

This could be accomplished through a sequence of steps:

a. Sequencing and scripting

A video programme (linear) consists of sequences of scenes. Each scene comprises of a series of shots. Thus the series for video
material for each unit were planned and the investigator prepared scripts. The investigator had experiences of producing educational video films and scripting. A narrative script was prepared keeping in mind the target group, previous knowledge, language level & vocabulary and speed of comprehension, the objectives to be attained, the concepts to be attained, methods to be used for presentation, the audio, video synchronization etc.

b. Frame construction

A frame is a single item or step or scene that represents a single idea with suitable visuals. Each concept was usually resolved into a number of frames with verbal medium and visuals.

Collecting primary sources i.e. raw video, audio resources from location, on line and library resources were attempted. A Digital camcorder was also used to incorporate still images, photographs, video, charts etc. Technical assistance became necessary but the investigator directed the process.

c. Resources needed

- A Digital camera or cell phone with video facility is an essential component. Certain accessories helpful to improve the quality of what can be shoot with this. A good tripod, light sources and remote microphones are suggested.

- A Scanner can be used to capture the images that appear on paper or drawn on paper.
• A computer with good amount storage capacity and video and audio capabilities the multimedia PCs available today can serve this purpose.

• A powerful computer is needed to convert the input from digital camera for editing. The computer should have a fast processor and large amount of memory (minimum 128MB RAM) to work with real time processing of video and audio external storage.

• It is good to consider an external storage of the product on CD for which a CD writer is required.

• Video capture and video editing software. Video editing software is required to combine the video and audio segments with other information sources. E.g.: VCD Cutter, Video cutter

d. Video editing

Video editing is the process of integrating or making changes in the video elements like text, audio, video, images etc., into a video production. Video editing involves adding text, deleting unimportant or portions not needed from video or audio, record narrations, adding video and audio transitions so as to create a well-integrated final product as envisaged. A microphone connected to the multimedia computers line-in brings audio signals into the computer (has sound processing capabilities). The final product can be a self-contained product. This was done with the help of a multimedia computer and technical support. The final product is stored in digital
format in CD ROM and can be displayed using a computer or can be projected.

e. Testing and revision

The investigator consulted well experienced practicing biology teachers, educationists and even some students of standard VIII to obtain feedback on the rushes developed- in aspects like language, comprehensibility, coverage and clarity, graphical and visual presentation, photography, audio etc. A schedule was prepared and used for the purpose.

Based on the feed back on the programme suitable modifications were made. The video lessons developed were validated from different angles viz- content, language, videography and audio. The responses of the evaluators to the various aspects considered were given in Appendix. The different aspects of the media considered were rated moderate by the evaluators.

The video programmes were exposed to a few samples from the target group as an attempt to establish comprehensibility. After making the video presentation, an Achievement Test was administered to the group to see whether the objectives fixed were realized. Based on the feedback necessary revision was made in the video programmes before experts subjected them to validation.

f. Validation of the video programme.

Validation of the video programmes include the judgment belonging to diverse angles, the effectiveness the package is assisting for producing the behavioural component and its efficacy for the
population of the student for whom the programme has been developed. These judgments were done based on collection and analysis of various types of data.

After the rejection and modification of certain frames the investigator attempted to get the video lessons validated. In the process of validation of individual or specific video lessons the researcher adopted the following steps:

- Developed video lessons.
- Obtained experts' views regarding the quality of video lessons using a schedule prepared for the purpose.
- Experimented the lessons on a small sample selected for the purpose.
- Conducted pre and post tests for each unit

4.13 Socio Economic Status Scale

In order to obtain the data regarding the student's socio-economic status, a personal data sheet has been used. This tool was developed by Nair, A.S. (Revised edition 2000) to measure socio-economic status of the students.

It measures the individual's father's occupational level and income level. An equal weightage was given to mother's or guardian's educational level, occupation and income level. The income levels are with respect to the latest income rating.

The tool was in the form of a questionnaire, which in addition to obtaining data for quantifying socio-economic status, was also
helping in obtaining personal information related to each subject. Education level, occupation level, income level were determined by quantifying the data and socio-economic status was determined. A copy of the test is appended (Appendix - I).

