Chapter II

REVIEW OF THE RELATED LITERATURE

2.0 INTRODUCTION

The computers have become an integral part of our life and are used in every conceivable field. The computers with their capability are found to be ideal tools for teaching. With the numerous advantages the CAI has, the student interacts with the specially programmed computer applications b. It is important for the students and the decision making authorities to understand the impact, its uses and its functioning methods. A technical subject consisting of theory, practical, principles, theorems, experiments and concepts is ideally suited to test the efficacy of this revolutionary concept in education. Among all the subjects taught at Higher Primary School level, science is considered to be the most suitable subject to test the CAI and its suitability for introduction in to the field of education at that level. Therefore, the effects of CAI on the students of Higher Primary School in Ahwaz City, Iran are being studied.

2.1 HISTORICAL OVERVIEW OF CAI

The roots of CAI date back to the 1950s when the first computer programs were developed. The traditional CAI has generally focused on the presentation of content and often fails to impart the valuable
knowledge through experience of an instructor. Accomplished educators often have multifaceted approaches in communicating complex concepts to students, continuously gauging comprehension and metaphorically switching gears to clarify deficits in understanding (Wang, Y.2000).

During the 1960s, educators were under considerable pressure to improve the quality of education as well as to educate a broader segment of society (Steinberg 1977). Holt deplored the limitations of the widely used lockstep instruction (Holt 1967). Rapidly expanding community colleges had to accommodate ever increasing strength of students. Teaching alternatives were sought at all levels and individualized instruction became a likely alternative. The application of computers in education made individualization even more feasible. The CAI systems were the first generation software tutoring systems. A CAI system presents a page of text or graphics and puts up a different page depending upon the student’s answer (Hefferman and Koedinger 2002). CAI is capable of individualizing instructions to meet the specific needs of the learner. Self-paced instruction, the ability to present content in a variety of ways (i.e., text, audio, video, and graphics) and features such as hypertext make CAI an effective learning medium. CAI is relatively a new field in which the pioneer efforts occurred in around 1960, following the introduction of computers into higher education. After the pioneer
efforts, a number of large-scale, heavily funded CAI projects have been conducted, with their results having implications on the future use of CAI as a classroom tool.

In the early 1980s, forerunners in the field of education had sought to integrate computers into instruction to enhance learning and teaching (Feldman et al., 2000). The first computers introduced to the learning environments were the Apple II computers and IBM PCs (Linn, Davis, and Bell, 2004). Initially, schools began incorporating computer programming courses into the curriculum (Linn et al., 2004).

However, CAI did not play a major role in the teaching strategies used by majority of science teachers (Poole, 2000). Science teachers have been leaders at developing particular aspects of information and communication technology (Poole, 2000). This discrepancy exists because CAI is expensive. A computer in every science classroom needs resources that extend outside the scope of school budgets (Poole, 2000). Therefore, many schools have focused on developing network technology, rather than distributing computers in various departments.

Furthermore, at professional level, most science teachers are not well trained in the use of ICT (Poole, 2000). The current technology did not exist when they were trained, as a result the staff development has been lacking. Ultimately, most teachers remained doubtful about the
efficacy of the technology in improving the performance of students (Poole, 2000).

2.2 NATURE OF CAI

Computers are already in use in Iran in banks, large firms, transport companies, the armed forces and elsewhere. Either owing to excessive compartmentalization of administrative departments or to relative order of political priorities, it did not appear that the Ministry of Education was ever involved at higher levels of decision-making. With their growing use in education and instruction, in training of teachers and teacher-educators, computers are being considered as prime objectives for the advancement of educational technology (Aubincau, 1986).

The use of computers in schools may be classified into learning about computers and learning with, from and through the computers. Knowledge of computers may be thought of as a continuum, ranging from skills and awareness of computers as learning and educational tools at one end, through programming in higher and lower level languages and to solid-state physics at the other end.

The terminology concerning computers as a learning medium varies widely and there are no universally agreed-upon definitions. Among those frequently encountered are: (a) CAI where computer acts as a tutor, teaching new skills, concepts or providing practice to learners.
Software in this mode is often referred to as drill, practice and tutorials. (b) Computer Based Learning (CBL) or Computer Assisted Learning (CAL) which includes various disciplines such as simulations, modeling, instructional games, problem-solving, information handling, and demonstrations (Anderson, 1986).

According to Fourie (1999), CAI is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the assimilation. It is also known as CAL, Computer Based Education (CBE), and Computer Based Training (CBT). CBT allows the students to monitor their own progress. CAI learning uses a combination of text, graphics, sound and video in the learning process. It is especially useful for distance learning.

The advent of Internet and the demand for distance learning has generated great interest in expansion of CAI. The first university formed to provide degrees entirely through Internet Courses was Jones International University in 1993. Currently, there are many colleges and universities offering web-based courses and programs (Helffer, 1999).

The computer serves many purposes in the classroom and it can be used to help a student in all areas of curriculum. CAI refers to the use of the computer as a tool to facilitate and improve instruction. CAI programs use tutorials, Drill and Practice, simulation, and problem solving
approaches to present topics and they test the student's understanding. These programs let students progress at their own pace, assisting them in learning the substance. The subject matter taught through CAI can range from basic Mathematics to more complex concepts, history, science, social studies and languages (Sharp, 1996).

Many educational software packages follow the same design as programmed instructions. Students receive the instructional material, followed by a "probe" (a small test); if the response is appropriate, they move on to the next lesson; lest they repeat the lesson or receive a different lesson covering the same material. This approach is called Computer Assisted Instruction (CAI).

Thomas (1997), Lepper and Gurtner (1989) and Roblyer (1998) have elaborated that the CAI suffers from some of the same problems as programmed instruction, that it is often repetitive and reduces learning to discrete units that sometimes obscure the relationships between ideas. They have also mentioned that the CAI is better suited for Drill and Practice than for building concepts and promoting comprehension. The research has shown that when used in addition to regular instruction, CAI improves the attitudes, motivation and academic achievement of students.

Welberg (1991) has examined 377 research studies and selected according to criteria for quality of research designs that had compared
CAI with conventional classroom instruction. While comparing educational methods for difference in their effects on learning, he found that in all cases the CAI combined with classroom teaching was superior to classroom instruction without computer assistance. The computer was found to be particularly effective with the handicapped, elementary students, and secondary students.

There is vast scope for further improvement in the use of computers in education as it is still in its infancy. However, the computer is bringing in some exciting innovations to education. The following are the areas in which computers are helping the educators:

- Take over most of the drudgery of schooling like classifying children according to abilities, preparing timetables and schedules, etc.
- Allocate learning resources to individuals and groups.
- Maintain progress cards and preserve them confidentially.
- Provide easy access to flies of information for reference and guidance.
- Provide direct interaction between students and the subject matter to be learned.
- Engage the students in tutorial interaction and dialogue.
The most exciting innovation in the educational technology is CAI. Though it is still in the developing stage, the day is not far off when it will revolutionize the whole process of teaching. Before discussing CAI in some detail, what appeals most to the teacher practitioner, are the modes of teaching, one is Computer-Managed Instruction (CMI) and the other is Computer-Based Instructional Simulation (CBIS). Both the techniques make use of the computer in different roles for instruction. In CMI, the role of the computer is mainly to maintain records and it does not provide any direct instruction to the learner. This type of instruction helps to assess the learner's present level of knowledge, weaknesses or gaps in his learning and remedial actions possible. Whereas CAI is directly involved in tutorial work, Drill and Practice and is of greater help in instruction. In the CAI, different programmes, one for the instruction and another for Drill and Practice may be needed. The CBIS is the most powerful application of computers in instruction as it provides realistic substitutes for real life experiences that might be otherwise impractical, time-consuming or even dangerous. CBIS creates model situations, which imitate some aspects of reality. The simulation model may be static or dynamic in which, conditions are changed as a result of feedback of learner's actions and responses (Sampath et al., 1990).
Two major types of CAI are identified as Adjunct first used by Victor Bunderson (Kearsley, 1982) and Primary. Adjunct CAI encompasses materials that supplement or enrich the learning situation. For example: short (half to one hour) CAI programs that support or illustrate concepts discussed in the regular classroom. Primary CAI materials, conversely, provide instruction of a substitute or stand-alone variety and are usually of longer duration (Chambers and Sprecher, 1983).

2.3 MECHANISM OF CAI

Before understanding the mechanism of CAI, it is necessary to understand the two models used for designing interactive educational programs. The first, Instructional System Design (ISD), the traditional model, determines a goal, sets objectives, delivers instruction, formulates questions and evaluates learning. The second, Hypermedia Design (HDM) focuses on the goals of students and how the students choose to access Information. While ISD is concerned with formulating goals, the HDM focuses on the goals of users. The selection of CAI or web-based design, should be based on whether the program is well designed and meets the needs of the intended users (Dewald, 1999).

There are many design models of CAI available today. One model developed by Fourie, I. in 1994 consisted of seven phases:
➢ Determination of the need and situation analysis.

➢ Formulation of aims and performance objectives and development of items for evaluation.

➢ Design of study material including development of a teaching strategy and media selection and integration (e.g. the inclusion of sound and video).

➢ Development and preparation including story hoarding and programming.

➢ Implementation and use.

➢ Assessment of student progress.

➢ Formative and summative & evaluation on a continuous basis.

After each phase is completed, it must be evaluated before moving to the next phase. CAI Design projects should consist of several members including a project manager, experts, advisors, evaluators, programmers, and graphic artists. The CAI must effectively meet the needs of its users. Also, the computer literacy tends to be a major problem. For successfully using the CAI, the students will have to master the basic computer knowledge and technological skills before. Good web-based instruction asks students to interact and not just memorize the information. It must be flexible and allow for differences in learning abilities. It should encourage in depth learning and not superficial learning. Students must
understand the concepts and how they fit in to the whole, be able to
integrate different parts, apply the information and receive feedback.
Web-based instruction provides opportunities for interaction to make it
meaningful for the students (Dewald, 1999).

Computer-Assisted Instruction (CAI) is defined as the use of
customers to provide course instruction on the course content mainly in
the form of Drill and Practice, Tutorials and Simulations. The common
form of practicing CAI is a type in which repetitive or "flash card"
approach emphasizes rote memory. It is used extensively at all
educational levels (Chambers and Sprecher, 1983), Tutorials use the
customer in a higher-level mode in which question-and-answer, dialogue-
type learning in the traditional tutor mode is emphasized. Like Drill and
Practice, it is used extensively at all educational levels.

Simulations, the third type of CAI provides a model in which the
student plays an important role and interacts with the computer.
Simulations have been used most often in higher education to model
scientific process. They are applicable to any field, however, and can be
of significant help in illustrating concepts, in helping students to develop
problem-solving techniques, and in allowing students to explore complex
interactions.
These three categories namely, Drill and Practice, Tutorials, and Simulations, make up what has come to be known in the United States as CAI. The Computer-Based Learning (CBL) in Europe and elsewhere are usually referred to as Computer Assisted Learning (CAL).

