CHAPTER III
CHAPTER III
METHODOLOGY

INTRODUCTION

The methodology of the present study describes the design of the study, construction of tools, data gathering procedures and data analysis. Selection of an appropriate methodology for the study provides clear direction to the researcher with regard to the various steps to be followed in carrying out the research successfully. Having described the rationale of the study supported by a detailed review of related literature in the previous chapters, the researcher describes the methodology of the present study in this chapter entitled "Effectiveness of the Computer Assisted Instruction and Cooperative Learning in Biology for Standard XI Students"

The methodology of this investigation is described under the following headings:

A. Variables
B. Selection and grouping of the sample
C. Pre and post test design
D. Selection of the content
E. Selection of media
F. Achievement tests
G. Data collection procedure
H. Data analysis procedure
I. Hypotheses framed for the study

A. Variables

Selection of proper variables is an important ingredient of a good research. Selection of right variables always improves the quality of the study and the generalisability of results. The present study aims at
studying the effect of several independent variables on the Biological science concepts of the XI standard students.

In this investigation, apart from the achievement scores, the following independent variables were included in the study.

a. Methods of Teaching

i. Computer Assisted Instruction,

ii. Co-operative learning,

iii. Conventional teaching.

Even though the focus is on learning, Co-operative Learning is included here as a method of teaching because teacher plays a key role in organizing, coordinating, conducting and facilitating group activities; hence, it is treated as a method of teaching in this study.

b. XI Standard Students

XI standard biology group students

The details with regard to annual income of the family, occupation, type of family and locality of the students were obtained from a carefully worded background information data sheet (Appendix I).

B. Participants

The students in the study, chosen as a convenience, cluster sample, are seven hundred and fifty higher secondary students, there are a wide range of SES levels, from children of professional, upper-class parents to lower middle class and the students are a mix of abilities, gender, and race.

Measures of Assessment Instruments

Curriculum Based Assessments are teacher made or textbook published instruments specifically designed to measure mastery of material presented. Mastery is considered to mean that students will score
at least 80% on each assessment. Various formats have been used such as multiple choice, matching, short answer, essay,

Today we see teachers using mainly the chalk and talk method in the classroom. This is not the only way of teaching. The students find biology as a separate subject at the higher secondary level. The teaching strategies and techniques are very important for the quality of teaching. For computer assisted instruction and co-operative learning method with respect to their achievement in biology, different types of schools were undertaken to find the similarities as well as dissimilarities. In computer assisted instruction, teaching is done using computer.

The investigator conducted the study in six schools in Salem district. Out of six two government schools and two government aided schools from the urban area and two government schools from the rural area were selected. Both in rural and urban schools, teachers resort to chalk and talk method. In the rural areas there is shortage of teachers, dearth of competent teachers specialized in the particular subject large classes leading to poor students’ performance, lack of facilities in the laboratory etc. The investigator selected the topics from the biology textbook prepared by Tamilnadu Textbook Society and prescribed for Class XI. Though multimedia was available for the X and XII standard, the students in XI standard did not benefit much, so the investigator was interested in preparing the instructional material for XI standard biology students. As the rural students were very much interested in group discussion the investigator also selected cooperative learning as one method of teaching in her research.

**Systematic sampling**

According to Nagarajan (2003), systematic sampling involves, selecting every \( K^{th} \) item of the population ie., \( K = N/n \), where \( N = \) Number of items in the population and \( n = \) number of items
proposed to constitute the sample; this number \( K \) is called the sampling interval. An element of randomness is introduced into this kind of sampling by using random numbers to pick up the unit with which to start.

The investigator applied systematic sampling techniques for selecting the sample for the present study. The investigator applied systematic sampling method to students of XI standard from different schools in Salem district. These schools included government and government aided schools from urban area and government schools from rural area. A total of 720 students were selected as the sample of the study. In this study, the investigator selected a particular class (XI standard biology students) from the population to constitute the sample because this category was considered to mirror the whole with reference to the characteristic in question.

According to the marks obtained by the students in the quarterly examination the students were divided into three groups. Only those students who have scored above 40 percent marks were selected and listed in alphabetical order. Students were asked to call out the numbers 1, 2 and 3 to form three different groups. Those students who called out number 1 constituted the Computer Assisted Instructional group, those students who called out number 2 constituted Cooperative learning group and students who called out number 3 constituted the conventional teaching group.