4.14 Kerala University Group Test of Intelligence (Verbal)

This is a point scale in Malayalam developed for measuring the general intelligence of students in secondary schools of Kerala. This has been developed by Pillai, Nair and Amma (1968). It is composed of five subtests.

1. Verbal analogy
2. Verbal classification
3. Proverbs
4. Number series and
5. Verbal reasoning

The five subtests, numbers of items and time limit for each are given in Table - 4.7.
Table 4.7

Sub tests, Number of items and the time limit for each sub test in the verbal group test of intelligence

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of sub tests</th>
<th>No. of items</th>
<th>Time limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verbal analogy</td>
<td>20</td>
<td>5 Min</td>
</tr>
<tr>
<td>2</td>
<td>Verbal classification</td>
<td>20</td>
<td>5 Min</td>
</tr>
<tr>
<td>3</td>
<td>Proverbs</td>
<td>20</td>
<td>5 Min</td>
</tr>
<tr>
<td>4</td>
<td>Number series</td>
<td>20</td>
<td>10 Min</td>
</tr>
<tr>
<td>5</td>
<td>Verbal reasoning</td>
<td>20</td>
<td>8 Min</td>
</tr>
</tbody>
</table>

4.14.2 Description of the subtests

a. Verbal analogy

These words are given of which the first two words suggest a relationship. The same relation is to be observed between the third word and a fourth one to be found out from the four words given in brackets.

Examples of the items in this subtest are given below:

1. Train: Station::Ship:
   (Ans. Harbour)

2. Policeman : Hat :: King :
   (Ans. Crown)

This test includes 20 items and the time limit is 5 min. It involves the ability to see the relationship between two things or ideas.
and to use the relationship to other situations. The items are based on Spearman's principle of cognition given below:

1. A person lent to find relations between the parts of any apprehended material.

2. If a person apprehends a presentation and a relationship presented with it the related experience or concepts (correlate) is also evoked.

Factor analytic studies showed that this involves a reasoning factor identified as 'education of relationships'.

b. **Verbal classification**

In this, for each item five words are given of which four can be grouped together according to some principles or law. The student has to choose the word that does not fit in the class of other words, and mark it in the scorecard according to instruction given below:

1. a) Addition  b) Subtraction  c) Multiplication  
d) Arithmetic  e) Division  
   
   (Ans. Arithmetic)

2. a) Football  b) Cricket  c) Hockey  
d) Chess  e) Volley Ball  
   
   (Ans. Chess)

Twenty items are included in the test. The mental process involved in answering items of this type is identified to be the same as that in analogy i.e. the mental process involved in 'education of relationships'.
c. Proverbs

Each item consists of a proverb followed by four statements explaining its meaning. The students have to choose the statements that come very close to the idea contained in the proverb. Two examples from the test are given below:

1. Slow and steady wins the race
   a) If we eat slowly we can eat a large amount of food.
   b) If we do slowly we can finish a work however hard it may be
   c) Any work should be done slowly
   d) Any work that is done slowly is good.

   (Ans. b)

2. All that glitters is not gold
   a) External and internal characters are not the same
   b) All shining things are not gold
   c) Gold need not glitter always
   d) Don't be amazed by seeing the outward appearance

   (Ans. d)

There are twenty items in the test. Items of this type are mostly saturated with 'g' and the mental ability involved in selecting the best statement is supposed to be "verbal comprehension."

d. Number series

In each item a series of numbers in a certain order is given of which one is missing. The students have to choose the correct numbers from those given in brackets. Two illustrative examples are given below:
1. 5, 9, 13, 17, 21 (a. 25 b. 34 c. 17)  
(Ans. 25)

2. 4/5, 5/6, 6/7, 7/8 (a. 7/16, b. 8/9, c. 18)  
(Ans. 8/9)

This sub test consists of 20 items. Thurstone identified that the mental ability involved in this type of problem is 'inductive reasoning'.

e. **Verbal reasoning**

A problem requiring the perception of some sort of relationship and its identification is given. The students have to select the correct answer to the problem from the four alternatives given. Two illustrative examples are as follows:

1. Suma is older than Usha. Geetha is younger than Usha. Prema is older than Suma. Then who is the oldest of them?
   

   (Ans. Prema)

2. A family went out for a walk. Son walked before the father. Daughter was walking behind the father and ahead of mother. Who walked last?

   a. Father  b. Mother  c. Son  d. Daughter

   (Ans. Mother)

Twenty problems of the above sort are included in subtest. Thurstone identified that the mental ability involved in answering items of this type is 'deductive reasoning.'
4.14.3 Validity and reliability

The test components have been adopted from popular standardized test with high 'g' loadings. This has been followed by procedures for attaining high internal validity ensured through items analysis. Inter-correlation of the subtests also has been worked out on a select representative sample (N=120). Table 4.8 shows the inter test correlation matrix of the sub test of the Verbal Group Test of Intelligence.