2.4 CHARACTERISTICS OF CAI

In CAI a computer is programmed with linear or branching programmes. It acts like a super teaching machine catering to the needs of a number of students at the same time. The characteristic of the CAI is its capacity to initiate flexible interactions with the students that is not possible in any other teaching machine. There are a number of ways in which this can be brought about. The computer is able to record and store the responses of all the students. It can use the available information in deciding the next input required to be given to the student. It can branch out not just in terms of one answer but also in terms of a whole series of previous answers. It can also record the time taken to answer a question and the degree of accuracy of response. It uses the information for computing and determining the next branch to be taken (Sampath et al, 1990).

A typical CAI installation consists of individual learning booths, each with a console. The student is seated. Facing him on the console is a television screen for displaying information. The student checks in with
the computer by displaying his identification number. This connects him with his part of the learning programme. A complete package of information stored in the system is presented sequentially. This information could take the form of video recordings, slides, motion picture films, filmstrips, etc. The student may question the computer and feed answers by means of a keyboard. The computer responds by displaying comments, answers and questions. Sometimes, the student may write directly on the cathode ray tube display screen with a "light pen". His answer will be picked by the computer and evaluated. When he has finished, the computer assigns him the next program, records his progress and prints out a report for his teacher (Sampalh et al, 1990).

The CAI starts by identifying the way a student seems to learn best. It reviews his past history of learning and then presents a programme built on his strength. Sometimes the computer stores all the information gained from all students who have taken the computer course previously. This information may be re-analyzed and much of the teaching strategies, which were not effective, may be rejected and strategies which have succeeded may be continued (Sampath et al, 1990). CAI is, therefore, not merely a sophisticated type of programmed instruction but it also uses electronic data processing, data communication, concepts of audio-visual and media theory, communication theory, systems theory amid learning
theory. In contrast with CAI, Computer-Managed Instruction (CMI) analyses the relationship between various factors pertaining to a student and suggests activities appropriate to individual students. This includes Programme for Learning in Accordance with Needs (PLAN) and Individually Presented Instruction (IPI). In general, students learn well with CAI in considerably less time (Sampath et al, 1990).

CAI makes use of multimedia software in the learning process including text, video, graphics, audio and internet technology. CAI is heavily used in the growing field of Distance Education. Traditionally, CAI, like programmed instruction, has been linear in nature. Web-based instruction on the other hand is nonlinear (Lawson, 1999).

There are numerous unique features of CAI which make it an exciting field. One of the most useful features is its adaptability to distance learning. Before the dominance of microcomputers, distance learning was mostly accomplished through programmed instruction or through mail, supplemented by telephone contact. On the contrary, CAI provides regular and timely interaction with the instructor and current feedback. Students can repeat tutorials as often as needed and work at their own pace. CAI also can be used with greater numbers of students than a traditional classroom would hold. CAI and web-based instruction have become accessible, to all kinds of students including individuals
with disabilities. Intelligent CAI is programmed so that it adapts to individual needs of the students. It acquires information about the current knowledge of students on a subject and his/her goals in learning the subject and based on this knowledge creates a user profile. It can then adjust itself to the individual student. Web-based instruction is unique in that the student and instructor can communicate with each other anywhere in the world within seconds via the Internet and feedback from the instructor can be obtained immediately (Mousund, 1998).

The CAI teaches specific skills and knowledge often narrowed on to a specific content area and grade range. It is in sharp contrast with tool software that can be used in general to help students through problem processing at any grade level and in any content area, such as word processors, concept processors (outliners, Inspiration), newsletter programs, spreadsheets, databases, audio-video editors, presentation programs (Power point), web browsers (Netscape, Internet Explorer), Logo (programming language), etc. Finding software that fits any of these categories is often difficult because one or more or all forms are commonly integrated into a single instructional software program. CAI can be developed in different modes based on nature of the content and competence level of students. The different modes of CAI can be:
A. Drill and Practice Software.

Drill and Practice software is the simplest, least expensive, most popular, and most abused type of CAI software in schools. Drill and Practice software assumes previous knowledge and only fits in the third stage, extended practice and perhaps the fourth, assessment, but it does not teach. Repetition is effective for practicing existing knowledge for fluency, recalling and perhaps elaboration or learning to apply the knowledge to different situations (e.g., learning to use foreign words in different or increasingly difficult contexts). Drill and Practice software is often abused through over use. The software is easy to write and is usually inexpensive which leads to a prevalence of poor quality programs especially in financially constrained schools. Quality Drill and Practice programs do exist but careful evaluation should be conducted before purchase.

CAI facilitates student learning through various methods. Different types of CAI Tutorials, Simulation, Drill and Practice, Problems Solving and Games are discussed in the following pages. Although a computer can be used in many ways in the educational programmes, the following are some of the areas where it proves to be effective in the instructional process.
In Drill and Practice, the student uses a specially designed electronic typewriter, which is connected to a computer by telephone lines. He identifies himself by a code and his name. The machine types out first question and the student responds. Soon the lesson is underway. The computer keeps track of performance of each student and can “read back” to the teacher, whenever the teacher requires it. Depending upon the programme, the student may be referred to a branching type of remedial exercise. As in programmed instruction, the student moves at his own pace, gets immediate feedback and receives individual tutoring. Drill and Practice software differs from Tutorial software in a big way. The Drill and Practice software helps the students remember and utilize skills they have been previously taught, whereas a Tutorial software teaches new material. Students must become familiar with certain concepts prior to working on Drill and Practice programs in order to understand the content. The design of a typical Drill and Practice program consists of four steps: (1) the computer screen presents the student with questions to respond to or problems to solve; (2) the student responds; (3) the computer informs the student whether the answer is correct; and (4) if the student is right, he or she is given another problem to solve, but if the student responds with a wrong answer, he or she is corrected by the computer (Sharp, 1996).
B. Tutorial Software.

In contrast to Drill and Practice programs, Tutorials do not assume prior knowledge. Tutorials teach material and may also include a Drill and Practice component as well as assessment. Therefore, tutorials can play an integral part in instruction or be used as stand-alone instruction for enrichment and re-mediation.

The subject matter is literally taught by the computer programme. Explanations are given orally through audio tapes and visuals are
presented in cathode ray tube as in television. The student responds on a
typewriter or by pointing on the screen with a light pen. The computer
reacts to response of students by 'talking' to him. Student makes further
responds. A kind of dialogue takes place between the student and
machine. CAI tutorials are based on the principles of programmed erring.
The student responds to each bit of information presented, by answering
questions about the material and then gets immediate feedback on each
response. Each tutorial lesson has a series of frames. Each frame poses a
question to the student, if the student answers correctly the next frame
appears on screen. Often there is a disagreement among educators on how
these frames should be arranged. While some educators are proponents of
the linear tutorials, the others prefer the branching tutorials. The linear
tutorial presents the student with series of frames, each of which supplies
the information or reinforces the information learned in previous frames.
The student is required to respond to every frame in the exact order
presented, and there is no deviation from this presentation, but the
students have the freedom to work through the material at his/her own
speed. The branching tutorial allows more flexibility in the way the
material is covered. The computer decides the matter to be presented to
each student. The responses of the students to the questions determine
whether the computer will review the previous material or skip to more
advanced work (Sharp. 1996).
While it is easy to say that tutorial programs should be highly graphic, branched, and interactive, it is not so easy a task to produce such software. The process of creating branches, alternative instructional sets for students of varying ability levels, is time consuming. Misconceptions and difficulties of students must be predicted and suitable instructions developed to assist the student.

C. Problem Solving Software.

The Problem Solving Software is software based on four traditional steps: (a) defining a problem; (b) devising a solution; (c) implementing the plan; and (d) evaluating the plan. If the evaluation step shows the solution was incorrect, the learner returns to the definition step or devises a new solution plan.

D. Enquiry.

In the enquiry mode of the CAI, the system responds to the enquiry by student with answers it has stored in its files to the extent that the algorithms it contains provide access to that information. In this mode, the student does not need to know much about the CAI system, but the instructional staff must learn how the system operates in order to establish files and search algorithms that anticipate student questions.
E. Simulations and Games.

Computer simulations include near-real experience provided by a computer. For example, many schools cannot afford field trips or expensive materials but can afford computer based simulations. Another example is where the real experience may be too dangerous (e.g., a chemistry experiment involving caustic or volatile substances) or impractical (e.g., breeding animals in the classroom to study genetics or taking a trip to the Smithsonian Institute in Washington D.C. or Louvre in France), leaving a virtual or simulated experiment as the next best option. Additionally, computer simulations can be used for telescoping the time. Events such as continental drift and tectonic plates that took/take place over a long period of time can be compressed into a brief time span, providing a visual representation that helps learners grasp the potentially abstract idea.

These have come into effective use in education during the past decade. Simulations are condensed learning exercises specifically designed to represent real life activities by providing learners with the essential elements of the real situation without its hazards, cost or time constraints. According to Thorson (1979), simulations are realistic imitations. Simulation is a mode of education which demands that knowledge be integrated with reality and behaviour. It helps students to
perceive values and ideas not as the material for armchair rhetoric, but as the bases for practical decisions and as touchstones of responsible actions.

Simulations are frequently planned in the form of competitive games to increase motivation and interest. Organized social simulation is called gaming e.g., historical games. Simulated learning came into prominence during the Second World War when it was extensively used to train recruits in skills such as aircraft flying, weapon system operation, etc. Now simulation is used for teaching various subjects as well as in areas like teacher training. Simulation may involve simulator trainers or mock-ups, which are three-dimensional teaching aids e.g., aircraft flight simulator. Role-playing is also a type of simulation, ranging from simple make-believe show to play acting and drama. Educational simulation games like other well-organized learning experiences must be carefully designed with clearly specified objectives. The most obvious use of simulation is extending the experience to students and in stimulating their interests. Simulation and gaming increases motivation, self-confidence and can accommodate students of different ages and levels of maturity. Some of the simulations take considerable time and demand too much from the teacher, in simulating the programs. The students will have to take risks as if they were confronted with real life situations without
having to suffer the consequences of failure. For example, the students can experiment with dangerous chemicals on the computer screen, and not be exposed to hazards of actual chemicals. With laboratory simulations, there is no expensive equipment to be bought and students do not have to wait for a long time for the effects of experimental conditions before they can observe the result. Moreover, students can repeat experiments easily as often as they wish. Simulation saves time and money, reduces risks, and works well in decision-making situations. Many educators feel that a well-designed simulation software affords students the opportunity to apply classroom knowledge in more realistic situations than can otherwise be set up in a classroom, which enhances learning of students (Sharp, 1996).

The strength of simulation is to force students to retrieve or discover relevant knowledge, experiences and problem solving skills under authentic situation. The simulations require students to take more responsibility in learning process. Active learners are most likely to benefit from this kind of use of computer-based simulation. For non-engaged learners, it is suggested that this kind of simulation be used in small groups. Through cooperative learning and social interaction, some students will overcome difficulties which occur when they use simulation by themselves.
In education, simulations have become increasingly popular, especially in science, mathematics, and social sciences. Many situations in the biological sciences cannot be done in a lab or in short periods in the field. Simulations give students the chance to experience situations not normally available in classroom settings.

F. Discovery.

Discovery software provides a large database of information specific to a course or content area and challenges the learner to analyze, compare, infer and evaluate based on their explorations of the data.

G. Modelling.

In this mode of CAI, the student will be required to construct the analogue contrary to simulations wherein it is specified by the tutor.