The investigator selected this type of sampling technique as it can be taken as an improvement over a simple random sampling method. It is an easier and less costly method of sampling and can be conveniently used even in case of large population. Systematic sampling is used when lists of population are available and they are of considerable length. This method may require less time and it is easier to check whether every student has been included in the sample.
The 720 students were divided into three groups of 240 students each. Out of these three groups, two groups were treated as experimental groups and one group was treated as the control group. Since two treatments were used, one experimental group was exposed to computer assisted instruction and the other group was exposed to the cooperative learning method treatment, whereas the control group was exposed to conventional teaching. The distribution of the sample is presented in Table I.

**TABLE I**

**DISTRIBUTION OF THE SAMPLE FOR THE STUDY**

<table>
<thead>
<tr>
<th>Group</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Government schools</td>
<td>Government aided schools</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td><strong>Sex</strong></td>
<td><strong>sex</strong></td>
</tr>
<tr>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>CAI</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Coop</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>CT</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>120</td>
<td>120</td>
</tr>
</tbody>
</table>

CAI - Computer Assisted Instruction; Coop – Cooperative Learning; CT – Conventional teaching; M – Male; F – Female.

Distribution of the sample for the study is shown in the Figure 2.
CAI - Computer Assisted Instruction; Coop – Cooperative Learning; CL – Conventional teaching.

FIGURE – 2

DISTRIBUTION OF THE SAMPLE FOR THE STUDY

C. Pre test and Post test design

Pre test and post test design was used in the present study. According to Wiersma (1990) in this design of the study the subjects are randomly assigned to the two or more groups and tested just prior to the experiment on a supposedly relevant antecedent variable possibly a second form of the test that measures the dependent variable.
In the present study the pre test, post test design was extended to three groups as shown below:

<table>
<thead>
<tr>
<th>Groups</th>
<th>pre test</th>
<th>treatment</th>
<th>post test</th>
</tr>
</thead>
<tbody>
<tr>
<td>G₁</td>
<td>→ O₁</td>
<td>→ X₁</td>
<td>→ O₂</td>
</tr>
<tr>
<td>G₂</td>
<td>→ O₃</td>
<td>→ X₂</td>
<td>→ O₄</td>
</tr>
<tr>
<td>G₃</td>
<td>→ O₅</td>
<td>→ X₃</td>
<td></td>
</tr>
</tbody>
</table>

Here G₁, G₂ G₃ indicate the members of the groups assigned. X₁, X₂ and X₃ indicate the experimental treatments namely the Computer Assisted Instruction, Cooperative Learning and Conventional teaching applied to groups 1, 2, 3 and dash (------) indicates no experimental treatment applied to group which was exposed to conventional teaching. Odd numbers O₁, O₃, O₅ indicate pre tests and those with even numbers O₂, O₄, O₆ indicate post tests.

D. Selection of the content

As Biology comprises of many areas, it became necessary for the investigator to identify the areas that could be included in the contents. On examination of the content, the investigator arrived at the following areas from the plant morphology, namely (i) Root system (ii) Shoot system and (iii) Leaves. The content used in this investigation was divided into ten sub topics. The subtopics were:

1. Morphology of flowering plants (Introduction)
2. Root system
3. Types of root system
4. Root modifications
5. Shoot system
6. Modifications of stem
7. Leaf
8. Venation
9. Simple and compound leaves and
10. Leaf modification.

The content of the lesson is presented in Appendix III.

E. Selection of Media

Since the objective of the present study, primarily focuses upon the effect of Computer Assisted Instruction, Cooperative Learning and Conventional teaching, the investigator selected these three media as treatments for the study and the procedure followed is described below.

Conventional Teaching

The traditional school featured teacher-directed whole-class instruction organized around texts, workbooks, and frequent tests in tracked classrooms.

a. Computer Assisted Instruction

Computer assisted instruction is considered to be one of the best individualized instructions. Computer assisted instruction facilitates learning with the help of computers. Computer assisted instruction has been developed from the principles of programmed Instruction.

Computer Assisted Instructional Material- A Brief Outlook

An instructional module that is self-contained in the sense that all the essential components of instruction are employed. It is self sufficient as the learner has all the necessary material for learning from the module itself and therefore there is no need for the learners to seek other sources. It is therefore designed to function as an effective instructional system. Each instructional module is designed to consist of modular sub-units developed keeping in mind the learner's time.