Table 4.8

Inter-Test correlation Matrix of the sub tests of the Verbal Group Test of Intelligence

<table>
<thead>
<tr>
<th>No.</th>
<th>TEST</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analogy</td>
<td>75</td>
<td>66</td>
<td>45</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Classification</td>
<td>63</td>
<td></td>
<td>47</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Proverbs</td>
<td>47</td>
<td></td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Number series</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Verbal reasoning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

External validity was calculated against school marks (N+50) and against Raven’s progressive Matrices Test (N=120). These were found to be 0.64 and 0.56 respectively.

The factorial validity of the test was later determined by Kurup (1969). The study shows that 75% of the common variance of the battery was accounted by the general factor, the 'g' factor of intelligence.
The test retest reliability is 0.79. The split half reliability of the whole test and sub tests (N=120) is given in Table 4.9.

Table 4.9
Split half reliability of the Verbal Group Test of Intelligence

<table>
<thead>
<tr>
<th>No</th>
<th>Subtest</th>
<th>Reliability co-efficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verbal analogy</td>
<td>0.88</td>
</tr>
<tr>
<td>2</td>
<td>Verbal classification</td>
<td>0.86</td>
</tr>
<tr>
<td>3</td>
<td>Proverbs</td>
<td>0.66</td>
</tr>
<tr>
<td>4</td>
<td>Number series</td>
<td>0.86</td>
</tr>
<tr>
<td>5</td>
<td>Verbal reasoning</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>Whole test</td>
<td>0.94</td>
</tr>
</tbody>
</table>

The values and procedures cited above show that the test is a valid and reliable measure of 'g' factor of intelligence. A copy of the test is given as Appendix - II.

4.15 Achievement Test in Biology for Std VIII

Achievement Tests in Biology for the topics, 'pollution', the cell' and 'the excretory system' were prepared by the investigator because no standard tests were available on the topics selected to test the effectiveness of the treatment. The ATs were prepared to assess the three domains of teaching such as knowledge, understanding and application. Only objective type test items were included in the test. The steps in developing a standardized achievement test were strictly followed by the investigator. The validity and reliability of the tests were
also found out. The effectiveness of the video materials have to be assessed in terms of student achievement in tests based on the content taught.

4.15.1 Construction of test items for draft test

As an initial step for developing AT, the investigator analyzed the whole content of each of the three units to form the basis of the treatment. Then decisions were made about the terminal behaviour of the student after being subjected to the treatment of the chunk of syllabus. The particular topics or unit of learning have educational objectives that could be classified into three categories namely cognitive, affective and psychomotor (Bloom, B.S. and others 1949).

In every category of objectives there occurs a hierarchical growth and each domain has various subcomponents. The objectives mentioned are to be achieved through classroom instruction. For this the teacher plans his lessons. In this venture the prominent questions are:

What is the level of the child?

- Why do I teach this lesson?
- In what way can I guide the mental development of the child?
- What learning experience should I provide the students to achieve these objectives?
- How should I evaluate the attainment of objectives?
Here learning experiences are the means to attain the defined objectives as well as other objectives. Learning results from the active interaction of the students to the stimulus situation that the teacher creates in the class. Thus the teacher's job is one of selecting and setting up such a situation in the classroom that stimulates the desired action. Thus objectives, instruction and evaluation are interrelated. Through evaluation we evaluate the outcomes of the learning experiences too. Thus the effectiveness of the medium used for providing learning experience - here, the video material will be revealed through the AT.

The segment of content which may vary from smallest piece of information to that of the biggest segment of knowledge may be considered as a domain from the point of view of testing. One can identify cognitive learning outcomes also with regard to the segment of content and a similar hierarchy can be established ranging from the simple knowledge to the higher mental process as shown below.