H. Interactive Knowledge Based Systems (IKBS).

The IKBS comprises a descriptive model of the Knowledge relating to a particular topic, system or situation. This can be explored by the learner, perhaps with an expert system providing tutorial guidance and explanation or by means of asking questions which will lead to an understanding and simulation of Knowledge.
I. Information Seeking.

In this mode of CAI the computer is used as a mentor and guide through a series of learning resources which may themselves not be based on the computer. The power of the computer to store, retrieve and process information, is used to help the students as they browse through the material.

J. Animation.

The literal meaning of animation is to breathe life into some thing. A transformation is involved to move things. It plays significant role in stimulating learning. In English language, animation is mostly associated with the work of film makers. Action is created from a series of images and we have the illusion of something living. Animation is that stimulus to the mental, physical and emotional life of people in a given area, which makes them experience a wide range of events or actions through which they find a higher degree of self - realization (Boal, 1992).

2.5 IMPLEMENTATION OF CAI IN EDUCATION

The concept of CAI was introduced in the 1960s. Two important projects in the history of CAI are Programmed Logic for Automatic
Teaching Operations (PLATO) and Time shared Interactive Computer-Controlled Information Television (TICCIT). These two projects were competing with each other to become the national automated instruction system in United States of America. Even though both of them were based on mainframe computers, the rest of the technical solutions differed from each other. Neither of them became predominant since the expected fall in installation and utilization costs did not take effect. Nevertheless, both of them served as bases for other instructional systems.

The PLATO, initiated at the University of Illinois in the early 1960s and developed by Control Data Corporation, was used for higher learning. It consisted of a mainframe computer that supported up to 1000 terminals for use by individual students. By 1985 over 100 PLATO systems were operating in the United States. From 1978 to 1985, the users logged 40 million hours on PLATO systems. PLATO also introduced a communication system between students that was a forerunner of modern electronic mail (messages electronically passed from computer to computer). The TICCIT system was a CAI project developed by Mitre Corporation and Brigham Young University in Utah. Based on personal computer and television technology, TICCIT was used in the early 1970s to teach freshman-level Mathematics and English courses.
Educators at Stanford University in California in collaboration with the International Business Machines Corporation (IBM) introduced CAI into selected elementary schools in mid 1950s and early 1960s. Initially, CAI programs were a linear presentation of information with Drill and Practice sessions. These early CAI systems were limited by the expense and the difficulty of obtaining, maintaining, and using the computers that were available at that time.

The built-in educational properties are the essence of CAI applications. These properties include clearly stated learning aims, methods to reach these aims and testing whether these aims are achieved. In addition, CAI applications support and guide progress of students. These properties separate CAI applications from other computer applications, such as multimedia and hypermedia applications and expert systems, which all have been used for instructional purposes. Since the educational properties are usually missing from other applications, their instructional use differs noticeably from that of CAI applications. Thus, CAI applications can be used as tutors, while the other computer applications can be considered as tools. Traditionally teaching has been a situation in which a teacher talks in front of students. Teaching this way is strongly teacher-centered and many times it has been the only possibility. Reasons for that could have been the lack of teaching
materials, teachers, classrooms, etc. Also the earlier learning theories assumed that students are like empty baskets and teacher’s task is to fill them with information. These kinds of theories are not valid anymore because, research has revealed that human learning is more complicated.

Today, the information that helps teach or encourages interaction can be presented on computers in the form of text or in multimedia formats, which includes photographs, videos, animation, speech, and music. The guided drill is a computer program that poses questions to students, returns feedback, and selects additional questions based on the responses of students. Recent guided drill systems incorporate the principles of education in addition to subject matter knowledge into the computer program.

A recent development with far ranging implications for CAI is the vast expansion of the Internet, a consortium of interlinked computers. By connecting millions of computers worldwide, these networks enable students to access huge stores of information, which greatly enhances their research capabilities. CAI can help the students to see the unseen, to test theoretical concepts, to comprehend abstract ideas, to communicate more effectively reducing the teacher-student ratio and help to take more informed decisions. (Goel. D.R and Tomar, Archana, Khirwadkar, Anjali
and Das, Anshuman, Joshi, Priya 2000) have listed other advantages as follows:

- Tutoring is personalized.
- Immediate feedback is provided.
- Repetitive tasks are performed with equal precision.
- Large amounts of data are stored.
- Automatic measurement of progress.
- Relevant instructions are provided to larger number of students.
- A teacher generally addresses a whole class and does not have time for individual queries while a student with a computer can interact with the software.
- Using CAI, the student learns at his own pace. Thus both gifted and slow learners feel satisfied.
- A good CAI can take student towards a guided discovery and so it can be creative.
- A visual interactive impact is more easily grasped by the students and retained for a longer time.
- Self evaluation and feedback mechanism help the students immensely.

The CAI is expected to accrue many benefits to students. Some of the important benefits are better and more comfortable learning for
students since they learn at their own pace and convenience, opportunities to work with vastly superior materials and more sophisticated problems, personalized tutoring and automatic measurement of progress. Kulik, Bangert and Williams (1983) have substantiated that teachers are also expected to gain from the CAI, as they experience less drudgery and repetition, greater ease in updating instructional materials, more accurate appraisal, documentation of progress and more time to work directly with students. With increasing advancement in computer technology, CAI is now seen by many as the method of providing instructions to large numbers of students simultaneously. The future CAI systems for higher education must have the following ingredients to focus better on student learning outcomes in the fast changing fields 1) interactions to allow individualization 2) assessment of mastery and 3) interactions revolving around the reasoning tools. The reasoning tools can foster the next generation of teachers who can develop CAI systems with high quality interactions.

In conformity with the aim of this research work, the necessity of media in education and its variety such as CAI and its usage in teaching and learning process has been well understood and appreciated as related to science as subject. As one of the objectives, is to study the effects of
CAI on teaching science subject, the researcher has felt the necessity comprehend more about science and its role in the modern world.

2.6 ROLE OF TEACHERS IN CAI

The CAI has not been designed to eliminate the teacher from the classroom and the education system. The machines can provide relief to the teachers from the mechanical aspects of teaching work. With the CAI being implemented holistically, the teachers will no longer be 'talking books' or 'paper correcting' machines. The teachers can work in areas like evaluation, planning, curriculum revision, guidance and human relations. Sampath et al, (1990) has enumerated that although we cannot forecast the areas where the computers may be helpful in future, the possibilities of their effective use in the educational scene are enormous.

2.7 ADVANTAGES OF CAI

The critical CAI experiments of the 1960s and 1970s, yielded mixed results. Other than the substantial learning gains exhibited by children using Drill and Practice modules, the results obtained in the Time shared Interactive Computer-Controlled Information Television (TICCIT) (a registered trademark of the Hazeltine Corporation) study, showed evidence gained from these large-scale experiments, indicated the superiority of CAI over regular classroom procedures. In addition to
the large-scale CAI experiments, a sizable number of CAI projects were evaluated by this time. The results of these smaller-scale studies, covering a variety of educational levels and diverse fields, yielded surprisingly consistent results.

The main advantages of CAI for students are that they can work at their own speed and at the time that is best suited for them. With web-based instruction, they can work at home, at school or anywhere with a computer and an Internet connection. Coupled with distance learning, it allows students with handicaps and learning disabilities, to learn in less restrictive environment. Christmann and Badgett, (1997) have opined that students who enroll in courses via CAI, including web-based classes, gain an opportunity to learn computer skills, which benefit them in many aspects of their professional lives.

The CAI proves better than all other aids in several respects. It not only saves time in learning but also performs outstandingly in processing the performance data. This characteristic helps to determine subsequent activities in the learning situations. The large amount of information stored in the computer is made available to the learner more rapidly than by any other medium. The facility of dynamic interaction between the student and the instructional programme is not possible in any other medium. With the CAI, materials can be completely individualized. The
software for CAI must be carefully programmed to perform the desired functions. This requires thorough planning at every step and prior planning. Since, the computers have very limited intelligence the instructions are required to be spelled out in explicit detail. Human beings are brilliant but sloppy thinkers where as the computers are stupid but accurate.

The field of CAI is based on number of disciplines but its primary origins lie in computer science and psychology from computer science and its predecessors. The mathematics and engineering are the forerunners of computer science and the programming that enables them to function, while the psychology is the precursor to the knowledge of learning theory, instructional strategy and motivation. The complex applications of these concepts were not always applied while designing CAI modules in the early experiments due to major problems encountered as a result of unfamiliarity with computers hardware and the difficulties in writing programs. Thus, the early experiments in CAI were mainly confined to simple uses such as Drill and Practice and Tutorials.

The CAI satisfied many of the theoretical requirements of a “good” learning environment stipulated by leading psychological theorist, Skinner (1968). Thus, it involves the individuals actively in the learning process, which supposedly facilitates learning (Mckenzie et al, 1978). It
also permits the learner to proceed at his own pace. The reinforcement of learning in such situations is immediate and systematic, which should assist more effective learning according to established theories of instruction. As per Christmann and Badgett (1997), yet another approach is to combine the traditional classroom with CAI and the Internet. Studies have shown that combining technology with the standard classroom approach actually improves the student performance manifold.

### 2.8 DISADVANTAGES OF CAI

Fourie (1999) has brought out that the disadvantages of CAI include the need to own or have access to computer with the necessary RAM and operating system, to possess the computer skills, physical problems such as Carpel-Tunnel Syndrome and eye disorders caused by sitting in front of the computer screen for long periods of time, non-availability and/or prohibitive cost of educational software, and the lack of human interaction in the learning process.

It is imperative that the CAI software be designed well right from inception. CAI must bridge different learning styles to be fully effective. Therefore, it should offer different types of examples and ways to solve problems. The instructors and students using CAI and web-based learning must get frequent feedback. The delays in feedbacks and communication
may actually hinder the success of students in comprehending the material.

Although computers open up the possibility of educating the students completely by individualized programmes, its chief limitation lie in the fact that it is prohibitively expensive. The computers are also likely to inject a non-human characteristic to educational programmes. This new technology may 'dehumanize' the man.

In some applications, especially those involving abstract reasoning and problem-solving processes, CAI has not been very effective. Critics claim that poorly designed CAI systems can dehumanize the educational experience and thereby diminish student interest and motivation. Other disadvantages of CAI stem from the difficulty and expense of implementing and maintaining the necessary computer systems. Some student failures can be traced to inadequate teacher training in CAI systems. Student training in computer technology may be required as well, and this process can distract from the core educational process. Although effort has been directed at developing CAI systems that are easy to use and incorporate expert knowledge of teaching and learning, such systems are still far from achieving their full potential.
2.9 CAI AND THE LEARNING THEORIES

There are many definitions of learning, derived from different explanations given by psychologists. For the purpose of this study, the learning is defined as the process through which experience produces changes in the nervous system, resulting in changes in behaviour. Here, the researcher is concerned with those theories of learning that have had the greatest effect on learning with the aid of a computer, as well as with those theories which appear to hold the greatest promise for future use in CAI.

Learning is a complex phenomenon. There are many different types of learning, ranging from the simplest response (such as withdrawing your hand after touching a hot toaster) to the type of thought that results in the solution to a complex scientific problem. Thus, some theories of learning have concentrated on acquisition of simple low-level behaviors and as a result, have been helpful in understanding that type of learning situation. As might be expected, such theories have fallen short when higher-level types of learning have been under consideration. Conversely, other theories have been concerned with global approaches that have aided understanding of higher mental processes involved in complex learning. But unfortunately, those theories seldom have been of significant help in accounting for the detailed components and
antecedents of such behaviour. Since CAI is applicable to a broad range of learning tasks, only the major theoretical representatives of both ends of learning continuum are being considered.