The developed learning modules are sequenced for this purpose. It was essential first to do a “content analysis” of the prescribed course of
study over a period of time and the investigator designed the modules based on the content.

Each module has the following components:

- **Title:** The title is clear and concise.

- **Introduction:** It gives the background and rationale of the module as well as the target populations for whom the module has been developed.

- **Overview:** It introduces the learner to the theme of the module, its purpose, structure, organizations and uses.

- **Instructions to users:** It includes clear instructions to the learner as to how he should proceed and what he should do each step or stage.

- **Pretest:** The pretest is done to find out the level of knowledge and skills of the learner. If his level of knowledge is up to the standard expected he can skip the module and go to the next. Otherwise he is asked to study the module.

- **Objectives:** The objectives are stated clearly in terms of expected learning outcomes.

- **Learning Activities:** Learning activities are provided in a sequential manner. They should be based on entry behaviour of the learner and his actual needs. They should also take into account individual differences. Different media and methodologies also should be employed.

- **Formative Tests:** They are given at the end of each sub unit to help the learner know whether he has achieved the expected behavioral outcomes.
• **Summative Evaluation**: It is done with the help of a post test. It helps the learner to know well and has attained the expected learning outcomes.

**Preparation of the Module**

The teachers in the study who employed ‘computer assisted instruction’ as a strategy are experienced veterans who have taught 6th grade to higher secondary level for several years. In the two government schools, one teacher has seventeen years of service and the other has twenty two years and in the two government aided schools from the urban area, one teacher has eleven years and another has nineteen years and in the two government schools from the rural area one has twenty three and the other has twenty years of service. Based on the years of experience, the Biology teachers opined and the investigator also found that Biology was very difficult for the students to learn and it was difficult for students to remember the concepts and terms. Hence the investigator strongly felt the need to develop a computer assisted instructional material in Biology subject.

First page of the module has the overview of the module which specifies the topic of the conceptual subunits and the pattern of the module.

In the succeeding pages, instruction is given to the students as to how to use the module for self learning. The third page contains objective type test items to assess the preliminary knowledge or the entry level of competence of the students required for learning the module.

After the entry test, it is followed by introduction of the topic. General and specific objectives are delineated in behavioral terms. Next the learning materials for the objectives set forth are presented. Necessary diagrams, pictures, examples etc., are included in the materials suitably.
Flow chart depicting the components of the Learning Module is given in the Figure 3.

FLOW CHART OF LEARNING MODULE

Since module is a self instructional package, there is a greater need for formative evaluation to measure the progress and guide the content and pace of the lessons. Formative evaluation is done to discover
the strengths and weaknesses in learning to make midcourse
corrections, in pace or content of instruction (Slavin, 1987).

In the modules, provision is made for formative evaluation in the
form of embedded tests. These tests are useful to the degree that it is
informative, closely tied to the curriculum being taught, timely and
frequent. Also they provide feed back to the students that they can use to
improve their learning. After all the learning materials are presented, a
post test is given. It is used to make summative evaluation of student’s
knowledge and skills. It allows for comparison among students. Finally
keys to the formative tests are appended at the end.

The above provision enables the students to make self study with
the help of the modules. The modules thus developed were carefully
edited for accuracy and relevance of the material, style, vocabulary,
density of presenting the facts and content interest. This scanning was
very useful to eliminate ambiguities, obscurities and other inadequacies.
It also helped to improve the logical sequence of the presentation and
also to improve the technical accuracy of the content presented. For
proper editing of the modules, the services of the colleagues and subject,
exerts in the respective disciplines were utilized.

Once the editing was over, the modules were ready for tryouts. Try-
out is an essential process of validation and the tryouts help in refining
the module and make it relevant to the target population. So the modules
prepared were subjected to individual try out.

The prepared material was given to the experts and to the students
for try out. Clarifications were made, remarks were added and the pre-
test and post test questions were also analysed according to this. On the
basis of these ratings and analysis of the tryout, necessary corrections,
modifications, refinements etc., were made then and there itself.
Thus after completions of the tryouts, the material became well refined.
In this study the investigator used computer assisted instructional package on the selected content areas to the sample. Plates 1 and 4 depict students taught through computer assisted instruction.