4.15.2 Strategy for test construction and external review

Now two strategies are possible for test construction. One may select the number of domains and test for elements of the level Knowledge, Comprehension, and Application together or test only the key ideas presenting the core indicating the learning outcome. In the second approach of the intended core learning outcomes are found to have attained by the student. The approach helps to reduce the length of the test because the lower level concepts need not be included.
The tasks thus identified should be viewed by those who are not involved in making decision regarding the item of content elements, the domain and its description, the Terminal behaviour. Major purpose of this external review is to sharpen the domain description and the specific objectives in order to make them more scientific and functional.

a. **Construction of test items**

   Question paper consisting of multiple-choice items was prepared. Majority of them were intended for the average, but neither the intelligent nor the dull was neglected. Items written were given to experts inviting their suggestions for improvement. Modifications were made accordingly. The items were arranged accordingly to their level of difficulty. The draft form of the question papers was prepared with necessary directions. Enough space was provided against each item for entering response.

b. **Try out**

   A try out was done on sample of 100 students of Std VIII. Enough time was given so as to enable all students to complete the test. The average time used was noted and the scoring was done by giving one mark to each correct response.

c. **Item Analysis**

   The quality of each item was determined by analyzing two important characteristics of the items

   i. Difficulty index
   ii. Discriminating power
Kelly's (1939) method was used to calculate the difficulty index and the discriminating power. Based on the scores obtained, students were arranged in descending order from the highest to the lowest. The first and last 27 papers were used for item analysis. The difficulty index and discriminating power were calculated using the formulae

\[
\text{Difficulty index} = \frac{(U+L)}{2N}
\]

and

\[
\text{Discriminating power} = \frac{(U-L)}{2N}
\]

Where

- \(U\) - is the number of students passing in the upper group.
- \(L\) - is the number of students passing in the lower group.
- \(N\) – is the number of students in each group.

Items having difficulty index between 0.25 and 0.75 were selected for the final test. Similarly discriminating power above 0.25 was selected for the final test.

d. Preparation of the final test

In order to get enough item for the final test, under each objective and content unit more number of items than the required were included than in the test and under each objective and content unit. Out of 50 items included in the try out, only 25 items were selected in each unit for the final test based on the difficulty index and discriminating power. A blue print was prepared for each topic - Pollution, The Cell, The Excretory system by giving due weightage to content, objectives and difficulty level. These were fixed with the concurrence of teachers who are handling the subject in various schools and subject experts.
The items were arranged and the time limit was fixed to 30 minutes. Spaces were provided to write the correct response. The ATs in Biology thus prepared are attached as appendices. Details regarding the weightage to content, weightage to objectives and weightage to difficulty level and blue print of the final tests prepared on the topic Pollution, The Cell and The Excretory system are as follows:

1. **Topic - Pollution**
   (i) **Weightage to content**

   The weightage to the content of the achievement test on pollution is given in Table 4.10.
Table 4.10
Pollution: Weightage to Content

<table>
<thead>
<tr>
<th>SI No</th>
<th>Content</th>
<th>Mark</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Population increase and pollution.</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Pollution–local and global level.</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Pollutants-sources, components and its nature.</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>Waste management.</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>5</td>
<td>Waste management: rules and agencies</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(ii) Weightage to objectives

The weightage given to different objectives in the achievement test on pollution is given in table 4.11.

Table 4.11
Pollution: Weightage to Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Comprehension</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>Application</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(iii) Weightage to difficulty level of questions

The weightage to difficulty level is given in table 4.12.
Table 4.12
Pollution : Weightage to difficulty level

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Difficulty level</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

(iv) Blue print

Giving due weightage to the objectives, content and form of questions blue prints were prepared for each unit. The cells in the blue print represent the number of items included in the test in relation to the particular objective and the mark is given in the brackets. The blue print of the topic pollution is presented in Table 4.13.
Table 4.13
Blue print of the Achievement Test in Biology for the topic 'Pollution'