The psychology is a relatively new science, having emerged from the field of philosophy and physiology in the late 1800s. The new psychologists adopted the rigorous scientific method of physiology, while attempting to understand philosophically based problems such as consciousness, memory and the workings of human mind. Unfortunately, little progress was made, and as a result, the concept of behaviourism emerged from within psychology and dominated the entire field from about 1913 to the 1970s. The behaviorism emphasized that progress could be made in psychology only through the elimination of such research topics as memory and mind while concerning oneself solely with observable phenomena - behaviour. John Watson introduced this concept and soon stimulus-response (S-R) psychology became the American tradition.

At about this time in the field of learning, Thorndike developed the law of effect, emphasizing the importance of reward (reinforcement) in learning. Later, in the 1930s, Skinner proposed the concept of operant conditioning, in which even the stimulus (S) was deleted from S-R, with now only the response (R) followed by reinforcement forming the critical
learning elements. Chambers and Sprecher (1983) have confirmed that over the years, Skinner's research was done so well and convincingly that his views came to dominate the field.

It was not until the past few years that psychologists again b by the lack of progress in understanding what many believed to be fundamental problems in the field, i.e. cognitive events such as thinking, memory, perception, and mental process in general. At about this time the computers became prevalent in higher education. The emphasis on information processing (in which computers were considered to be analogous to the brain and in which concepts such as memory replaced stimulus-response bonds) was accompanied by a general, social and professional acceptance to the value of such machines. This provided the groundwork for revolution. The revolt occurred with experimental psychologists joining with linguistics and computer science professionals to form the new field of cognitive science. This field, concerned with understanding mental processes and making extensive use of the modeling capabilities of computers, brought on entirely new light to bear on the topic of learning.

In the following pages, the researcher will review those topics in learning theory on which there is general agreement. Following this, the researcher will examine the major concepts of Skinner’s Operant
Conditioning, the basic tenets of cognitive theories, and the emerging role of Bandura's social learning theory. In each case, the investigator will attempt to relate these concepts to design of CAI courseware and indicate appropriate instructional strategies for Drill and Practice, tutorials and simulations.

Most theorists agree that certain conditions are necessary to occur for learning. These conditions include contiguity, reinforcement, and repetition (practice). The basis for behaviorist theory was that a stimulus (S) that elicited a response (R) that was immediately followed by positive reinforcement would result in increasing the probability that the response would occur upon further presentation of the stimulus. Thus, S-R-Reinforcement became the learning model. Skinner agreed with the contiguity principle, but emphasized the importance of the immediacy of the reinforcement following the response. The cognitive theorists have, in general, agreed with Skinner on this point. There is also general agreement among theorists that repealed occurrences of the response followed by reinforcement are necessary in order for learning to occur and for the materials to be retained.
2.9.1 Skinner's Operant Conditioning and CAI

Skinner's views grew out of observations of the performance of animals in a device that he invented. It consisted of a small box with a lever at one side. Whenever the animal depressed the lever, a pellet of food (positive reinforcement) was delivered. This came to be known as Skinner’s box, and has been widely used in learning studies for more than 50 years.

Skinner associated himself in the early years predominantly with the study of low-level behaviours of animals and as a result contributed significantly to our knowledge of how simple behaviours are both learned and weakened (extinguished). Skinner then applied these concepts to complex behaviour and its modifications. His assumption was that high-level behaviour, when properly analyzed, could be interpreted in terms of the complex interplay of elementary concepts and principles. He entirely rejected cognitive explanations of behaviour as well as any explanations, attributing behaviour to internal factors within humans or animals.

Skinner's later years were concerned with testing his theories concerning complex behaviour through the study of learning human subjects. He developed teaching machines and programmed learning, based on his response/reinforcement model.
Skinner (1968) strongly emphasized positive reinforcement throughout his writings. Early studies indicated that punishment only temporarily suppressed behaviour. Later studies did indicate that punishment can be effective. In general, a combination of strong positive reinforcement for a correct response and mild punishment for an incorrect response has been found to provide optimal support for learning.

Chambers and Sprecher (1983) have quoted that in Skinner's Laser Work dealing with complex human learning, he emphasized the analysis of the task into small, discrete objectives so that repeated reinforcement could be applied to simple, discrete responses. He stressed that students be given task in a hierarchy so that they would learn essential components first so that they would not fail.

2.9.1.1 Application in CAI

Skinner's views are directly applicable to the Drill and Practice and Tutorial forms of CAI, and have been used successfully for many years.

Reinforcement in Drill and Practice: Skinner's main thesis is that positive reinforcement should consistently follow each occurrence of the desired response until the selected level of masters is reached. Although he himself had little to say about punishment for wrong answers, most of his followers now accede that a mild punishment - a penalty such as a
reduction in score - following an incorrect response can be beneficial to learning.

Once mastery is reached, Skinner emphasized that students must be weaned from this approach in order to avoid rapid extinction (weakening) of the response. To do this, he recommended shifting from continuous reinforcement to a pattern of intermittent reinforcement. The most effective pattern yielding the greatest retention of learning appears to be a shift, first to a fixed-ratio schedule (in which every fifth or tenth, etc., response is reinforced), and finally to variable-ratio schedule (in which every ninth response is reinforced with delivery on a random basis). Skinner also emphasized that through these methods, behaviour could be maintained indefinitely on a very small number of reinforcements. Skinner (1968) concluded that through a proper understanding of contingencies of reinforcements, we should be able to make students eager and diligent and be reasonably sure that they will continue to enjoy the things we teach them for the rest of their lives.

In the design for the revised version of this programme, once the student has successfully reached mastery at all difficulty levels, the computer randomly selects problems from all levels and presents them to the student. Although the same reinforcement and punishment principles are used, the application is switched from continuous reinforcement to
intermittent. The pattern moves first to fixed ratio and then to a variable ratio. Thus in this sequence, a total of 20 problems are generated. For the first 10 problems, every other problem correctly solved is reinforced and every other problem incorrectly solved is mildly punished. In the last 10 problems, for every three problems correctly solved, one is randomly selected for reinforcement, and for every three problems incorrectly solved, one is randomly selected for the mild punishment. Students correctly solving all 20 problems exit into the game sequence and are permitted to play as long as they choose (Chambers and Sprecher, 1983).

Application to Tutorials: Skinner's illustration of how to develop a programmed learning sequence is directly applicable to the design of CAI tutorial modules, as follows:

- Obtain a clear, detailed objective specification of what it means to know the given subject matter.
- Write a series of information, questions and answers frame that expose students to the material in graded steps of increasing difficulty and that frequently retest the same facts from many different angles.
- Require the learner to be active, i.e., require a response for each frame.
- Provide immediate feedback for each answer (response).
➢ Try to arrange the material and questions in such a manner that the correct response is likely to occur and be reinforced (i.e., avoid errors, so that learning is not accompanied by punishing failures).

➢ Permit students to proceed at their own pace.

➢ Provide ample backup reinforcement (praise, merits) for diligent and effective work.

Role of the Teacher: Skinner also expressed definite views concerning the role of the teacher in the learning situation. In Skinner's own words: The best way to help the student give birth to the answer he is struggling to recall is to give him a strong hint or even the whole answer, but that is not the best way to make sure that he will recall it in the future. As Comenius has said that “the more the teacher teaches, the less the student learns” The better the teacher, the more important it is that he frees the student from the need for instructional help (Skinner, 1968).

The application of these views on the importance of student control is especially helpful when considering the design and development of tutorials. In this type of learning situation, the computer plays the role of advisor, and the learning strategies involved are concerned with presentation of materials and questions, hints and help messages to assist
the student as needed to achieve the correct answers, followed by reinforcement of the correct responses.

2.9.2 Cognitive Theories and CAI.

Cognitive theories are based on information-processing models. These are concerned with how individuals gain knowledge and how they use it to guide decisions and perform effective actions. These theories try to understand the mind and how it works. To achieve this, they view the computer as a model of the brain and employ much of the terminology and concepts of information processing.

A cognitive learning theory is concerned with several key items: (1) effect of stimuli on the organism's receptors; (2) storage of information in Short-Term Memory (working memory) (STM); (3) storage of information in Long-Term Memory (LTM) (4) processes involved in encoding and decoding information; and (5) retrieval of the stored information, its possible combination with other data, and its ultimate effect on behaviour of the organism.

Certain stimuli in the environment affect receptors of an organism. These stimuli produce patterns of neural activity that are briefly registered by sensory registers. The data are then transformed and recorded in Short-Term Memory (STM), an important concept in
cognitive theory. Characters of STM are as follows: (1) only prominent features of the original stimuli are recorded; and (2) STM has the capacity to hold, only about 4-7 items for a limited time (20-30 seconds). The materials then are either retained in STM through rehearsal, transferred to Long-Term Memory (LTM) or lost.

According to one prominent model (Bower And Hilgard, 1981), LTM contains information originally held in STM, which had undergone a process of semantic encoding. This process changes information from words and stimuli to propositions that have meaning and contains codes for retrieval at later times.

Cognitive theory recognizes the importance of reinforcement, but does not give it the central importance accorded by Skinner. It indicates that learner behavior sets in motion a process that depends on external feedback, which involves confirmation of correct performance.

An important concept contained in some cognitive theories is the executive control process. This process controls cognitive strategies relevant to learning and remembering in relation to such important activities as controlling attention, encoding of incoming information, and retrieval of stored data. These types of activities were not considered in traditional behaviorism, nor were they given importance by Skinner.
Their applications to CAI, however are critical. It is perhaps in this area that cognitive theory has contributed the most to CAI.

Considering cognitive learning theory overall, the following kinds of processing during any single learning act could include:

- **Attention** - selection among incoming stimuli.
- **Selective perception** - encoding selected items for storage in short-term memory.
- **Rehearsal** - maintaining data in STM.
- **Semantic: encoding** - preparing information for storage in LTM.
- **Retrieval** - searching and restoring information in working memory.
- **Response organization** - selecting and organizing performance.
- **Feedback** - the external event that sets in motion the process of reinforcement.
- **Executive Control Process** - Selecting and activating cognitive strategies (Gagne and Briggs, 1979; Bower and Hilgard, 1981)
A graphical illustration of the above model is provided below:

**Figure 2.2 Cognitive Learning Theory Model**

Cognitive models evolved primarily as a result of the dissatisfaction with the limited concerns and understanding of complex process provided by behaviorist theory. Thus, Skinner was criticized not for providing inaccurate descriptions of learning, but rather for providing incomplete descriptions. The cognitive theories set out to complete this task and to provide a foundation for studying and understanding complex processes.
With regard to success of this movement, Norman (1981), a leading practitioner in the field, indicated his concern with the narrowness of cognitive science itself. He emphasized its lack of concern for an individual interaction with other people, the environment and the influence of history and the culture of people. He especially emphasized lack of consideration of the special problems and issues confronting an organism that must survive.