Computer Assisted Instructional Package used for the study is given in the Appendix IV.

b. Cooperative Learning

Collaborative nature of scientific and technological work should be strongly reinforced by frequent group activity in the classroom. "putting students into groups to learn is not the same thing as structuring cooperation among students"

Peer Interaction

Informal cooperative learning groups of two to four students can be convened for as little as 5 minutes across the auditorium rows to discuss a challenge question, check for understanding of a concept, or construct a list of concepts that students are finding confusing. These groups can occur before, during, or after a lecture and can provide opportunities both for students to explore their understanding with others and for instructors to listen to student understandings. These groups have no structured continuity and may or may not share the content of their discussions with the instructor orally or in writing.

Jigsaw Approach

The explicit goal of the jigsaw discussion is for students to share their expertise and to gather information from peers who have completed a different task. For example, students in a developmental biology course may be asked to read articles about body plan patterning during embryonic development. As opposed to having all students read articles on the findings in multiple organisms, each student would be assigned readings highlighting findings in one organism, such as the fruit fly, nematode worm, zebrafish, or mouse. After completing the reading,
students would be assigned to jigsaw groups that would bring together four students, each of whom had completed readings on one organism, with the requirement that each student report to the others in an effort to identify common features

**Assigning Roles**

To facilitate positive interdependence among group members during a team project, instructors can assign, randomly or strategically, specified roles within groups. Assigned roles in cooperative learning are procedural and not roles of intellect or talent; they serve to delegate individual authority to students and engage all students in the work of the group. Scaffolded by these procedural roles, the intellectual work of the group is accomplished cooperatively by all team members. Common procedural roles that can be used in informal, as well as formal, cooperative learning groups include facilitator, recorder, reporter, and time keeper. In addition, instructors may choose to design other procedural roles depending on the age of the students and the nature of the task.

According to Beth Lewis, (2008), Co-operative learning is a form of active learning where students work together to perform specific tasks in a small group.

Co-operative learning is the instructional use of small groups so that students work together to maximize their own and each others' learning. The idea is simple. Class members are organized into small groups after receiving instruction from the teacher. They then work through the assignment until all group members successfully understand and complete it. Cooperative efforts result in participants striving for mutual benefit so that all group members gain from each other's efforts, recognizing that all group members share a common fate, knowing that one's performance is mutually caused by oneself and one's
colleagues, and feeling proud and jointly celebrating when a group member is recognized for achievement.

The basic concept of co-operative learning revolves around active small group learning environments. Students cluster together, discuss topic and learn to take charge of their own learning. Team spirit is stressed as students learn to work together in mixed ability groups. Students work together to accomplish a learning goal and their team is held responsible for each group member's learning. The student's objective is not only to complete a task, but to learn something as a team. The success of one student aids others.

The basic elements of the cooperative learning

**Interdependence:** Co-operative learning groups are based on positive inter- dependence among group members where goals are structured. So that students need to be concerned about performance of all group members as well as their own. In order to provide a cooperative learning situation, students must perceive that they are positively inter-dependent with other members of their learning group

**Accountability:** In co-operative learning groups all the members are accountable for mastering the materials or content selected for learning. In traditional learning groups, individual students are often not held accountable for providing their share to the group work.

**Individual Differences:** In co-operative learning groups and in traditional learning groups the students are typically homogenous and heterogeneous in ability.

**Leadership:** In co-operative learning groups all members share responsibility for performing leadership actions in the group. In traditional learning groups a leader is often appointed and put in charge of the group.
**Individual responsibility:** Responsibility for each others learning is shared in cooperative learning groups. Group members are expected to provide help and encouragement to each other in order to ensure that all members do the assigned work. In traditional learning groups, group members are seldom held responsible for each others learning.

**Task maintenance:** The goals of co-operative learning groups focus on bringing each member’s learning to the maximum and on maintaining good working relationships among the students. In traditional class room learning group’s students most often focus only on completing the assignment.

**Social skills acquaintance:** Co-operative learning requires that all students appropriately use interpersonal and small group skills. Students are also motivated to use collaborative skills of leadership communication etc. when they work in a group. In traditional class room learning group, teachers often assume that students have the required inter personal and small group skills.

**Teacher’s role:** In co-operative learning method, the teacher observes the group, analysis the problems faced by the students while working together, and gives feed back to each group on how effectively they are working. Teacher observation and intervention seldom take place in traditional learning groups.