<table>
<thead>
<tr>
<th>Objective</th>
<th>K</th>
<th>C</th>
<th>A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Population increase and pollution.</td>
<td>1(1)</td>
<td>1(1)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2. Pollution—local and global level.</td>
<td>2(1)</td>
<td>1(1)</td>
<td>2(1)</td>
<td>5</td>
</tr>
<tr>
<td>3. Pollutants—sources, components and its nature.</td>
<td>3(1)</td>
<td>3(1)</td>
<td>3(1)</td>
<td>9</td>
</tr>
<tr>
<td>4. Waste management.</td>
<td>3(1)</td>
<td>1(1)</td>
<td>3(1)</td>
<td>7</td>
</tr>
<tr>
<td>5. Waste management: rules and agencies</td>
<td>1(1)</td>
<td>1(1)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10</td>
<td>6</td>
<td>9</td>
<td>25</td>
</tr>
</tbody>
</table>

K – Knowledge, C – Comprehension, A – Application, O – Objective type.

The number in parenthesis indicates the mark and the number outside indicates the number of questions.
ii. Topic - The Cell

(i) Weightage to content

The weightage to the content of the achievement test on 'The Cell' is given in Table 4.14.

<table>
<thead>
<tr>
<th>SI No</th>
<th>Content</th>
<th>Mark</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Discovery of the cell.</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Basic structure of a typical cell.</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>Cell organelles and their functions.</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>Structural differences between plant cell and animal cell.</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(ii) Weightage to objectives

The weightage given to different objectives in the achievement test on the topic "The Cell" is given in Table 4.15.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>11</td>
<td>44</td>
</tr>
<tr>
<td>Comprehension</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Application</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
(iii) **Weightage to difficulty level of questions**

The weightage to difficulty level is given in the following table 4.16.

**Table 4.16**

The Cell: Weightage to difficulty level

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Difficulty level</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>25</td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(iv) **Blue print**

Giving due weightage to the objectives, content and form of questions blue prints were prepared for each unit. The cells in the blue print represents the number of items included in the test in relation to the particular objective and the mark is given in the brackets. The blue print of the topic the cell is presented in table 4.17.
Table-4.17

Blue print of the Achievement Test in Biology for the topic ‘The Cell’

<table>
<thead>
<tr>
<th>Objective</th>
<th>Form</th>
<th>Content</th>
<th>K</th>
<th>C</th>
<th>A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery of the cell.</td>
<td>O</td>
<td>2(1)</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Basic structure of a typical cell.</td>
<td>O</td>
<td></td>
<td>12(1)</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Cell organelles and their functions.</td>
<td>O</td>
<td></td>
<td>8(1)</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Structural differences between plant cell and animal cell.</td>
<td>O</td>
<td>1(1)</td>
<td>1(1)</td>
<td>1(1)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>11</td>
<td>13</td>
<td>1</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

K – Knowledge,  C – Comprehension  
A – Application,  O – Objective type.

The number in parenthesis indicates the mark and the number outside indicates the number of questions.
iii. Topic - The Excretory System

(i) Weightage to content

The weightage to the content of the achievement test on the Topic 'The Excretory System' is given in Table 4.18.

<table>
<thead>
<tr>
<th>SI No</th>
<th>Content</th>
<th>Mark</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Significance of excretion.</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Kidneys and associated structures.</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Cortex and medulla.</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Structure of a Nephron.</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>5</td>
<td>Filtration of waste materials between the glomerulus and Bowman’s capsule.</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Reabsorption of water and dissolved molecules from the nephric filtrate.</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>Removal of urine.</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

(ii) Weightage to objectives

The weightage given to different objectives in the achievement test on the topic "The Excretory System" is given in Table 4.19.
Table 4.19
The Excretory System : Weightage to Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>11</td>
<td>44</td>
</tr>
<tr>
<td>Comprehension</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Application</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

(iii) Weightage to difficulty level of questions

The weightage to difficulty level is given in table 4.20.