2.9.2.1 Application in CAI

Cognitive learning theories are most applicable to the design and development of tutorials. This approach has been pioneered most actively by Robert M, Gagne (1982), a former follower of Skinner and the behaviourist model. Gagne has emphasized the importance of identifying the goals of the learning task followed by the development of specific instructional objectives to meet these goals. He emphasizes that such objectives must be stipulated in concrete behavioral terms. To develop instructional objectives, it is necessary to analyze the criterion task into elementary behavioural components and to determine their organization. The level of skills of the students must then be assessed and programmes designed to teach the skills.

In development and presentation of materials, Gagne has followed Skinner in emphasizing that learning must occur in small steps,
sequenced so that lower-level learning required for performance on more complex task is learnt first. Again, like Skinner, he has emphasized the use of positive reinforcement in a repetitive manner.

With regard to the role of teacher or advisor in CAI, he had again followed Skinner’s lead by emphasizing that hints and help needs to be adapted to the individual learner. He has suggested that students be provided a little help at a time, thus permitting the student to use as much as he needs. The student is thus placed in control of the learning situation. As far as the mastery is concerned, Gagne has expanded Skinner's basic views on the topic to include more details related to human learning. He has defined mastery as materials that have been learned to the level of which they are readily accessible to recall at the time of learning.

Gagne's most significant contribution, however, relates to his application of cognitive learning theory to the task of designing CAI modules. Thus, he has brought to the topic some additional insights and emphases, such as his concern with gaining the student's attention and developing expectancies. This can be achieved in a CAI module by providing advance organizers in the instruction. These organizers might take the forms of charts or graphs that reflect the structure and organization of the lesson content.
Another point raised by Gagne is in defense of Drill and Practice. He indicated his belief that Drill and Practice, if viewed as a part of cognitive learning theory, simply speeds up the learning process, that it makes learning more efficient by making lower-level skills (such as the basic mathematics) automatic. Since such skills are used quite often, and STM has a limited capacity, Drill and Practice reinforce the indexing characteristics of the basic skills, thus permitting them to be retrieved and placed in STM for using very quickly (Gagne, 1982).

Gagne (1982) identified five categories of learning outcomes that he believes represent all types of learning. These include: (1) intellectual skills (how to do something an intellectual sort); (2) cognitive strategies (capabilities that govern the individual's own learning, remembering, and thinking behaviour); (3) verbal information; (4) motor skills; and (5) attitudes.

Within these various types of learning, Gagne (1982) expressed his belief that there must be nine events of instruction. The internal learning processes (expressed in terms of cognitive theory) and external instructional events that he has postulated are listed below:
Table 2.1: Internal processes of Learning and Instructional events that may be used to support them

<table>
<thead>
<tr>
<th>Internal Learning Processes</th>
<th>External Instructional Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Alertness.</td>
<td>• Gaining Attention.</td>
</tr>
<tr>
<td>• Expectancy.</td>
<td>• Informing learner of lesson objective.</td>
</tr>
<tr>
<td>• Retrieval to working memory.</td>
<td>• Simulating recall of prior learning.</td>
</tr>
<tr>
<td>• Selective perception.</td>
<td>• Presenting stimuli with distinctive features.</td>
</tr>
<tr>
<td>• Semantic encoding.</td>
<td>• Guiding learning.</td>
</tr>
<tr>
<td>• Retrieval and responding.</td>
<td>• Eliciting performance.</td>
</tr>
<tr>
<td>• Reinforcement.</td>
<td>• Providing informative feedback.</td>
</tr>
<tr>
<td>• Cueing retrieval.</td>
<td>• Assessing performance.</td>
</tr>
<tr>
<td>• Generalizing.</td>
<td>• Enhancing retention and learning transfer.</td>
</tr>
</tbody>
</table>
2.9.3 Bandura’s Social Learning Theory and CAI

A. Social Learning Theory has attempted to combine cognitive psychology and the principles of behaviour modification with its own special emphasis on the person in the social setting with all the resulting ramifications. Social learning theory has provided much needed breadth to these other theoretical positions and has provided a basis for many of the types of learning that appear to occur in simulations. The theory attempts to describe how personality could evolve out of social conditions. It deals explicitly with techniques of personality assessment and behaviour modification in clinical and educational settings.

Behaviour theory in general and Skinner’s Operant Conditioning principles in particular, have placed great emphasis on learning by direct experience, by the application of reinforcement to response. Although social learning accepts these concepts as valid conditions for some types of learning, the theory also has proposed that a large amount of human learning is done vicariously, through observing another person making the responses (or reading about it or viewing pictures of it) and then by trying to imitate the response of the model.
Bandura (1977) has stated his views with regard to observational learning as, Most human behaviour is learned observationally through modeling: by observing others, one forms an idea of how new behaviours are performed, and on later occasions this coded information serves as guide for action. He pointed out that observational learning is governed by four component processes: (1) attention; (2) retention process; (3) conversion of symbolic representation into appropriate actions; and (4) motivational processes.

Attention refers to the fact that people must attend to and perceive accurately the significant features of the modeled behaviour. Attention processes determine what is selectively observed and extracted from exposure to others. Retentional processes draw attention to the fact that individuals must remember the modeled behaviour in order to be influenced by it. Observers, who translate observed behaviour into words, learn and retain better than those who do not. Observational learning concerns transforming learning into actions. This involves refinement of behaviour through self-corrective adjustments on the basis of feedback. Finally, Motivation affects observational learning in that behaviour that seem effective for others are favoured over behaviours that are seen to have negative consequences. As a result, it has been found that high-
status models are more often imitated (their behaviour is seen as leading to success).

Since earlier theories were primarily concerned with reinforcement, it may be helpful to quote Bandura's position: According to the social learning view, observational learning occurs through symbolic processes during exposure to modeled activities before any responses have been performed and does not necessarily require extrinsic reinforcement. Reinforcement does play a role in observational learning, but mainly as an antecedent rather than a consequent influence. Anticipation of reinforcement is one of several factors that can influence what is observed and what goes unnoticed (Bandura, 1977).

2.9.3.1 Applications in CAI

The implications of Social Learning Theory seem most appropriate for the type of learning that occurs in many CAI simulations. Although real models are not used in such simulations, the computer provides a reality situation in which the student may learn vicariously through interaction with the model. In such cases, the reinforcement apparently occurs as a result of student responses to the model, which brings about a change in conditions. The student controls the situation and is thus positively reinforced.
Several observations seem appropriate in relation to applying social learning theory to the design of simulations. The first, relates to the importance of instructions to students to guide the learning. The instructions should provide students with information concerning content, structure, and goals of the simulation, and in addition should inform students concerning the benefits of adopting the modeled behaviour. As Bandura (1977) has pointed out, this will result in the development of expectations that serve to reinforce learning. The second, simulation should include as much interaction between students and the computers as possible, and the implication should be used by each student a number of times. This will enhance retention and permit feedback to improve the modeling.

From the motivational point of view, the computer should provide a model that is as humanlike as possible. Also, characteristics of high-status models should be employed whenever possible. Similarly, relevancy of subject matter is important. The degree to which students feel the subject matter is relevant, will directly affect their performance. In designing CAI modules, relevance can be improved by selecting topics or design themes that represent important issues for the students or by demonstrating the practical or applied aspects of the subject matter. Finally, the way in which the faculty discuss the use of the simulation in
class, the importance they accord it, and the physical surroundings in which the simulation is used all will positively or negatively affect the outcome of the modeled learning.

To sum up, reinforcement is probably the most-accepted concept in learning theories in general and is central to the theories outlined for use in the development of CAI courseware. Yet most behavioural theories speak almost exclusively of the need for contiguity and repetition of reinforcement. In CAI, however, both quantity and types of reinforcement are to be considered. So far as the quantity is concerned, it has not been found to be of significant importance in most studies. Thus, providing two minutes of game playing as a reward for attaining mastery will probably achieve as significant reinforcement effects as five minutes.

A key item, however, is the type of reinforcement - it must be geared to the needs of students and must be perceived by students as satisfying (i.e., as truly positively reinforcing). Thus, reinforcement of a drawing of a spaceship in full colour may meet the needs of a first grader, successfully achieving mastery of simple addition problems, while extends into an interactive game sequence after three or so successful solutions to algebraic equations may be what is required at the junior high level. Relevance is the key factor, which of course makes it difficult to
develop courseware applicable to diverse age and grade levels of students.

2.10 WHAT IS SCIENCE?

A discussion on scientific methods and attitudes presupposes the concept of what science is. It has already been mentioned elsewhere that science is not just a body of knowledge as it used to be considered in earlier times. It is a static view presenting science as a host of facts, principles, laws and theories along with the vast lot of systematized information used for interpreting the events in our environment and universe at large.

It is true that ever since men tried to understand nature, and to adjust themselves for existence and survival, human knowledge has accumulated. Men, then began to study nature's laws and behavior systematically and classified the gathered knowledge for convenience. But under the current wider context, science is much more than this. Science is dynamic. It is knowledge as well as the process of its continuous development and refinement. Thus science is both a product as well as a process. It is an endless process of observation, exploration and acquisition through empirical and conceptual means. The
characteristics of this process are growth through continuous acquisition, generalization and refinement (Cotton 2001).

2.10.1 Science and the modern world

The modern civilization is a scientific civilization. This is an age where the modern society is completely drawn into the scientific environment; and science has become an integral part of our life and living. The wonderful achievements of science have glorified the modern world. But the total effect of this shrinks to insignificance if compared to the entire transformation of human habits and human mentality produced by the long line of men of thought from Hales to the present day.

In recent times, there has been rapid addition of knowledge to the world of Science. Great advancements of science and technology and the use of these scientific achievements in promoting the well-being of mankind through their application in the field of industry, communication, transport, engineering, agriculture, medicine has made science more important than ever before. Science has, in fact, radically transformed the material environment of the citizens of the modern world. We knew the importance of science in our world and to understand and learn perfectly, there are various methods in teaching science and one of these methods which we are going to discuss about in
the next paragraph is the CAI method that plays the significant role in teaching science to students in the classroom (Cotton 2001).

2.10.2 CAI in teaching science

In past few years the teachers everywhere recognized the help that books give them in teaching students. But at the present, in line with developing changes in technology and its effects in education, the recognition is changed. The teachers look at the features of technology such as computers as a new and powerful tool for helping them to teach students more effectively. In developed countries a great deal of research has been done to emphasize on the teachers, the effects of the use of computer as a teaching tool on student achievement, attitudes, learning rate, retention, etc., (Cotton, 2001).

The use of computer-based instructional technologies in teaching Higher Primary School science goes back to the 1970s in the form of CAI (Christmann and Badgett, 1999). These early uses of IT, nonetheless, were limited to simplistic, unidimensional, drill-and-practice applications, which did not carry much promise for educators especially in the light of enhanced and deeper understandings of the realities and complexities of learning and classroom environments (Mandinach and Cline, 1994). However, since the early 1980s, science educators have become
increasingly interested in the educational implications, both curricular and pedagogical, of advances in information technologies. First, educators realized that such technologies were increasingly becoming an integral part of science, and that this change in the nature of the scientific enterprise had significant implications for Higher Primary School science curricula. To successfully prepare students for future careers in science, as well as for citizenship in an increasingly scientifically and technologically laden world, higher primary school curricula need to incorporate learning about IT as target instructional outcomes (information technology as “ends”) (American Association for the Advancement of Science (AAAS), 1990, 1993; National Council of Teachers of Mathematics (NCTM), 1987, 1989, 1991, 1995; National Research Council (NRC), 1996). Second, educators came to believe that technological advances greatly enhanced the potential of IT as effective pedagogical tools, which could enhance the learning of science content and processes (information technology as “means”) (Bereiter, Scardamalia, Cassells, and Hewitt, 1997; Hannafin and Land, 1997; McCluskey, 1995; Scardamalia and Bereiter, 1996).