The teachers who facilitated cooperative learning in their classrooms were computer savvy. Very enthusiastically they organized the classes. Two of the teachers (one in Government School and one in Aided School) have joined the school recently through Teacher Recruitment Board. Two of them (one in Government School and one in Aided School) have five years and the other two teachers (one in Government School and one in Aided School) have 7 years and 9 years of service respectively.
In order to study the effectiveness of cooperative learning the students were oriented towards the concepts as well as the expectations of the cooperative learning procedure. The selected content in Biology consists of ten subtopics. Instructional objectives were planned before starting the teaching-learning of actual classroom instructions. Care was taken to see that no student absented herself for the class since each class focused on a specific instructional area. The following model was formulated as the instructional procedure for the entire training programme. In the cooperative learning sections, students were given a handout with their group assignment and a seating chart the first week that group activities were used. Students were asked to sit with their groups in designated areas for the remainder of the course. No formal instruction was given on how to carry out group activities. However, the instructor pointed out at the beginning of the study that each person evaluates his or her peers at the end of the term for how well they contributed to the functioning of the group. Contributing to group function was defined to include the following: preparation for class, willingness to speak up during group activities as well as to ask and answer each others' questions, and to show respect and consideration for other group members and their ideas. In the traditional lecture sections no groups were assigned, and students were allowed to choose their own seats.

Instruction in the cooperative learning sections was carried out using short PowerPoint (Microsoft) lectures interspersed with multiple-choice questions posed to the students. No points were associated with these questions, and at least two or more questions were posed each class period. Most questions were designed to require the students to apply their understanding of a concept to a problem or situation. Students were given time to discuss possible answers in their groups, after which a single group answer was submitted. After the groups
submitted their responses, the instructor displayed a summary of their answers to the class. The instructor then solicited the class to explain why they chose particular answers in order to reveal students' thought processes and to uncover misconceptions.

1. Every classroom lecture was classified into separate thematic instructional areas. The investigator gave a brief outline of the thematic areas and then the students were asked to read the material from their textbook itself.

The students were divided into eight groups. Each group consisted of 5 students.

The following groupings were arrived at:

<table>
<thead>
<tr>
<th>Group</th>
<th>serial no. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1, 9,17,25,33</td>
</tr>
<tr>
<td>2</td>
<td>2, 10,18,26,34</td>
</tr>
<tr>
<td>3</td>
<td>3, 11,19,27,35</td>
</tr>
<tr>
<td>4</td>
<td>4, 12,20,28,36</td>
</tr>
<tr>
<td>5</td>
<td>5, 13,21,29,37</td>
</tr>
<tr>
<td>6</td>
<td>6, 14,22,30,38</td>
</tr>
<tr>
<td>7</td>
<td>7, 15,23,31,39</td>
</tr>
<tr>
<td>8</td>
<td>8, 16,24,32,40</td>
</tr>
</tbody>
</table>

2. The selected themes were then discussed for a period of 30 minutes by the 1,2,3,4,5,6,7 and 8 separately. Each group discussed the topic in the light of the general orientation and with the text book they are having. When discussions were going on in the groups, the investigator provided assistance wherever necessary.
3. On the completion of the discussion, the students were regrouped as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>serial no. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-5</td>
</tr>
<tr>
<td>2</td>
<td>6-10</td>
</tr>
<tr>
<td>3</td>
<td>11-15</td>
</tr>
<tr>
<td>4</td>
<td>16-20</td>
</tr>
<tr>
<td>5</td>
<td>21-25</td>
</tr>
<tr>
<td>6</td>
<td>26-30</td>
</tr>
<tr>
<td>7</td>
<td>31-35</td>
</tr>
<tr>
<td>8</td>
<td>36-40</td>
</tr>
</tbody>
</table>

In this grouping, each group consisted of five students, and the regrouped members discussed the topic. An important feature of this learning is that each student is compelled to talk and the groups did not have any dominant leader and all of them shared the responsibility amongst themselves. Students engaged in Cooperative Learning are shown in Plates 2 and 4.

4. During the final 5-10 minutes, the students met as a class and the investigator reviewed the discussion points made earlier.

5. In the light of this classroom interaction, the investigator gave references for further reading. This procedure was followed for 20 periods of 45 minutes each to complete the biological concepts.

