CHAPTER - VI

Summary
6.1. INTRODUCTION

Educators, in both private and public sectors, have demonstrated an increased interest during the past few years in the role of computer technology as applied to educational/training process. This interest has been, to a great extent, a function of the emerging technologies associated with low-cost personal computers, the recognition of the need for better means of individualizing education and an appreciation of the many ways computer support can improve the instructional and management responsibilities requisite within a total instructional system (Burns and Bozeman, 1981).

Only a short time ago, the use of computers in education would have been important to only a relatively few persons involved in research and development activities. Educational computing seemed far removed from the real world of practice. Now computer support is available to even the smallest of schools, Colleges and organizations.

The availability has raised a host of questions regarding applications of the technology. While many of these questions have been and continue to be of concern to researchers and scientists, they were of limited significance to practitioners. To-day, educators at all levels—from classroom personnel to executives charged with policy formulation—are voicing an expression beyond simple curiosity about educational
computing. They require and demand information related to the effectiveness and efficiency of computer-based education (CBE) systems.

Early advocates of computer support for the instructional process offered the promise of greater student achievement, more efficient use of human and material resources, improved attitudes towards the learning process, and an enhancement of education in general. Were these empty promises never to be realized, or have they been fulfilled? In order to seek answers to this question, the effects of computer use on a large number of outcomes, areas were examined to compare the achievement effects produced by all forms of computer-based instruction (sometimes alone and sometimes as a supplement to traditional instruction) as compared with the effects of traditional instruction alone. While the research support is not as strong as that indicating the superiority of CAI, the evidence nevertheless indicates that CBE approaches as a whole produce higher achievement than traditional instruction by itself.

Bangert-Drowns 1985, Braun 1990, Kulik and Kulik 1987, Roblyer, et al. 1988 Swan, Guerrero, and Mitrani 1989 have concluded that “while both traditional and computer-based delivery systems have valuable roles in supporting instruction, they are of greatest value complementing one another”.
According to Batey 1986, Capper and Copple 1985, Kulik and Kulik 1987, Rupe 1986, Stannett 1985, researchers have also found that CAI enhances learning rate. Student learning rate is faster with CAI than with conventional instruction. In some research studies, the students learned the same amount of material in less time than the traditionally instructed students did; in others; they learned more material in the same time.

Capper and Copple 1985, Kulik 1985, and Bangert- Drown 1985; Rupe 1986, Stennett 1985; Woodward, Carnine and Gersten 1988 claims that if students receiving CAI learn better and faster than students receiving conventional instruction alone, they also retain their learning better. The research indicate that the retention of content learned using CAI is superior to retention following traditional instruction alone.

Much of the research that examines the effects of CAI develops to the conclusion than the use of CAI leads to more positive student attitudes that the use of conventional instruction. This general finding has emerged from studies of the effects of CAI on student attitudes toward:

- Quality of instruction (Kulik and Kulik 1987; Rupe 1986).
- School in general (Batey 1986; Bialo and Sivin 1990; Ehman and Glen 1987; Roblyer, et al. 1988).

Bangert-Drowns 1985, Bangert-Drowns, et al. 1985, Becker 1990, Bracey 1987, Ehman and Glen 1987, Kulik, Kulik and Bangert-Drowns 1985, Okey 1985, Stennet 1985, Swan, Guerrero and Mitrani 1989 found that CAI is more beneficial for younger students than for older ones. While research shows CAI to be beneficial to students in general, the degree of impact decreases from the elementary to secondary to post-secondary levels.

Bangert-Drowns 1985, Bangert-Drowns, et al. 1985, Kinnaman 1990, Kulik, Kulik and Bangert-Drowns 1985, Okey 1985, Roblyer 1988 compared low achieving and high achieving students in their research. These comparisons show that CAI is more effective with low achieving students than with high achieving ones.


According to Ehman and Glen 1987, Schmidt, et al. 1985-86, Lower – versus higher cognitive outcomes, Closely related to the above is the
finding that CAI is more effective for teaching lower-cognitive material than high cognitive material.


6.2 WHY STUDENTS LIKE CAI

Bialo and Sivin 1990, Braun 1990, Mokros and Tinker 1987, Robertson, et al. 1987, Rupe 1986, Schmidt, et al. 1985-86; Wepner 1990 have researched that, the following is a list of reasons given by students for liking CAI activities and / or favouring them over traditional learning. These student preferences also contribute to our understanding of why CAI enhances achievement.