This idea has appeared in two most important subjects that are science and mathematics. Indeed, the teachers who are teaching science or math have shown increasing interest in the use of computer for
classroom teaching. The science teachers for some reasons, based on their opinion, indicate the importance of CAI in the science curriculum, increasing motivation and reinforcement by use of, for instance, science video disc games, improving problem solving and critical thinking skills especially when students face complex concepts while these concepts are impossible to find out with static, inert media such as books and chalkboards, reducing time when dealing with difficult concepts.

Moreover, it is stated that science computer programs demonstrate concepts, instruct, and remediate student errors and misunderstandings from preschool through college levels. Some programs help students learn key vocabulary words; others demonstrate concepts such as how machines work, the life cycle of a butterfly, and the positions of the stars and planets, science fair projects. Many science textbooks come with interactive CD-ROMs that can be used to reinforce ideas. Computer-created graphic organizers and concept maps can be used by students to organize ideas in science or as a guide for interpreting information found in a science textbook. Students can spend time in a virtual laboratory studying chemical reactions or observing a microscopic cell. They can answer questions about animals, see how clouds and mountains are formed, or watch the movement of the plates of our planet. There are games, quizzes, and information to support and enhance instruction.
Problem-solving activities help students improve their higher order thinking skills and challenge students. This study describes employing CAI in teaching science, as it will lead to higher achievement in VIII standard students.

These packages are also effective because they deal with more practical examples than those in any textbook and give students virtually a hands-on experience. Students may be exposed to experiences or simulations that they would not normally encounter (Mumford, 1992). Group work has also become a much more important part of the classroom environment. Similar to the workplace, students are encouraged to collaborate their ideas and thoughts with other members of their “team”. This is becoming a necessary skill which will benefit these students for the rest of their lives. CAI technology has brought with it drastic changes to the conventional classroom/laboratory. Teachers, students and parents are all required to change their role in education. The teacher’s role has changed from that of an oracle of knowledge to a guide and/or resource person (Matray and Proulx, 1995). As previously mentioned, students have changed from complacent, passive onlookers to active participants in the classroom. CAI has encouraged students to explore more and memorize less. There is evidence that CAI is beneficial for slow learners also (Young, V. 1983). One explanation for this may be
that the computer is more attractive and motivating to the student. It seems to promote engagement (Hitchcock and Noonan, 2000). The students prefer programs with higher interaction requirements as well as the use of animation, sound, and voice features. (Hitchcock and Noonan 2000).

Various studies (Entwistle, 1981; Schmeck 1988; Ford and Chen, 2001) have shown that when learners can learn in a way that suits them, improvements in the effectiveness of the learning process normally ensue. Humans are multi-sensory animals. The more senses through which we receive information, the easier it is to remember. According to Fletcher (1990), people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do. The fact that the computer can exercise various senses and present information in a variety of media, can enhance the learning process. Also, the ability to provide quicker (and perhaps more directed) feedback is an added benefit of CAI.

This permits information to be reviewed or examined out of sequence. Related material also may be explored. In some group instructional activities, the lesson can progress according to the dynamics of the group. CAI can dramatically increase a student's access to information. The program can adapt to the abilities and preferences of the individual student and increase the amount of personalized instruction a
student receives. Many students benefit from the immediate responsiveness of computer interactions and appreciate the self-paced and private learning environment. Moreover, computer-learning experiences often engage the interest of students, motivating them to learn and increasing independence and personal responsibility for education. Although it is difficult to assess the effectiveness of any educational system, numerous studies have reported that CAI is successful in raising examination scores, improving student attitudes, and lowering the amount of time required to master certain material. While study results vary greatly, there is substantial evidence that CAI can enhance learning at all educational levels. Therefore there is a need to explain the importance of computers.

2.11 RESEARCH IN CAI

CAI refers to applications specifically designed to teach a variety of subject areas to children and adults. In CAI, students receive feedback from the computer, which controls the sequencing of the subject matter (Freedman, 1991).

Advocates of CAI have high expectations for the computer as an instrument for identifying and meeting individual needs. Many studies conclude that using CAI to supplement traditional instruction is better than the instructional program itself.
2.11.1 Studies related to Effectiveness of CAI in Mathematics and Statistics

Helaiya, Sheetal. (2004) conducted a study "Development and Implementation of CAI package for Teaching Statistics to B.Ed. Students." A CAI package was developed through Visual BASIC by the investigator on Teaching Statistics. 16 B.Ed. Students of Department of Education, MSU, Baroda having Computer Education specialization constituted the sample for the study. Pre-test, treatment, post-test single group pre-experimental design was used for the study. The treatment was found quite effective as evident through the mean gain scores and favorable reactions.

Chang (2000) reported a significant increase in scores on a measure of academic achievement when CAI on arithmetic was used to teach addition and subtraction. The final results of the study indicate that CAI can have a positive effect on skills and achievement for at risk secondary students.

Ryan (1991) conducted effects on microcomputer applications in elementary schools and the results of 40 independent studies that looked at the effects of CAI in reading and mathematics were analyzed. Ryan found that CAI raised academic achievement, on an average, by 0.309 standard deviations. The author concluded that a typical student’s score
would be raised from the 50th percentile to the 62nd percentile when exposed to CAI.

Roberts and Madhere (1990) in a study involving elementary and junior high schools stated that their findings indicated marginal successes in academic gains in reading and mathematics, and an overwhelming positive student attitude toward the computer assisted medium of instruction and learning.

Goode (1988) found that fifth and sixth grade students who used CAI, scored significantly higher in mathematical concepts and computation than a control group of students who used the traditional approach. Harrison (1993) found that students who received computer instruction showed greater increase in their achievement scores in multiplication and subtraction than students who received traditional mathematical instruction.
Kulik, Bangert and Williams (1983) analyzed 48 studies on the effects of computer-based teaching on secondary students in mathematics and science. Thirty-nine of these studies reported those students with computer-based teaching, scored better in final examinations than did students in conventionally taught classes. The other nine studies, reported, students in conventionally taught classes scored better in final examinations.

2.11.2 Studies related to Effectiveness of CAI in Science

Pandian, S.S. (2004) revealed that the CAI students demonstrated significantly higher achievement gains in biology. The variables Self-Esteem, attitude towards Biology and computer were influenced by the CAI. In contrast the attitude of students towards school could not be influenced.

Chang (2000) studied the inclusion of problem-solving-based, CAI within the regular classroom setting in order to improve earth science learning. Participants included 294 Tenth grade High School students who attended 8 Earth science classes in Taiwan. Two Earth science teachers taught the classes at 2 Public High Schools. The problem-solving-based, CAI used in this study by the experimental group, emphasized the following five-staged, problem-solving processes (Chang, 2002). In the first stage the problem was presented. Students initially
were shown a video clip of the debris-flow hazard that occurred in the Nan-Tou Province of Taiwan in 1996 (Ion, 2004). Then through guided inquiry provided by the computer program, they were asked to identify facts associated with this specific problem and to determine possible factors that might cause this hazard. The purpose of the second stage was to encourage students to plan a solution by analyzing and investigating the research questions, the factors causing the debris-flow hazard. In the third, students examined all the necessary materials in association with the debris flow hazard. In the fourth, students underwent a virtual field trip to conduct geological investigations provided by the problem-solving-based, CAI and to find solutions to the debris-flow hazard problems. In the fifth, students prepared final reports. The lecture-Internet-discussion-instruction used in this study by the comparison group, emphasized lectures given by teachers, use of textbooks and other materials, clear explanations of important ideas to students, and occasional presentations with regular computer-Internet usage and after-Internet discussions.

Bayraktar (2001) who has studied achievement of students in Secondary and College science education in the United States, has assessed in a comprehensive meta-analysis on the effectiveness of computer assisted instruction in the science subject area. This study
covered a three decades period. The aim of this study was to evaluate the status of this instructional method when compared to traditional instruction and to see overall trends. The results of this study showed that out of 42 studies, only one showed no difference between CAI and the traditional instruction group in terms of science achievement outcome. This analysis revealed that computers were more effective when used in simulation or tutorial modes than in Drill and Practice in science subject areas. Simulations create a more active learning environment, thus, increasing student involvement and enhancing achievement. Drill and Practice is generally associated with rote learning. Science requires students to be involved in higher-level cognitive processes such as questioning, hypothesizing, problem solving, analyzing, and synthesizing. This meta-analysis also revealed that CAI was more effective when computers were used individually. According to the results of this study, CAI is more effective when used as a supplement to traditional instruction rather than as a substitute. Lowe (2001) reviewed several other meta-analyses from the 1980s and 1990s and concluded that each of the reviewed meta-analyses showed a small positive effect size for computer-based education (CBE). The author described CBE as a term that includes CAI over conventional instruction. However, Lowe stated that research indicates that where CBE and conventional instruction was delivered by the same instructor, the CBE advantage was reduced to
insignificant levels; further, simulation and tutorials as supplemented to
c conventional instruction appeared to be the most effective.

Sanja (2001) conducted a comparative study of the effectiveness of
CAI and CMI on student’s achievement in science, their self concept and
study involvement. Both CAI and CMI were found to be contributing
significantly towards the achievement of pupils in science, in developing
their self concept and in increasing their study involvement.

(Chang, 2000). A number of variables were held constant, such as
Grade Level (10th grade) of Earth science students and the equivalent in
situational content and duration. The independent variable was the
instructional plan, and the dependent variables were achievement of
students and attitudes towards earth science. The multivariate analysis of
covariance measured the dependent variables, the post-test of student
achievement and attitudes. The Earth Science Achievement Test post-test
scores obtained by the experimental and comparison group showed that
the students taught using the problem-solving-based, CAI scored higher
than the comparison group students. Furthermore, the univariate analysis
of covariance performed on the Attitude Toward Earth Science Inventory
indicated that the problem-solving-based, CAI groups had a better
attitude towards Earth science than did the lecture-Internet-discussion-
instruction groups. Chang used the univariate analysis of covariance
results to show that students in the problem-solving-based, CAI groups showed greater gains than the comparison groups did, at the Knowledge level of Bloom's taxonomy. But, there were no differences between students in the experimental groups and comparison groups when higher-order test questions were asked. Chang concluded that the kind of the test questions on the debris-flow hazards and typhoon topic were too difficult for both groups of students. In another study, Springer (2002) studied academic performance improvements in delivering metric CAI (as a proctored tutorial) to pre service teachers and found that those individuals who received the CAI performed, significantly better on a metric post-test than those students who received no instruction. Also Jenks (2002) while comparing paging text and scrolling text versions of a linear metric CAI module, found with both the paging and scrolling treatments, pre service teachers who scored low on the pre-test had a much larger mean improvement on the post-test than did the students who scored high on pre-test. This could indicate that the linear metric CAI was effective as a remedial also.