Root system was taught for eight periods which includes root types and modifications of root system, shoot system and modifications of shoot system was taught for four periods and types of leaves, venation
Plate 1:
Computer Assisted Instruction

Plate 2:
Cooperative Learning

Plate 3:
Conventional Method
Plate: 4
Computer Assisted Instruction

Plate: 5
Cooperative Learning

Plate: 6
Conventional Learning
and modifications was taught for eight periods through Co-operative learning. Cooperative learning material used for the study is given in Appendix V

c. Conventional Teaching

Conventional Teaching is a method of communication, which is deeply engraved in the fabric of the educational system and the most commonly used lecture method being economical way of getting a vast amount of information across, to a large group within the shortest time. The investigator followed this method to the control group. Plate 3 and 6 shows students learning through Conventional Teaching.

The control group consisted of 240 students. They were taught biology by explaining difficult terms without the help of any instructional aids. The method was lecture method, with explanation of important words, concepts etc. To complete the lesson 20 periods were taken. After 20 days they were informed about the administration of an achievement test.
Table II. An Overview of Computer-assisted, Cooperative and Conventional Methods of Teaching - Characteristics

<table>
<thead>
<tr>
<th>Structure of Student—Student Interactions in the Classroom</th>
<th>Common Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer Assisted Instruction</strong></td>
<td>• Students work individually.</td>
</tr>
<tr>
<td></td>
<td>• Students have common learning goals and tasks.</td>
</tr>
<tr>
<td></td>
<td>• The instructor grades students using norm-referenced methods (e.g., curve-based grading).</td>
</tr>
<tr>
<td><strong>Conventional Teaching</strong></td>
<td>• Students work individually.</td>
</tr>
<tr>
<td></td>
<td>• Students have individualized learning goals and tasks, different from those of other students.</td>
</tr>
<tr>
<td></td>
<td>• The instructor grades students using criteria-referenced methods (e.g., rubric-based grading).</td>
</tr>
<tr>
<td><strong>Cooperative Learning</strong></td>
<td>• Students work in small groups.</td>
</tr>
<tr>
<td></td>
<td>• Students have shared learning goals and tasks within a group which may be similar or different from other groups.</td>
</tr>
<tr>
<td></td>
<td>• The instructor grades students both on their work as a group and on their individual work.</td>
</tr>
</tbody>
</table>

Tools used for the collection of data

In order to collect the data, achievement tests were used as the prime tool for the study. Since the present research is structured by using pre-test, post-test and control group design, one set of achievement tests as pre and post test was constructed for standard XI.
F. Achievement test

The investigator attempted to construct an achievement test in biological science for standard XI. The achievement test was designed to measure individuals' quality of learning a particular school subject at the end of instruction. Achievement test helped to determine the status of academic learning of an individual or a group.

The pre test was given just preceding the treatment and the post test just succeeding the treatment for studying the effect of treatment. The investigator herself developed pre-test and post-test question paper for standard XI students in the topic 'Root, Stem and Leaves'.

The tools prepared for the measurement are as follows:

a. Item pool
b. Pilot study
   - Reliability and Validity
c. Item analysis.

a. The item pool

While constructing the achievement test the investigator prepared test items to administer to the students. The investigator made a thorough review of the related literature and the test items that had been used in testing. Thus a draft pool of items for the test was developed. These draft items were given to ten biology expert teachers. At this stage, there were 75 items in the test. Based on their suggestions these test items were edited, reviewed and finalized with 28 items.

The items in the final draft were of 20 objective type questions such as choose the correct answer for five marks, fill in the blanks for five marks, match the following for five marks, true or false for five marks, 5 very short answer type each carrying two marks so totally ten
marks and 4 short answer type each question carries five marks so totally twenty marks as given in the Appendix VI.

b. Pilot study

The pilot study thus developed by the investigator was administered to 60 students belonging to two higher secondary schools namely the government and the government aided schools (20 from each school). Since the investigator used pre test, post test, control group design, achievement tests had to be given to each student on two occasions. The pre test scores just preceding the treatment and the post test scores just succeeding the treatment were used for studying the effect of the treatment upon the dependent variable. The procedure of establishing reliability and validity are described below:

Reliability and Validity

Research in education is application oriented. It should have a contributory effect the theory or the practice of education. Only where validity and reliability are established, the findings of the study become trustworthy. As Merriam (1988) states regardless of the type of research, validity and reliability are concerns that can be approached through careful attention to a study’s conceptualization and the way in which the data were collected, analysed and interpreted.