Student say they like working with computers because computers:

- Are infinitely patient
- Never get tired
- Never get frustrated or angry
- Allow students to work privately
- Never forget to correct or praise
- Are fun and entertaining
• Individualize learning
• Are self-paced
• Do not embarrass students who make mistakes
• Make it possible to experiment with different options
• Give immediate feedback
• Are more objective than teachers
• Free teachers for more meaningful contact with students
• Are impartial to race or ethnicity
• Are great motivators
• Give a sense of control over learning
• Are excellent for drill and practice
• Call for using sight, hearing, and touch
• Teach in small increments
• Help students improve their spelling
• Build proficiency in computer use, which will be valuable later in life
• Eliminate the drudgery of doing certain learning activities by hand (e.g., drawing graphs)

6.3 COMPUTER MANAGED INSTRUCTION:
The basic rationale of Computer Managed Instruction (CMI) is an attempt to relieve the teacher or trainer of various tedious and time-consuming management tasks and so leave him with more time to devote to the essence of teaching. In an ideal CMI environment, there
would be a smooth partnership between the teacher, the student and the computer, in which each performed those tasks most suited to their (its) abilities. The teacher, freed of the administrative burden, would be able to devote his time to the task of helping students for which he was trained, and hopefully enjoys, the student would enjoy a course of study which was tailored to his individual needs and preferences, with ample feedback to guide his students; the computer, having no need of job satisfaction, but able to process information quickly and accurately, would take over the routine management of the courses.

The computer is therefore here cast in a background, supportive role in which it helps to manage, rather than to provide, learning opportunities.

6.3.1 Computer Managed Instruction Cycle:

There are four broad areas in which the computer may be used to provide management support. Firstly, it can construct, mark and analyse tests for diagnostic or assessment purpose. Second, it can keep records of the students performance and progress through their courses. Third, based on what is known about each student and the structure of the course, it can provide individual guidance for each student, directing or advising him on his choice of route through structured course materials. Finally, from its records, it can report on the performance and progress of the students and of the course to the individual students, the tutors and the managers of the education or training institution.
6.3.1.1. Assessment

The process of assessment is at the heart of most CMI systems and is the function which initially attracts most new users of the technology. The traditional process of assessment involves the teacher in a lengthy task of marking tests by hand. The student gains little from taking the test because the effort required to provide him with any more feedback than just a final score is too great.

FIGURE-I

ACTIVITIES OF STUDENT

- STUDENT STUDIES MODULE
- TAKES TEST
- STUDIES FEEDBACK
- DISCUSSES PROGRESS WITH TUTOR
- SELECT NEXT MODULE
- INFORMS COMPUTER OF CHOICE
6.3.1.2. Multiple Choice Tests

The introduction of new forms of assessment, particularly the use of multiple choice question (MCQ) tests, stimulated the development of techniques for making tests with the aid of a computer. In the simple form of a MCQ, the student is posed a question and is asked to select one from a list of alternative answers which follows the question. One of these is the 'correct' answer and the rest are used as distractors, devised to appear credible to students who can not determine the answer accurately. The MCQ can appear in a variety of forms such as:
- choice one response from several alternatives,
- choose two or more responses from the alternatives,
- determine whether a statement is true or false,
- match two lists of items.

FIGURE-II
ACTIVITIES OF COMPUTER

MARKS TEST
PROVIDES FEEDBACK
ADVICES ON NEXT MODULE
6.3.1.3. Feedback

The student's assessment may be used by the organisation to determine how well he is progressing in relation to the course, his peers or some set standard. It may be used for the benefit of the student himself, to give him feedback on his performance and help him to identify and rectify problems in his learning. This feedback, used to turn the test into a learning situation, can be provided at a number of levels. At the question level, the tutor may wish to provide a comment to each student who answers a question in a certain way. This might range from a simple message of encouragement for a correct response, to a detailed explanation of why a false answer was incorrect. Unless the tutor can devote a considerable amount of time to each student, it is usually impossible to carry out this sort of post-mortem analysis without some assistance from a CMI system. If the test is already being scored by a computer, then it is a simple matter to arrange for suitable comments to be associated with each response to each question in the test, and for the appropriate comments to be printed out for each student. The student's score on particular parts of the test or his overall score can similarly be used to select a suitable message on his performance, and at a higher level, his performance can be combined with other information stored about him, to give him feedback on his progress.
6.3.1.4. Routing

The concept of using the computer to guide students through structured course materials is based on the assumption that the majority of students should follow one of a small number of paths. The rules governing the optimal path that should be followed by a particular student can then be pre-specified by the tutor and subsequently interpreted by the CMI system. At this point, the discourse may be interrupted by the educational psychologist who points out, quite correctly, that since we do not fully understand how students learn, it is impossible to lay down rules as to which is the best route through any course. This is a valid criticism of a system which attempts to prescribe and enforce a best route through the materials for all students. However, it can be argued that is possible to provide useful guidance for most of the students, for most of the time. This can then cater for most of the routing decisions that would otherwise be taken by the tutor and allow him more time to concentrate on the minority of students who are in need of intelligent, as opposed to routine, help. The CMI system is used to support the tutor, not to replace him.
6.3.1.5 Record Keeping

In order to guide students effectively and to provide useful information to tutors and students, the CMI system must maintain records, about the students' performance and progress, about the performance of the course and the tests involved – and perhaps about the teachers as well. The information stored relates to the students' scores on each test, to the modules they are currently studying, and to those they have completed. It may also include background information about their learning preferences, aspirations and problems, and comments made about them by the tutor. For each of the test within the computer
managed course, the system may store statistics on overall performance and on each question.