Yadav SH. (2000) conducted a study of the effectiveness of the computer software for students of standard I. A significant gain has been found in terms of mean achievement on the software on Alphabets and Animals. Most of the students were found to have positive reactions
towards the software. Teachers welcomed the media integrated approach towards learning.

Goel. D.R., et al. (2000) conducted a project implementing CAI in Schools: “An Experience”. The project was conducted to study the effectiveness of CAI (Satellite, Solar System & Magnet (VIII) Pollution, Electricity, Thermal Conductivity, and Biogas (IX), Organic Chemistry, Optics, Periodic Table and Chemical Bonding (XI) in terms of achievement of the students. Also an attempt was made to train teachers in the use of CAI on optics, thermal conductivity, periodic table and chemical bonding, solar system, electricity, magnetism, accountancy, photosynthesis, geometry, rhymes, English, cell division and Balgeet. It was found that out of the packages implemented through control group-experimental group design, the value of 't' was not significant, whereas, the packages implemented through single group pre-test post-test experimental group design the value of 't' was significant. The students and teachers were found to have favorable reactions towards the CAI.

Khirwadkar A. (1999) developed a CAI package in subject of Chemistry for standard XI Science Students studying GSTB syllabus and studied the effectiveness of the developed software in terms of instructional time and achievement of students. Also, she studied the effect of software package on achievement of students in relation to
intelligence level of students, motivation level, and attitude towards the package and the attitude of the students and teachers regarding the effectiveness of the CAI package with respect to contents, presentation, examples, illustrations, graphs and figures, evaluation items, utility of software and instructions given in the instructional manual. The developed software package was found to be effective in terms of academic achievement of the students. The students and teachers were found to have favourable opinion towards the software package. An interaction effect of IQ, motivation and opinion of students on their academic achievement was found.

Christmann and Badgett (1999) conducted a meta-analysis of the research that assessed the effect on the academic achievement of science students exposed to versus those not exposed to CAI within four academic areas (general science, biology, chemistry, and physics) and across three educational settings (urban, rural, and suburban). Eleven research studies met predetermined selection criteria (related to research design, sample size, and data analysis) and were included in the analysis, which revealed a positive but small overall mean effect size of 0.266. For the 2343 students included in the analysis, this overall effect size means that “the difference in academic achievement resulting from CAI was an improvement of 10.4 percentile ranks from the central region on the
distribution” (p. 140). However, effect sizes for different subject areas varied substantially: General science: 0.707, physics: 0.280, chemistry: 0.085, and biology: 0.042. Similar differences in effect sizes were found across educational settings with students in urban settings achieving the highest gains (0.685) and those in rural settings achieving the lowest (effect size: 0.156). Students in suburban settings achieved relatively small gains (0.273). The authors concluded that CAI was more effective than traditional instruction in enhancing achievement among science students. Nonetheless, this conclusion should be viewed with caution given the relatively small overall mean effect size.

Malone and Reiland (1995) A program that teaches Newton’s Third Law. A study was conducted, demonstrating this program’s effectiveness. The teachers found that the students were very inventive and actually enjoyed learning this normally difficult topic. “The use of these methods saved (the teachers) considerable class time and, best of all, post-test results show that the students internalized Newton’s third law and retained it till (the end of the school year).”

Lazarowitz and Huppert (1993) assessed the influence of integrating a computer-assisted learning program into classroom-laboratory instruction on 181 (82% female) grade 10 students’ knowledge with regard to bacterial growth and science process skills. The treatment
spanned three 45-minute periods per week for four weeks. Compared to students in the control group who received conventional classroom-laboratory instruction, students in the experimental group used the program to simulate and construct graphs of microorganism growth. Females in the experimental group achieved significantly higher scores than the control females on content knowledge and science process skills (specifically, interpreting data and controlling variables). No such differences were found for male students in the experimental group.

Price (1989) conducted an attitude survey and observed student progress in a middle school science project where CAI was used as a tutorial and research tool. It was concluded that in this way the use of CAI encouraged an overall improvement in motivation and interest in the science research project.

Linn (1986) conducted an experiment in which eight eighth grade students of science classes used computers as lab partners for a semester. These students learned to use the computer to collect and display data and save and print out their reports. They used tools such as temperature and light probes, which were attached to the computer, and the results were, displayed on their computer screens. Linn found that the students instructed in the micro-based lab outperformed seventeen years old who took a standardized test on scientific knowledge. In addition, these
computer-taught students demonstrated a very positive attitude toward experimentation.

Moore et.al. (1980) found higher student achievement with computer simulations when students had to interpret the results of the experiments to make decisions. The finding of Surtumerville (1984) was similar that if the students only had to follow directions and calculate the results, there was no difference between the experimental and control groups. According to Thomas and Hooper (1991), the results of the science simulation studies are very promising. This is particularly encouraging, even when a study shows no significant difference between students who use the traditional method and students who use the computers. This means that simulations can substitute for laboratory experiments, which is advantageous because science simulations are less dangerous, less time consuming, and less expensive than actual lab work.

2.11.3 Studies related to Effectiveness of CAI in teaching Languages

Hirakumar M. Barot (April 2005) conducted "A study of the effectiveness of CAI in Sanskrit for standard VIII students". The study was conducted to develop CAI in Sanskrit for standard VIII students and to study its effectiveness in terms of mean achievement of students in Sanskrit and to study the reactions of the standard VIII students regarding the effectiveness of the developed CAI package. 86 students of standard
VIII of Shree Ambe Vidyalaya, Waghodia Road, Baroda constituted the sample for the study. A single group pre-test and post-test design was employed for the study. Achievement test and reaction scale were constructed by the investigator. Flash MX, Corel Draw 11.0 and Front Page were used for the development of software. The 't' value, frequencies and percentage responses were used for data analysis. The developed CAI in Sanskrit was found effective in teaching Sanskrit to VIII standard students. The reactions of the students towards the developed CAI in Sanskrit were found positive.

Pardeshi R. (2005) conducted "A study of the relative effectiveness of CAI and CAIPI in learning Trigonometry by English medium students of standard IX of Baroda City". The objectives of the study were to develop the CAI and study its effective in mono, diad and triad settings and its relative effectiveness in the three settings and through reactions of the students. All the four hypotheses of the study were formulated in the null form. The study was conducted in the three sections of standard IX of Zenith High School, Baroda, dividing each section into two groups-experimental and control. The CAI was developed using Flash-MX, Directors and Corel Draw 11.0 along with the internet. An achievement test was constructed for administering as pre-test and post-test. The data were analyzed through mean, SD, uncorrelated 't' and ANOVA. No
significant difference has been found in the mean achievement scores of the experimental group in mono, diad, triad and control groups, respectively. Significant difference has been found in the mean achievement scores of the experimental group in triad and control group. The students were found to have positive reactions towards the developed CAI.

Macwana, SH. (2004) focused on the development of Computer Assisted Learning Material (CALM) on optics for standard IX Gujarati medium students and to find out its effectiveness in terms of the achievement of students and reactions of the students and teachers. The study employed experimental and control group design. Standard IX Students of Kalrav School, Halol (Section A: 40 and Section B: 40), and their teachers constituted the sample for the study. The CALM was found effective in terms of achievement and reactions.

Suwanna Ruttanthummatee. (2004) conducted a study "Effectiveness of CAI for Primary School Students: A Experimental Study". It is a development-cum-experimental study. Pre-test, post-test design with replication groups was used for conducting the experiment. Two experimental groups along with eight replication groups, each consisting of 30 students were drawn. In all 150 students of Pratom-3 and 150 students of Pratom-6 belonging to Buriram Province participated in
the study. CAI programmes on 5 units for learning each language were used for conducting the experiment. The characteristics of different tools used for the study, namely, criterion tests and opinionnaires have been well established. The data have been suitably analyzed through mean, SD and t-tests. The study has resulted in the development of CAI Programmes on selected five units of Thai language both for Pratom-3 and Pratom-6. The CAI Packages developed by the investigator on Thai language have been found effective at both the levels, that is, Pratom-3 and Pratom-6 as evident through the t-values with the students of Buriram Kindergarten with Experimental Groups 1 and 2. The CAI Packages developed by the ONPEC on English language have been found effective at both the levels, that is, Pratom-3 and Pratom-6 as evident through the t-values with the students of Buriram Kindergarten with Experimental Groups 1 and 2. The CAI Packages developed by the investigator on Thai language and ONPEC on English language have been found equally effective at both the levels in Buriram Kindergarten. The CAI Packages developed by the ONPEC on English language were found significantly and equally effective with all the eight replication groups. The CAI Packages developed by the ONPEC on English language received favorable opinions both by the teachers and students. Replication and the repeated demonstration of the effectiveness of the CAI developed by the investigator is one of the salient features of the study.
Zyoud M.M. (1999) conducted a study on Development of Computer Assisted English Language Teaching for VIII Standard Students. The study reveals that when the computer is used to its full potential, it can help the students achieve more in learning vocabulary, grammar and comprehension to the learners with different IQ, motivation and attitude. It helps the students learn better because it provides them with a lot of freedom and responsibility to learn at their own pace. The students were found to have positive attitude towards Computer Assisted English Language instruction.

### 2.11.4 Studies related to Effectiveness of CAI in Differences Areas of Curriculum

Cotton K. (2001) in his study found that software can be used to help students develop their writing skills and contribute to higher quality written work. In addition to improving writing abilities of students, use of writing software can foster positive attitudes toward computers, course content, and school in general. Computer software provides many instructional benefits, but CAI can have a much greater impact on student learning. In a classroom utilizing CAI, students often work independently or in pairs at computers around the room. Software on each computer effectively guides students through a series of interrelated activities and instruction, addressing a variety of learning styles. Computers can display
instructions or descriptions on demand, play audio of instructions or descriptions that students can hear through headphones and show video of a person talking to them, interspersed with visual depictions of material relevant to the activity, CAI is effective at delivering this content to students without ever tiring or getting impatient. Students enjoy working in a CAI environment because it provides them with immediate, positive feedback, grades all students fairly and provides them with more control over the speed at which instruction is delivered. Computers never mind repeating themselves. It also frees up the teacher to move about the room from station to station and provide relevant supplemental information. Students receiving individual instruction are more likely to pay attention and therefore retain more information.

Ranade M.D. (2001) conducted a single group and control/comparison group pre-test-post-test design study to compare efficacy of CAI with regular classroom teaching and studying from the textbook. Over a period of time retention of content was also studied. The findings of her study indicated that:

- The response of students to CAI was overwhelmingly positive.
- ‘t’ test for comparison of pre and post–test means revealed that CAI led to increased achievement.
While visually enhanced and non-enhanced presentations were equally effective in bringing about learning, the former led to better long-term retention.

Efficacy of CAI had never been found to be less than regular classroom teaching or regulated self-study from text books.

CAI led to greater inter-student interactions.