Table 4.20
The Excretory System : Weightage to difficulty level

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Difficulty level</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>14</td>
<td>56</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

(iv) Blue print

Giving due weightage to the objectives, content and form of questions blue prints were prepared for each unit. The cells in the blue print represents the number of items included in the test in relation to the particular objective and the mark is given in the brackets. The blue print of the topic the Excretory System is presented in table 4.21.
Table 4.21

Blue print of the Achievement Test in Biology for the topic
'The Excretory System'

<table>
<thead>
<tr>
<th>Objective</th>
<th>K</th>
<th>C</th>
<th>A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>1. Significance of excretion</td>
<td>5 (1)</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2. Kidneys and associated structures</td>
<td>1(1)</td>
<td>2(1)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3. Cortex and medulla</td>
<td>2(1)</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4. Structure of a Nephron</td>
<td>1(1)</td>
<td>6(1)</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>5. Filtration of waste materials between the glomerulus and Bowman’s capsule</td>
<td>1(1)</td>
<td>1(1)</td>
<td>1(1)</td>
<td>3</td>
</tr>
<tr>
<td>6. Reabsorption of water and dissolved molecules from the nephric filtrate</td>
<td>1(1)</td>
<td>1(1)</td>
<td>1(1)</td>
<td>3</td>
</tr>
<tr>
<td>7. Removal of urine</td>
<td></td>
<td>2(1)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11</td>
<td>10</td>
<td>4</td>
<td>25</td>
</tr>
</tbody>
</table>

K – Knowledge,   C – Comprehension
A – Application, O – Objective type.

The number in parenthesis indicates the mark and the number outside indicates the number of questions.
h. Reliability and Validity of the Achievement Test

The Reliability and Validity of the tests were found as follows

i) Reliability of the Achievement Tests

In the present study the split half method was used to determine the validity of each of the test. The scores obtained for each individual for the test were divided into two groups by pooling into odd numbered items and even numbered items. Only 40 answer sheets were selected using the random sampling method. The reliability of the whole test was calculated by the Spearman Brown prophecy formula and the details are given table 4.22.

\[ R = \frac{2r}{1+r} \] (Garret; 1981)

Where \( R \) - reliability coefficient of the test

\( r \) – correlation coefficient of the test
Table 4.22
Table showing the reliability of the whole test

<table>
<thead>
<tr>
<th>Unit</th>
<th>Items</th>
<th>n</th>
<th>Mean</th>
<th>S.D</th>
<th>r</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollution</td>
<td>Odd</td>
<td>40</td>
<td>11.80</td>
<td>4.686</td>
<td>0.84</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>Even</td>
<td></td>
<td>12.15</td>
<td>5.251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Cell</td>
<td>Odd</td>
<td>40</td>
<td>14.17</td>
<td>3.923</td>
<td>0.96</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>Even</td>
<td></td>
<td>14.60</td>
<td>4.877</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Excretory</td>
<td>Odd</td>
<td>40</td>
<td>11.65</td>
<td>4.735</td>
<td>0.73</td>
<td>0.84</td>
</tr>
<tr>
<td>System</td>
<td>Even</td>
<td></td>
<td>12.45</td>
<td>5.064</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The obtained reliability value of the test on pollution is 0.91, the cell is 0.97 and the excretory system is 0.84. This shows that each test has a substantial reliability (Best & Khan; 1996)

ii) Validity of the Achievement test

In an achievement test, content validity; construct validity, Statistical or Empirical validity is important. Validation was done during the field-testing of the video programme. For determining the effectiveness the final test was used as a pretest and posttest for obtaining the scores of the students before and after the encounter of the programme.

a. Content validity

Coverage of the subject matter of the unit will yield satisfactory validity with regard to the content. Careful inspection of the content of the test is sufficient to establish the content validity. The
procedure adopted for constructing the test gives clear evidence on the content validity of the test.

b. **Construct validity**

Construct validity refers to an analysis of "effective expression" of items in the test. Selection of ideas to be presented, its organization, presentation, paragraphing, writing effective sentences, effective use of words, form and style of message are the main components for analysis of effective expressions (Thorndike and Hagen, 1955, p.112).