6.3.1.6. Reporting

To manage his teaching or training effectively, the tutor needs information about his students' performance and progress. The student also needs feedback to manage his own learning. Thus the CMI system must provide reports, based on the stored records, to all those involved in the teaching and learning process. These reports must be accurate, up to date, and most important, provide the appropriate information in the appropriate format. The student's report will include detailed feedback which is needed by his tutor who is interested in broader indications of progress.

6.4 THE ROLE OF CMI IN PROMOTING INDIVIDUALIZED INSTRUCTION

Computer managed instruction is a highly specialized application of the computer to assist in the process of managing an individualized instructional plan for students. It consists of two required functions. First, the computer tests the student to identify his/her strengths and weaknesses. The result is a diagnosis which indicates which objectives the student has and has not mastered. A unique dimension added by CMI is that the diagnosis is individually tailored for each student's pattern of performance. Based on the diagnosis, each student receives
a computer-generated prescription, that is an individual course of study
designed to help the student meet the specific unmastered objectives.
The second function of CMI is, therefore, perspective. CMI is not simply
computerized testing or item-banking as these do not provide
individually-tailored diagnostic and perspective functions.
Hansen (1970) listed five major functions of CMI: (a) providing
diagnostic evaluations with learning prescriptions, (b) counseling
students about adaptive learning strategies and career development, (c)
developing an optimal scheduling system to match students and
learning resources, (d) maintaining an appropriate student instructional
record system, and (e) limited use of CAI for drill and practice.
Most of the specific conditions (alterable variables) identified by Bloom
(1984) can be enhanced with the use of CMI. Individualized
reinforcement can be provided for each student, item, and objective
through CMI. Similarly, CMI can provide corrective feedback precisely
where and when it is needed, to the individual student. Cues and
explanations can be built into the CMI application and presented only to
those whose performance indicates additional help is needed. Student
classroom participation is interpreted to mean the active cognitive
processing of information by each individual student, irrespective of
level of participation. In a CMI exercise, the student must be actively
processing information at a significantly more intense rate than during
conventional instruction. During conventional instruction, there are
many distractions which often cause the student to miss what is going on. During CMI, the student's attention is directed to the task at hand (assuming the ability level of the student is reasonably matched with the difficulty level of the CMI items. Research conducted by Flanagan (1969), Cooley and Glaser (1969), Silberman (1968) and Anderson et al (1975) supports the above explanation.

6.5 COMPUTER ASSISTED INSTRUCTION AND SOME ALLIED TERMS

It will be helpful, to offer some definitions of CAI and other kinds of learning activities involving computers. As Kulik, Kulik, and Bangert-Drowns point out in their 1985 research summary, "the terminology in the area is open to dispute". This is putting it mildly. Those seeking to make sense of the array of terms used by educators and researchers--computer-assisted instruction, computer-based education, computer-based instruction, computer-enriched instruction, computer managed instruction--can easily become confused. The following definitions are a synthesis of those offered by Bangert-Drowns, et al. (1985), Batey (1987), Grimes (1977), Samson et al. (1986), and Stennett (1985), and represent commonly accepted (though certainly not the only) definitions of these terms:

- Computer-based education (CBE) and Computer-based Instruction (CBI) are the broadest terms and can refer to virtually any kind of computer use in educational settings, including drill and practice, tutorials, simulations, instructional management, supplementary
exercises, programming, database development, writing using word processors and other applications. These terms may refer either to stand-alone computer learning activities or to computer activities that reinforce material introduced and taught by teachers.

- Computer-assisted instruction (CAI) is a narrower term and most often refers to drill-and-practice, tutorial, or simulation activities offered either by themselves or as supplements to traditional, teacher directed instruction.

- Computer-managed instruction (CMI) can refer either to the use of computers by school staff to organize student data and make instructional decisions or to activities in which the computer evaluates students' test performance, guides them to appropriate instructional resources, and keeps records of their progress.

Computer-enriched instruction (CEI) is defined as learning activities in which computers (1) generate data at the students' request to illustrate relationships in models of social or physical reality, (2) execute programs developed by the students, or (3) provide general enrichment in relatively unstructured exercises designed to stimulate and motivate students.

6.6 EMERGENCE OF THE PROBLEM

Much of the research that examines the effects of CAI and other microcomputer applications on student learning outcomes indicate that CAI and CMI leads to more positive students attitudes than the use of
conventional instruction which ultimately leads to enhancement of learning and regardless of the grade level, time and conditions. (Batey 1986; Brauan 1990; Dalton and Hannafin 1988; Savard 1980; Roblyer, et al. 1988; Rodriguez and Rodriquez 1986; Stennett 1985).

Kuliks et al summarised several meta analysis and concluded that students learned more and liked the instruction more when it was delivered by computer. Meta analysis also revealed that instructional and learning time was reduced through CAI and CMI. (Kulik, Bangert and Williams, 1983; Kulik, Kulik and and Bangert Drowns 1984; Kulik, Kulik and Cohen, 1980). The meta analysis of 31 studies conducted by Liao (1992) concluded that CAI is mildly effective approach for teaching students cognitive skills in the classroom setting.

These studies reported above, suggests that in spite of the differential background of the subjects, Computer Assisted Instruction was effective in raising the achievement of the students (Szabo and Schlender, 1996; Rehaag and Szabo, 1995).