The methods of estimating reliability by using four different procedures as shown below:

1. Test-retest method
2. Alternate or Parallel form method
3. The Split-Half method and
4. The Rational Equivalence method.

The test and retest was administered on randomly selected 20 students from each school.
The test-retest method involves repetition of a test on the same group immediately or after a lapse of time, and computation of correlations between the first and second sets of scores. The correlation coefficient thus obtained indicates the extent or magnitude of the agreement between the two sets of scores and is often called the coefficient of stability. (Kothari, 2006)

In order to gain confidence and to get their whole hearted involvement in the investigation, the investigator established a good rapport with the students. The standardized achievement test developed by the investigator was distributed and it was administered as a pre test.

Out of 60 students, 40 belonged to experimental groups who were exposed to two different instructional ‘methods’ namely computer assisted instruction and co-operative learning. The remaining 20 students belonged to the control group taught by conventional teaching method. After ten days the students were administered the same achievement test to find out the effectiveness of the study which was considered as a post test score.

The two sets of scores (pre test and post test) of each group were collected and the correlation between the two sets was calculated separately by using the product moment method of correlation. The reliability coefficients of the pre tests and post tests are presented in Table III.
TABLE III

RELIABILITY COEFFICIENTS USING TEST-RETEST OF XI STANDARD BIOLOGY GROUP STUDENTS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Coefficient reliability</th>
<th>Pre test</th>
<th>Post test</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAI</td>
<td>0.87</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Coop</td>
<td>0.83</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Conventional</td>
<td>0.84</td>
<td>0.90</td>
<td></td>
</tr>
</tbody>
</table>

CAI – Computer Assisted Instruction; Coop – Cooperative Learning.

The reliability coefficients presented in the Table II indicate that the pre and post tests of all the three groups had high reliability value.

The validity of a test or evaluation device can be defined as the degree to which the test measures what it is intended to measure. Validity is a relative term and has reference to a particular purpose of situation (Aggarwal, 2004).

The preparation of test items was preceded by a thorough and systematic examination of all the areas of the content in the book. The tests were given to experts for their comments of the adequacy of the test items, their relevance, unambiguity of language, etc. The test items were reviewed in the light of the suggestions given by experts for content adequacy and finally concluded that the test possessed content validity.

c. Item analysis

Item analysis of a test comes after the preliminary draft of a test has been constructed, administered on a group of students and scores. According to Oosterhof (1990) item analysis procedure includes two level of analysis of items namely the level of item difficulty index and the level of item discriminating power. Item analysis is a technique by which the test items are selected or rejected.
Item difficulty may be defined as the proportion of the examinees that marked the item correctly and item discrimination specifies the degree to which each test item distinguishes between the more versus less knowledge students who are generally referred to as the students of high achievement group and low achievement group.

When a test item is moderately difficult and has high discrimination, it indicates that the item is efficiently identifying the subset of students who are yet to learn the skill being tested.

**Difficulty Index**

The difficulty index was calculated by using formula

\[
\text{Difficulty Index} = \frac{U + L}{2N}
\]

where \(U\) = Number of correct responses in the upper group

\(L\) = Number of correct responses in the lower group

\(N\) = Number of students in each group.

**Discriminating power**

The discriminating power was calculated by using the formula

\[
\text{Discriminating Power} = \frac{U - L}{N}
\]

where \(U\) = Number of correct responses in the upper group

\(L\) = Number of correct responses in the lower group

\(N\) = Number of students in each group

In general, for teacher-constructed tests, an item discrimination can range from -1.00 through zero to +1.00. Items having negative discrimination are rejected. Items having discrimination index above 0.20 are ordinarily regarded satisfactory for use in most tests of academic achievement. Items that are of moderate difficulty are more likely to
establish a high level of discrimination. After establishing the reliability and validity of the tests for each group, they were used for item analysis. The item difficulty values and item discrimination values of high group and low group were calculated. The items for which the difficulty level ranged from 50 to 70 percent and the discrimination index ranging from 25 to 30 percent of each group were selected as the final test item.

After item analysis, the investigator has constructed and validated the achievement test for 50 marks. This achievement test consisted of 20 objective type questions such as 5 choose the correct answer, 5 fill in the blanks, 5 match the following and 5 true or false, 4 short answer type questions and 5 very short answer type questions. This test needs 45 minutes of duration for an average student to answer.