In the present study the ideas of selected topics were organized in a logical order by the investigator and adequate representations to all concepts were given. Simple and lucid language was used so as to make it readable and comprehensible and the achievement test prepared by the investigator fulfilled the requirement of effective expression and hence the tests have good construct validity.

c. **Statistical or Empirical validity**

The empirical validity of the test was calculated by correlating the scores of the test with marks of three recently conducted tests obtained from the school (Ebel, R.L; 1960). The product moment coefficient of correlation was calculated. These values indicate that the tests have good empirical validity. Table-4.23 shows the details regarding empirical validity of the tests. A copy of the three achievement tests are appended (Appendix 3, 4 & 5).
Table 4.23
Empirical validity of the Achievement Tests.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Test</th>
<th>n</th>
<th>Mean</th>
<th>S.D</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollution</td>
<td>CT</td>
<td>40</td>
<td>22.475</td>
<td>9.346</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>40</td>
<td>23.700</td>
<td>9.426</td>
<td></td>
</tr>
<tr>
<td>The Cell</td>
<td>CT</td>
<td>40</td>
<td>27.175</td>
<td>8.413</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>AT</td>
<td>40</td>
<td>28.675</td>
<td>8.594</td>
<td></td>
</tr>
<tr>
<td>The Excretory</td>
<td>CT</td>
<td>40</td>
<td>22.375</td>
<td>9.001</td>
<td>0.98</td>
</tr>
<tr>
<td>System</td>
<td>AT</td>
<td>40</td>
<td>24.100</td>
<td>9.120</td>
<td></td>
</tr>
</tbody>
</table>

4.16 Procedure of Experimentation.

4.16.1 Administering Group Test of Intelligence and SES Scale and grouping.

The experiment was conducted at HSS, Thirumala for about 3 months during the periods allotted for teaching Biology a week.

The Kerala University Group Test of Intelligence (verbal) was first administered over all Std VIII students (English medium) of the school. After establishing a rapport with the students proper instructions were given on what are the objectives of the testing and how they have to respond. The response sheets and test booklets were distributed and after 30 minutes they were collected back by the investigator.

Next day the socio economic status scale was administered among the same batch of students after giving proper instructions.
Special care was given to collect complete information about the socio-economic status of all the participants.

Students were divided into two groups of boys and girls at random consisting of 35 students in each group. These two groups were made equivalent with the help of group matching techniques on the basis of mean intelligence scores and mean SES scores. However further treatments were done on all the students of each group but the scores of only 140 students were taken into account that remained in the groups after group matching.

4.16.2 Instruction and tests

4.16.2.a Teacher controlled Video Assisted Instruction to the experimental group and posttest.

Group A was selected for providing the Video Assisted Instruction in a teacher-controlled manner. The students' entry-level behaviour was assessed through a pre-test. The teacher then introduced the unit and enabled to gain the concepts with the help of video assistance. The students were prepared to view the programme based on the points already noted. After the screening a review of the video lesson was done. Students cleared their doubts seeking the help from the teacher whenever felt so.

Students were asked for clarification if any and were allowed to review. After completion of the unit the posttest was administered to the group to assess the achievement. The same procedure was repeated with each unit subjected for study.
4.16.2.b. Traditional instruction to the control group and post test

Group B was subjected for traditional teaching where lecture cum discussion method was followed with the support of usual necessary illustrations or aids. The conventional classroom teaching followed a pretest. At the end of the unit the posttest was administered to assess the achievement.

The pretest and the posttest administered to the experimental group and control groups was the same and the same teacher taught the three selected topics to the two groups.

Thus the experiment was completed in three months as per the regular class timetable.

After the collection of data scoring was done. Only those students chosen for the study in the groups after group matching and regular in all the treatments remained in the groups. Thus only 70 students of experimental group (35 boys & 35 girls) and 70 students of control group (35 boys & 35 girls) were considered as the sample for the study.

4.17 Statistical Analysis

The pretest and the posttest scores of the experimental and control groups were consolidated sex wise too, for statistical analysis along with their intelligence scores and SES scores to know whether there exists any relationship between these variables and achievement. It was necessary to find out whether there were any significant differences between the achievement scores of the pre test and post test in select topics in Biology as one of the main objectives.
of the study was to compare the effectiveness of TCVAI and TM for which descriptive statistics like mean and standard deviation of achievement scores were used. Analysis was done using the method of 't' test for analysing the significance of difference to compare the performance of experimental and control groups in relation to the variables selected. Since the degree of relationship existing between the variables could be measured in one figure and reduces the range of uncertainty associated with decision making and the prediction is likely to be more valuable and near to reality, correlation study was used extensively. Graphical presentation were also made.

The analysis of data through the application of above statistical techniques have been reported in the following chapter.