In India the effectiveness of CAI on achievement has been investigated by Panda and Chaudhary (2000), Suresh (2000), Mahapatra (1991) Adhikari (1992) Das (1999), Khiswadkar (1999), Girdhari Lal (1986) and Sood (1987). All the above studies reported significant improvement in academic achievement of the students when using CAI mode of teaching. These finding are further supported by the studies of Kinzie, Sullivan and Berdel (1987). Effect of CAI on cognitive skills, Self
Concept attitude towards computers, Self Confidence study habit has been the focus of research in the current research literature. CAI promotes mastery of course content regardless of students cognitive styles, saved time for students and was cost effective method of teaching (Lowery and Barbara, 1988).


Review of literature on CAI and CMI suggests that none of the researchers in India or even abroad appears to have adhered to tenets of two modes of teaching through computer. Besides this, no study to the best of knowledge of the investigator has been conducted simultaneously on CAI and CMI and its relative effective on Self-Concept, Study Involvement and Academic Achievement. The present investigator has therefore, undertaken the problem of assessing effectiveness of CAI and CMI on achievement in Science, Self Concept and Study Involvement.

TITLE OF THE PROBLEM

"A COMPARATIVE STUDY OF THE EFFECTIVENESS OF COMPUTER ASSISTED INSTRUCTION (CAI) AND COMPUTER
6.7 EXPLANATION OF THE TERMS USED IN THE RESEARCH

Computer Assisted Instruction (CAI) -
The use of the computer to assist in the delivery of information is called Computer Assisted Instruction (Poppen, 1988). Educators differ in their definition of CAI i.e. CAI is often described as the use of a computer to augment classroom instruction by providing instruction and course content in the form of Drill and Practice, tutorials and simulations (Coburn et al., 1982). Decorate (1988) prefers the term Computer Guided Learning (CGL) because it places more emphasis on the activity of the learner. CAI is a form of individualized instruction where a student works at his or her own pace through written material displayed visually on the computer terminal. Written material used in the computer is sequenced logically according to the structure of the subject.

In the present research the following definition has been used as an operational definition of the term Computer Assisted Instruction which states "The use of computers to assist in the delivery of information, which is in the form of individualized instructions, where a student works at his/her own pace through written material displayed visually on the computer terminal".
Computer Managed Instruction (CMI) -
In this research Computer Managed Instruction refers to either use of computers by school staff to organize student data and make instructional decisions or to activities in which the computer evaluates students' test performance, guides them to appropriate instructional resources, and keeps records of their progress.

Conventional Method of Teaching -
In Conventional method of teaching the teacher is the only active participant in the teaching learning process and the pupils are the passive listeners. The mode of the instruction is lecture, which is often supplemented by home assignments.

Achievement in Science -
It is the level of learning and attainment in a particular area of the subject in terms of knowledge, understanding, skills and applications. In the present investigation, Achievement in science refers to the marks obtained on achievement test in science developed by investigator related to units taught to experimental groups and control group.

Self Concept -
The definition given by Sherry and Verma (1993) has been adapted as an operational definition of the term Self Concept. Self Concept means- "those perceptions, beliefs, attributes and feelings which the individual views as part of characteristics of
himself. It is his own conception of his health and physique, intellectual abilities, academic status, behavior, temperament qualities, mental health, emotional tensions and socio-economics status.

**Study Involvement -**

The definition given by Bhatnagar (1982) has been adapted as an operational definition of the term Study Involvement, which states, "The degree of involvement is determined by the (i) number of needs satisfied and (ii) the extent of their satisfaction through the performance of task. Study involvement as conceptualized in this context, therefore, may be classified as intrinsic motivation for study.

### 6.8 METHODS AND PROCEDURE

#### 6.8.1 Design

An experimental design is to the researcher what a blueprint is to an architect. A well developed design provides the structure and strategy that control the investigation and extract dependable answers to the questions raised by problem hypotheses.

The investigator employed Quasi Experimental Method for the study. It involves Pre Test and Post Test parallel group design with equivalent purposive sample in the form of intact section of class VII of the same school. After making intensive study of the literature related to Computer Assisted Instruction and Computer Managed Instruction, the experimental procedure was executed. Two Experimental Groups and
one Control Group were formed. The first Experimental Group (denoted as E1) was taught Science through Computer Assisted Instruction, the second Experimental Group (denoted as E2) was taught Science through Computer Managed Instruction and the third group or the Control group (denoted as C) was taught Science through Conventional method.