**G. Data collection procedure**

The investigator selected 720 students from six different schools of Salem City. As discussed in the previous sections, the pre test, post test, control group design was used for this study.

Out of the 720 students, 480 belonged to experimental groups who were exposed to two different instructional ‘methods’ for a period of twenty days. The remaining 240 students belonged to the control group who were taught through conventional method.

For all the three methods 20 periods were given. Out of 20 periods of 45 minutes duration each, eight periods comprising of 360 minutes are devoted for learning and teaching the topic Root System, four periods of 180 minutes for the topic Shoot System and 360 minutes comprising eight periods for the topic Leaves.

For each method the implementation lasted for 20 days and altogether implementing all three methods took two months. After completing each topic a formative test is given to find out whether
the students have become mastery with the concept. Time and periods allotted for each topic is shown in table IV.

**TABLE IV DURATION OF TIME ALLOTTED FOR EACH TOPIC**

<table>
<thead>
<tr>
<th>Methods</th>
<th>Root</th>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periods allotted for each topic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAI</td>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Coop. learning</td>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Conventional teaching</td>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

CAI – Computer Assisted Instruction; Coop – Cooperative Learning.

After completion of the training the investigator administered the same test which was administered initially to find out the effectiveness of the study. The students were allowed to sit freely while responding. They were given 45 minutes to answer the test.

This achievement test consisted of 20 objective questions, such as choose the correct answer for five marks, fill in the blanks for five marks, match the following for five marks, true or false for five marks, 5 very short answer type each carrying two marks so totally ten marks and 4 short answer type each question carries five marks so totally twenty marks.

The answer sheets were collected by the investigator. Then the pre test scores and post test scores were subjected to further analysis.

**H. Data analysis procedure**

In the first stage, the difference between pre test and post test scores for the three groups were analyzed by computing ‘t’ value for the two correlated mean scores of all the three treatments.

In the second stage of analysis the gain scores of pre tests and post tests of experimental groups and control group were compared using the test of one way Analysis of Variance and Covariance.
The results obtained through these comparisons were interpreted on the basis of achievement of performance of experimental and control groups.

I. Hypotheses framed for the study

1. There is no significant difference between the pre test and post test scores of students in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.

2. There is no significant difference between the pre test and post test scores of students of government schools in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.

3. There is no significant difference between the pre test and post test scores of students of government aided schools in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.

4. There is no significant difference between the pre test and post test scores of students of rural school in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.

5. There is no significant difference between the pre test and post test scores of students of urban school in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.

6. There is no significant difference between the pre test and post test scores of boys in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.

7. There is no significant difference between the pre test and post test scores of girls in Computer Assisted Instruction, Cooperative learning method and Conventional teaching.
8. There is no significant difference between the post test scores of the students of government and government aided school in Computer Assisted Instruction method, Cooperative learning method and Conventional teaching.

9. There is no significant difference between the post test scores of the students of rural and urban school in Computer Assisted Instruction method, Cooperative learning method and Conventional teaching.

10. There is no significant difference between the post test scores of boys and girls in Computer Assisted Instruction method, Cooperative learning method and Conventional teaching.

11. There is no significant difference among the groups in the pre test and post test scores.

12. There is no significant difference among the post test scores of students in different methods.

13. There is no significant difference among the groups of government school students in the pre test and post test scores.

14. There is no significant difference among the post test scores of government school students in different methods.

15. There is no significant difference among the groups of government aided school students in the pre test and post test scores.

16. There is no significant difference among the post test scores of government aided school students in different methods.

17. There is no significant difference among the groups of rural school students in the pre test and post test scores.

18. There is no significant difference among the post test scores of rural school students in different methods.
19. There is no significant difference among the groups of urban school students in the pre test and post test scores.

20. There is no significant difference among the post test scores of urban school students in different methods.

21. There is no significant difference among the groups of boys in the pre test and post test scores.

22. There is no significant difference among the post test scores of boys in different methods.

23. There is no significant difference among the groups of girls in the pre test and post test scores.

24. There is no significant difference among the post test scores of girls in different methods.

25. There is no significant difference among the pre test scores of the Computer Assisted Instruction and Cooperative learning method and Conventional teaching.

26. There is no significant difference among the post test scores of the Computer Assisted Instruction and Cooperative learning method and Conventional teaching.

Conclusion

In Chapter IV qualitative as well as the descriptive analysis of the data and interpretations follow.