The design comprised three stages; the first stage involved pre-testing of all the pupils of three groups (E1, E2 and C) on Socio-Economic Status, General Mental Ability, Self Concept, Study Involvement and Achievement in Science. The Second stage involved treatment of twelve weeks. The experimental treatment consisted of teaching four units of VIIth grade Science through Computer Assisted Instruction to experimental group I (E1), through Computer Managed Instruction to experimental group II (E2) and through Traditional method to control group (C). In the third stage i.e. post-test stage, the pupils were post-tested on Self Concept, Study Involvement and Achievement in Science just after the treatment so as to determine the effect of treatment. A detailed description of the design of the experiment has been given in the table 6.8.1
Table 6.8.1
DESIGN OF EXPERIMENT (PRE-TEST, POST-TEST PARALLEL GROUP DESIGN)

<table>
<thead>
<tr>
<th>S No</th>
<th>Duration</th>
<th>Phase</th>
<th>Groups</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>One Week</td>
<td>Orientation</td>
<td>Group E1</td>
<td>Tests administered:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>i) Socio Economic Status Scale (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group E2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>ii) General Mental Ability Test (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>iii) Self Concept</td>
</tr>
<tr>
<td>2</td>
<td>4 Days</td>
<td>Pre Test</td>
<td>Group E1</td>
<td>ii) Self Concept</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>i) Socio Economic Status Scale (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group E2</td>
<td>ii) General Mental Ability Test (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>iii) Self Concept</td>
</tr>
<tr>
<td>3</td>
<td>12 Weeks</td>
<td>Treatment</td>
<td>Group E1</td>
<td>iii) Self Concept</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>i) Socio Economic Status Scale (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group E2</td>
<td>ii) General Mental Ability Test (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>iii) Self Concept</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group C</td>
<td>iv) Study Involvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>v) Achievement Test in Science</td>
</tr>
<tr>
<td>4</td>
<td>4 Days</td>
<td>Post Test</td>
<td>Group E1</td>
<td>iv) Study Involvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>i) Socio Economic Status Scale (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group E2</td>
<td>ii) General Mental Ability Test (Co-Variate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(N=30)</td>
<td>iii) Self Concept</td>
</tr>
</tbody>
</table>

6.8.2 Sample

The present study was conducted on a sample of 90 pupils studying in three sections of the Class VII of Evergreen Public School, Vasundhera Enclave, New Delhi. From each section 30 students were selected purposively. Two sections formed the two Experimental Groups (E1 and E2) and one section formed the Control Group (C). The school for the
investigation was selected because it has adequate number of computers to execute the treatment.

Sample School: Evergreen Public School, Vasundhera Enclave, New Delhi.

Sample: VII th class students of Sample School.

A detailed description of the sample is given in table 6.8.2.

**TABLE : 6.8.2**

**TABLE SHOWING NUMBER OF STUDENTS INCLUDED IN E₁, E₂ AND CONTROL GROUP**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Class</th>
<th>No. of Subjects Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group E₁</td>
<td>VII A</td>
<td>30</td>
</tr>
<tr>
<td>Group E₂</td>
<td>VII B</td>
<td>30</td>
</tr>
<tr>
<td>Group E₃</td>
<td>VII C</td>
<td>30</td>
</tr>
<tr>
<td>Total Sample</td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>

6.8.3 Tools Used

To measures the pupil's at Pre Test and Post Test stage on the criterion variables and the co-variates, the following tools were employed for the collection of data.

1) Socio Economic Status Scale developed by Kulshreshtha was used to measure pupil's Socio Economic Status.

2) Raven's Progressive Metrices developed by Raven was used to measure pupil's Intelligence.

3) Self Concept Questionnaire (SCQ) a test of Self Concept by Sherry and Verma was used to measure pupil's Self Concept.
4) Study Involvement Inventory by Asha Bhatnagar was used to measure the pupil's Study Involvement.

Science Achievement Test (developed by the investigator herself) was used to measure the Achievement of pupils in Science.

6.8.4 Experimental Procedure

It comprised of three stages –

i) Pre-Test

ii) Experimental Treatment

iii) Post-Test

6.8.5 Statistical Techniques Employed

The following statistical techniques were employed to analyze the data obtained from the experimental treatment.

i) Descriptive statistics such as means, S.D's, Skewness and Kurtosis were worked out in the pre-test scores of Socio Economic Status, General Mental Ability, Self Concept, Study Involvement and Achievement in Science and post-test scores of Self Concept, Study Involvement and Achievement in Science. Bartlett's test was applied for testing homogeneity of variance of sub groups.

ii) Analysis of variance (ANOVA) was applied on pre-test, post-test and gain scores of Self Concept, Study Involvement and Achievement in Science.
iii) To test the significance of difference between means of Self Concept, Study Involvement and Achievement in Science, "t" test was employed on post-test and gain scores.

iv) Histograms were drawn on pre-test, post-test and gain scores of Experimental group I, Experiment group II and Control group in respect of Self Concept, Study Involvement and Achievement in Science.

6.9 FINDINGS

The results have been drawn on the basis of the objectives framed for the study and by testing the hypotheses formulated thereafter. The major findings of the study are as follow-

1) At the end of the experiment, it was found that the group of pupils taught Science through Computer Assisted Instruction was effective in raising the Self Concept of the pupils.

2) The post-test mean score of the pupils taught Science through Computer Assisted Instruction increased significantly which indicates that Computer Assisted Instruction enhances Study Involvement of the pupils.

3) The group of pupils taught Science through Computer Assisted Instruction showed significantly higher post-test mean score on Achievement in Science in comparison to pre-test mean achievement score.
4) At the completion of experiment, it was found that the group of pupils taught Science through Computer Managed Instruction was effective in raising the Study Involvement of the pupils.

5) The post-test mean score of the pupils taught Science through Computer Assisted Instruction was found to be significantly higher on increasing the Study Involvement in comparison to pre-test score.

6) The group of pupils taught Science through Computer Managed Instruction showed significantly higher post-test mean score on Achievement in Science in comparison to pre-test scores.

7) At the completion of the experiment, the group of pupils taught Science through Computer Managed Instruction achieved significantly higher mean score on the test of Self Concept than the pupils taught Science through Computer Assisted Instruction.

8) The post-test mean score of the group of pupils taught Science through Computer Managed Instruction was significantly higher on the test of Self Concept than the group of pupils taught Science through Traditional Method.

9) At the end of the experiment, it was found that there was no significant difference on the test of Self Concept between the group of pupils taught Science through Computer Assisted Instruction.
Instruction and the group of pupils taught Science through Traditional Method.

10) The mean gain score of the group of pupils taught Science through Computer Managed Instruction was found to be significantly higher on the test of Self Concept, than the group of pupils taught Science through Computer Assisted Instruction.

11) The group of pupils taught Science through Computer Managed Instruction showed significantly higher mean gain score on the test of Self Concept than the group of pupils taught Science through Traditional Method.

12) There was no significant difference between the group of pupils taught Science through Computer Assisted Instruction and the group of pupils taught Science through Traditional Method on the mean gain score of Self Concept.

13) The post-test mean score of Study Involvement of the group of pupils taught Science through Computer Assisted Instruction was found to be significantly higher than the group of pupils taught Science through Traditional Method.

14) At the end of the experiment, it was found that the group of pupils taught Science through Computer Managed Instruction achieved higher mean score on Study Involvement than the group of pupils taught Science through Traditional Method.
15) The results of the present study showed that there was no significant difference in the post-test mean score of Study Involvement between the group of pupils taught Science through Computer Managed Instruction and the group of pupils taught Science through Computer Assisted Instruction.

16) The group of pupils taught Science through Computer Assisted Instruction showed significantly higher mean gain score on Study Involvement than the group of pupils taught Science through Traditional Method.

17) The mean gain score on Study Involvement of the group of pupils taught Science through Computer Managed Instruction was found to be significantly higher than the group of pupils taught Science through Traditional Method.

18) There was no significant difference in the mean gain score of Study Involvement between the group of pupils taught Science through Computer Managed Instruction and the group of pupils taught Science through Computer Assisted Instruction.

19) The post-test Achievement mean score of the group of pupils taught Science through Computer Managed Instruction was found to be significantly higher than the group of pupils taught Science through Computer Assisted Instruction.

20) The group of pupils taught Science through Computer Assisted Instruction showed significantly higher gain in mean
Achievement score than the group of pupils taught Science through Traditional Method.

21) After the completion of the experiment, group of pupils taught Science through Computer Managed Instruction achieved significantly higher mean score on Achievement than the group of pupils taught Science through Traditional Method.

22) The mean gain score of the group of pupils taught Science through Computer Managed Instruction was found to be significantly higher on Achievement than the group of pupils taught Science through Computer Assisted Instruction.

23) The group of pupils taught Science through Computer Assisted Instruction showed significantly higher mean gain score on Achievement than the group of pupils taught Science through Traditional Method.

24) The mean gain score of the group of pupils taught Science through Computer Managed Instruction was found to be significantly higher in Achievement than the group of pupils taught Science through Traditional Method.

6.10 CONCLUSIONS

On the basis of the above findings, the following conclusions have been drawn –

1) It has been found that the post-test mean Self Concept score of the pupils of Experimental group E1 were significantly
higher than pre-test score. This suggests that the pupils who were taught Science through Computer Assisted Instruction have significantly improved in Self Concept.

2) It has been found that the post-test mean score of the pupils of experimental group E1 was significantly higher in comparison to pre-test score. This suggests that Computer Assisted Instruction is effective in increasing the Study Involvement of the pupils.

3) The results of the study showed that the mean post-test Achievement score of the pupil of experimental group E1 were significantly higher than mean Achievement score of pre-test. This concludes that Computer Assisted Instruction is effective in raising the Achievement of pupils.

4) It has been found that the post-test mean Self Concept score of the pupils of Experimental group E2 were significantly higher in comparison to pre-test score. This suggests that the pupils who were taught Science through Computer Managed Instruction have significantly improved in Self Concept.

5) It has been found that the post-test mean score of the pupils of experimental group E2 was significantly higher in comparison to pre-test score. This suggests that Computer Managed Instruction is effective in increasing the Study Involvement of the pupils.
6) The results of the study showed that the mean post-test Achievement score of the pupil of experimental group E2 were significantly higher than mean Achievement score of pre-test. This concludes that Computer Managed Instruction is effective in raising the Achievement of pupils.

7) It has been found that the post-test Achievement score and the mean gain Achievement score of the pupils of experimental group E1 and those of the control group C differ significantly in favour of experimental group E1. This implies that the pupils who were taught Science through Computer Assisted Instruction have shown significant improvement in their Achievement in Science than the pupils who received instruction through Traditional Method. This suggests that Computer Assisted Instruction has contributed in raising the Achievement of pupils in Science.

8) It has been found that the post-test Achievement score and the mean gain Achievement score of the pupil of experimental group E2 and those of the control group C differ significantly in favour of experimental group E2. This implies that the pupils who were taught Science through Computer Managed Instruction have shown significant improvement in their Achievement in Science than the pupils who received instruction through Traditional Method. This suggests that
Computer Managed Instruction has contributed in enhancing the Achievement of pupils in Science.

9) The results of the study showed that the pupils of experimental group E2 achieved significantly higher mean score than the pupils of experimental group E1. The mean gain score of Achievement of the pupils of the experimental group E2 was also found to be significantly higher than the mean gain score of the pupils of experimental group E1. This suggests that the Computer Managed Instruction is better than Computer Assisted Instruction in raising the Achievement of pupils in Science.

10) The results of the study showed that the pupils of the experimental group E2 achieved significantly higher mean score on the test of Self Concept than the pupils of the experimental group E1. Mean gain score of the pupils of the experimental group E2 was also found to be significantly higher than that of the pupils of the experimental group E1. Thus, it can be safely concluded that Computer Managed Instruction is more effective than Computer Assisted Instruction in improving their Self Concept.

11) It has been found that the post-test Self Concept score and the mean gain Self Concept score of the pupil of experimental group E2 and those of the control group C differ significantly in
favour of experimental group E2. This implies that the pupils who were taught Science through Computer Managed Instruction have shown significant improvement in their Self Concept than the pupils who received instruction through Traditional Method. This suggests that CMI has contributed in raising the Self Concept of pupils.

12) The results of the study showed that there was no significant difference between post-test Self Concept score and the mean gain Self Concept score of the pupils of experimental group E1 and those of the control group C. This implies that pupils who were taught Science through Computer Assisted Instruction have not shown significant improvement in raising the Self Concept of the pupils than the pupils who received instruction through Traditional Method. Thus, Computer Assisted Instruction was not effective in raising the Self Concept of the students.

13) It has been found that the post-test Study Involvement score and the mean gain Study Involvement score of the pupil of experimental group E1 and those of the control group C differ significantly in favour of experimental group E1. This implies that the pupils who were taught Science through Computer Assisted Instruction have shown significant improvement in enhancing Study Involvement than the pupils who received
instruction through Traditional Method. This suggests that Computer Assisted Instruction has contributed in enhancing the Study Involvement of pupils.

14) The results of the study showed that pupils of the experimental group E2 achieved significantly higher mean score on Study Involvement than the pupils of the control group C. Mean gain score of the pupils of the experimental group E2 was also found to be significantly higher than that of the pupils of the control group C. Thus, it can be safely concluded that Computer Managed Instruction is also effective than Traditional Method in enhancing the Study Involvement.

15) The results of the study showed that there was no significant difference between post-test Study Involvement score and the mean gain Study Involvement score of the pupils of experimental group E2 and those of the experimental group E1. This implies that pupils who were taught Science through Computer Managed Instruction have not shown significant improvement in enhancing the Study Involvement of the pupils than the pupils who received instruction through Computer Assisted Instruction. Thus, Computer Managed Instruction and Computer Assisted Instruction were equally effective in enhancing the Study Involvement of the students.
In conclusion, the Computer Managed Instruction has been shown to be an effective educational tool in teaching Science. However, it may not be able to stand alone. Though Computer Assisted Instruction was found significantly favourable yet Computer Managed Instruction was significantly more favourable.

It can be concluded that both Computer Managed Instruction and Computer Assisted Instruction improved significantly the scores of the pupils of experimental group E2 and those of experimental group E1 as far as their Study Involvement is concerned. Also, both the modes of teaching i.e. Computer Assisted Instruction and Computer Managed Instruction were helpful in raising the Self Concept of the pupils as well as the Achievement in Science.

6.11 EDUCATIONAL IMPLICATIONS

In the current scenario of education, the role of teacher and the methods of teaching are changing dynamically. The teacher is burdened with the responsibilities of imparting knowledgeable education and to encourage the students to adopt the knowledge. The computer is finding an important place in current teaching system. Multimedia instruction is currently being used in variety of ways across discipline in elementary, secondary and higher education. The present study has a wide range of implications in the field of education. Some of the implications are given below:
1) The use of Computer Assisted Instruction and Computer Managed Instruction lead to more positive attitude towards computer. Thus when taught through computer the student feels more involved in studies which helps significantly in raising their Achievement.

2) With the help of Computer Assisted Instruction and Computer Managed Instruction, the teacher is freed of the administrative burden. They, thus would be able to devote more time to the task of helping students for which they are trained. Moreover, the students will also enjoy a course of study, which is tailored to the individual needs and enriched with ample feedback to guide them in their studies. A computer will act in supportive role in the background, where it will help to manage the learners learning and process the information quickly and accurately.

3) Educational tutorial given through Computer Assisted Instruction and Computer Managed Instruction motivates the students sufficiently to sustain their interest in the process of learning.

4) Traditional method of teaching if supplemented with Computer Assisted Instruction can prove to be more effective in enhancing achievement. This is supported by the finding of Kulik 1983, 1985; Kulik, Bangert, and Williams 1983; Roblyer 1988.

5) Computer Assisted Instruction and Computer Managed Instruction modes of teaching needs to be introduced for
teaching science as they significantly enhance Academic Achievement among pupils. This is also supported by the findings already conducted in this field by Prabhakar (1989); Himani (1990); Mahapatra (1991).

6) Quality computer program, which include colorful animations, graphic displays, form a versatile and effective alternative change in instructional strategy. An excellent science course may be taught without the use of a computer, however, the careful incorporation of computers for teaching science course will help the students to grasp the basic concepts of Science.

7) Psychomotor skills can be learnt better through electronic media and communication technology because they work as a live teacher and guide the learner more effectively.

8) There is a need for greater intervention of National and State government to give directions in planning for relevant courses, staff development and student support services with Computer Assisted Instruction and Computer Managed Instruction. The teachers at pre-service stage as well as in-service stage need to be trained in the application of Computer Assisted Instruction and Computer Managed Instruction so that they are able to develop tasks in their subjects according to these modes.

9) Computer Assisted Instruction and Computer Managed Instruction can make teacher instruction more informative as the
teacher will take the help of software program, which will make it
easier for the students to correlate the topic with day to day
activities.

10) With Computer Assisted Instruction and Computer Managed
Instruction students' progress at their own speed, which is
particularly advantageous in mixed ability situations. This leads
to individualization of instruction and students move at their own
pace, thus gifted are not bored, slow learners are not rushed
and shy students are not embarrassed. As such Computer
Assisted Instruction and CMI modes of teaching studied here in
and their discernible impact has an important bearing in the
present context.

11) The failure of educational technology can be attributed to many
reasons. Jalihal (1970) attributed the ineffectiveness of
conventional education technology to overburdened teachers
and inadequate library facilities. These shortcoming can be
overcame with the help of Computer Assisted Instruction and
Computer Managed Instruction.

12) Computer Assisted Instruction should find a permanent place in
school time table. If teacher and teacher educator are open
minded in the use of computer as a tool for education then
computer machines can be better utilized for education.
13) "Science for All" and "Scientific Literacy" are matters of great concern for the under developed and developing countries like India. This requires systematic and comprehensive strategies for creating a congenial learning environment for teaching process in Science. Computer Assisted Instruction and Computer Managed Instruction modes of teaching, if used, as teaching strategies can be an effective mode as they are alternative to "Learning By Doing" or even "Child Centered Approach". Learning science through them becomes an interesting and lively activity.

The Computer Assisted Instruction and Computer Managed Instruction modes of teaching have an important role in bringing about an enrichment in teaching learning process; they could serve as a instructional approaches to manage the classroom activities in order to achieve a variety of educational objectives. Computer Assisted Instruction and CMI are more appropriate to particular pupil needs.

6.12 SUGGESTIONS FOR FURTHER RESEARCH

In India, the use of Computer Assisted Instruction and Computer Managed Instruction in Science education has remained almost completely unexplored. Very few number of studies has been conducted in this direction. Based on the findings of current study, some
of the suggestions for further research in the area of Computer Assisted Instruction and Computer Managed Instruction are identified as follows-

1) The present study has been conducted only on limited topics of Science syllabus, more studies may be conducted involving larger content of the curriculum and different subjects.

2) The present study has been conducted on Class VII. To confirm the findings of the present study it is desirable to investigate the effect of Computer Assisted Instruction and Computer Managed Instruction on Achievement of learners of different Grade levels, Sex, Intellectual level, Socio Economic status and Subject areas.

3) The similar study can be extended to a larger sample and for longer span of time.

4) Further research can be conducted to explore the effectiveness of Computer Assisted Instruction and Computer Managed Instruction on disadvantaged groups such as backward, low achievers, mentally retarded and gifted.

5) Similar studies may be conducted to compare the effectiveness of Computer Assisted Instruction and Computer Managed Instruction with other instructional modes.
6) Effectiveness of Computer Assisted Instruction and Computer Managed Instruction may be studied in relation to other variables such as group size, creativity, economic background, age, cognitive style, personality and classroom climate etc.

7) The study indicates that Computer Managed Instruction and Computer Assisted Instruction is an effective intervention for improving students academic Achievement, Further research is needed to predict and explain how Computer Assisted Instruction and Computer Managed Instruction can become more effective instructional tool, because there are many instructional factors that positively affect student learning outcome i.e. co-operative learning, individualized instructions, sequenced lessons and class size etc.

8) The study may be replicated on rural, tribal and slum population where chances of dropouts and failures are high. The present study was carried out on a sample taken from an urban school situated at Delhi; studies can be conducted on schools located in rural areas.

9) Future researches should generate research pertaining to why Computer Assisted Instruction helps some students to learn in some areas, more so, than in others, such research could be
useful in exploring how Computer Assisted Instruction might enhance specific type of learning, singularly or in collaboration with others educational interventions.

10) Students' interest or willingness to study through Computer Assisted Instruction and Computer Managed Instruction may be probed and their effect on motivation may be studied in a longitudinal manner.