Patel R. (2001) conducted a study "Learning through CALM in relation to selected production variables and contiguity". The study was conducted to analyze CALM in relation to production variables and contiguity, to study the effectiveness of CALM in terms of mean achievement of students and to study the learning through various message items in relation to production variables and contiguity. 30 students of standard VIII (2000-2001) of Shreyas Vidyalaya, Manjalpur, Baroda were selected for the study. There has been found significant gain through interaction with CALM on Solar System and Magnet. The status of CALM in terms of production variables and contiguity in terms of achievement has been found to be quite high except on a few teaching points where there was need to improve upon graphics, mode of presentation, spatial contiguity of text and animation, and temporal contiguity of animation and narration.
Das A. (1998) explored the effectiveness of computer assisted learning material on Rhymes in different modes. The study was conducted to develop computer software on rhymes in text, graphics-text, text-music, graphic text music, and graphics-text-music-recital modes and to study the effectiveness of CALM prepared in different modes for learning the rhymes in terms of word meaning (lexicon), analytical understanding, comprehensive understanding, writing ability, recitation ability and LSRW ability. The second standard pupils of Baroda High Schools (1996-1997) constituted the sample for the modes of presentation, may not ensure higher cognitive language learning. Further intelligibility of a message is a function of sender, message, medium, mode, receiver, and the environment.

Greenlee et al. (1996) studied into the effect of CD-ROM software on reading comprehension of students showed significantly higher comprehension scores when students were reading the longer and more difficult narratives from the computer. Greenlee-Moore and Smith attributed these results of the notion that the textual manipulations of the interactive CD-ROM software produced higher scores on comprehension questions related to the text of more difficult and lengthier narratives. They maintained that an explanation for these results were that the computer group could get the pronunciation and definitions of difficult
words while the actual book group received no vocabulary help. The actual book group knew that they could ask for assistance from their teacher. However, they continued reading without seeking assistance. The authors suggested that comprehension was higher when reading from the computer because the student received immediate assistance on vocabulary, which tremendously affects comprehension. The study concluded that students reading from an actual book did not use meta cognitive behaviors and did not seek any assistance when they had difficulty with the reading material. They simply skipped unknown words and continued reading and did not ask for assistance, most likely to avoid embarrassment.

Tirosh, et al. (1990) reported on a study designed to use CAI to correct misconceptions of pre-service teachers about division story problems. It was found that CAI was effective in improving performance in writing expressions for division problems, increasing awareness of a tendency to divide by the smaller number and helping teachers explicitly recognize and correct their misconception about the relative size of the dividend and the divisor.

Lore and Chamberlain (1988) found that a CAI integrated curriculum was effective (e.g., reached a pre-established learning benchmark) when averaged with over all grades. However, some grades
performed at or above the benchmark while other grades performed below. Specifically, they found that grades 3, 4, 6, and 7 met or exceeded the goal level of academic achievement; grades 1, 2, 5, and 8 did not reach the goal level.

Burns and Bozeman's study (1981) showed evidence that a curriculum supplemented with CAI led to gains in achievement in some areas of curriculum. Tsai and Pohl (1977) studied the effectiveness of the lecture approach and CAI on college students learning how to program. They found a significant difference when achievement was measured by quizzes or final exam scores. When professors used the lecture approach supplemented by CAI, it was more effective. The lecture approach alone was the least effective method of instruction.

2.11.5 Studies related to Comparison between CAI and other methods of Teaching

Christmann and Badgett (2000) compared the academic achievement levels of college students who had classes that used traditional methodology with those of college students who had classes in which CAI was used as a supplement to traditional methodology. The authors compiled data from 26 studies and calculated an overall mean effect size of 0.127. When exposed to CAI, typical student achievement moved from the 50th percentile to the 55th percentile.
Glickman (2000) conducted a non-equivalent control group design study and found that the CAI treatment group did significantly better than the control group on concept understanding. However, there were no significant differences between the treatment and control groups on a measure of achievement.

Huxford (1999) in a study comparing traditional instruction modes with a CAI mode argued that the results suggest that CAI is not as useful for instruction as previously believed. In the study, college students from the different groups did not perform significantly different on measures of cognitive and affective learning.

Christmann, et al. (1997) conducted a meta-analysis of the effect of CAI in secondary education for the years of 1984 to 1995. They selected only studies that were correlative, quasi-experimental, or experimental in design and concluded that CAI had a greater effect size in the 1980s than it did in the 1990s (through 1995). Their research indicated that for the 12 year period (1984 to 1995), secondary students exposed to CAI, showed higher academic achievement than 57.2% of those students exposed to traditional instruction. Christmann examined research from 1984 to 1995 that studied CAI effects on academic achievement of secondary students (grades 6-12). They found a small positive effect size of 0.187 for CAI. Students exposed to CAI showed higher academic achievement than
57.2% of those students exposed to traditional instruction. Christmann also noted that the effect of CAI, based on the studies used in the meta-analysis, declined between 1984 and 1995.

Christmann, et al. (1997) conducted a meta-analysis that compared the academic achievement of students in grades six to twelve, who received either traditional instruction or instruction supplemented with CAI across eight curricular areas. The mean effect size for science—derived from eight relevant research studies, was 0.639 in favor of the CAI students. This mean effect size, it should be noted, was the highest among all eight academic areas investigated and indicates a relatively substantial effect for CAI on the achievement of secondary science students.

Snowman (1995) provided further support for CAI at the secondary level. The results of this study showed positive effects of computer-based education on secondary students. The typical student in a computer-based class scored at the 60th percentile while the typical student in a traditional class scored at the 50th percentile on final examinations. Fletcher-Flinn and Gravatt (1995) examined studies on CAI from 1987 to 1992 and found that there is an overall favorable effect size at all grade levels for CAI versus traditional classroom settings. Included in the meta-analysis were several studies in which the same teacher taught both the CAI and
“traditional” versions of a course; the researchers isolated the results of these studies and found no significant differences between CAI and traditional instruction. Further, Fletcher-Flinn and Gravatt found that, for those studies using paper and pencil equivalents of the CAI, there were no significant achievement differences between treatment and control groups.

Yalcinalp, et al. (1995) compared the effect of utilizing a CAI tutorial program versus traditional recitation sessions to supplement classroom instruction on understanding of students of chemical formulas and the molecular concept. Participants were 101 grade 8 students in two general science classes. Both experimental and control students attended the same lectures, but received differential supplementary instruction (i.e., CAI versus recitation sessions). Students in the experimental group scored significantly higher than the target concepts, as well as their ability to solve problems involving these concepts. It should be noted, nonetheless, that the above three studies did not control the significant confounding variables, such as novelty and teacher effects, and the increased efforts usually invested in novel approaches that are introduced into otherwise traditional educational settings.

Teachers face the challenge of motivating students and foster in them a positive attitude to improve their chances for success in school.
For example, an essential element for improving spelling of students is keeping their interest high. There are many studies that report positive attitudes of students towards the computer and how computers motivate students and help them maintain high interest (Hatfied, 1991).

Danley and Baker (1988) conducted a study involving the teaching of special education ‘mainstreaming’ to pre service teachers using CAI and traditional lecture modes of instruction. They found that neither method proved superior to the other in a measure of content learning. Rowland (1988) argued that the results of the study indicate tutorial CAI should be used for teaching basic concepts and simulation CAI would be better suited to teaching the application of concepts. Further, it was suggested that if CAI is to be effective, educators should match the CAI type to the intended learning goals. Rowland (1988, April) argued that the results of the study indicate tutorial CAI should be used for teaching basic concepts and simulation CAI would be better suited to teaching the application of concepts. Further, it was suggested that if CAI is to be effective, educators should match the CAI type to the intended learning goals.

Kulik and Bangert-Drowns (1985) analyzed 28 studies that examined the effectiveness of CAI with elementary students. Of these studies, 27 examined terminal-mainframe configurations, and only one
looked at microcomputer configuration. CAI related instruction appeared to improve student achievement by 0.47 standard deviations, on average, over students receiving conventional instruction. The authors calculated that a typical student scoring in the 50th percentile with conventional instruction would score in the 68th percentile with CAI.

In addition to this finding, however, Kulik et, al. (1983), while surveying 11 CAI studies involving college students, found that the differences favour the development of positive attitudes toward the subject matter as well as toward computers as a result of exposure to CAI. The same finding was also expressed in the study conducted by Garshman and Sakamoto (1981). Although this finding could be considered only as a tentative indication at that time, it certainly pointed towards a goal that faculty in general shares-to motivate the students to learn more about their field on their own.

Another experiment, designed to measure the effects of student-teacher contacts on use of CAI, was reported by Tsai and Pohl (1977). Using students in an introductory statistics class at the university level as subjects, they divided the class into several groups. The groups then received instruction for a two-week segment of the course in one of the following methods: 1. lecture/discussion (regular classroom), 2. programmed instruction (i. e., students were told to real material in a
programmed textbook), 3. CAI tutorials; 4. programmed instruction with periodic discussion sessions with faculty; and 5. CAI tutorials with periodic discussions with faculty. Tests were given at the end of the period and again after six weeks in order to measure retention. The results of the achievement tests at the close of the initial two-week period clearly favoured the CAI tutorials supplemented by the faculty discussion sessions. However, the results of the retention tests showed no significant differences among the groups. In another study, students found to be extroverted on personality measures tended to drop out of CAI training at significant level. However, when human interactions were increased, drop out rates decreased (Hoffman and Waters, 1982).

Kulik (1983) found that CAI has the potential for improving student achievement scores in pre-college classes. The results of the meta-analysis showed that the average effect of CAI was to raise student achievement by approximately 0.4 standard deviations

CAI research has generally been positive regarding the time it takes to learn concepts. Dence (1980) has described that several studies have substantiated that students learn more quickly with CAI than with traditional instruction. Gleason (1981) reviewed CAI research and interviewed researchers. His conclusion regarding CAI was that it results in a 20 to 40 percent saving in time as compared with traditional methods
of instruction. Fisher (1983) has reported that students using the computer completed their work 40 percent faster than when they did not have access to it. Krein and Mahlom (1990) have found that CAI reduced the time by 25 percent it took for students to learn the instructional material. A finding common in almost all studies is that the use of CAI reduces learning time, as compared with the regular classroom (Hirschbuhl, 1980).

Some researchers have tried to find out if students prefer computer-based methods simply because a computer is involved. Other research has focused on influence of computer on attitudes of student towards school and curriculum. Bracey (1992) has found that students reacted favorably to use of computer for instructional tasks. He has reported that students who worked on the computer had a more positive attitude towards the machine than those who had not used the computer. Kulik et, al. (1983) has reviewed studies on attitudes of students towards the curriculum after using CAI. In three of the studies reviewed, the results were statistically significant for the CAI classroom. In their meta-analysis, Roblyer et, al. (1998) has found that students do not seem to prefer the computer over other media. However, there were few studies with data measuring performance of students for computer media: thus, the results are unclear. Another common finding of studies in this area is that students usually
develop a more positive attitude towards computers in general as a result of their exposure to CAI (Russel, 1982).

Alderman, (1978); Gershman and Sakamoto (1981) have deduced that although improvement in learning is probably the most sought after result of CAI applications, the most positive statement that can be made about it at this time is that most studies show that the use of CAI, either improves learning or shows no difference when compared to the traditional classroom approach.

2.11.6 Studies related to differences between Gender in achievement by CAI

Sacks et. al. (1994) examined the relationship between attitudes of alternative high school students toward computers and computer use over a four-month time period. The results of the study showed that attitudes of girls towards computers improved over the course of the study, while the attitudes of boys remained the same. Results also found that attitudes of girls towards computers with pre-post correlations were not stable, while attitudes of boy were. However, there were no overall gender differences in actual use of the computers nor did use of computers increase across the course of the study.
Swadener and Haruiafin (1987) studied the gender similarities and differences in attitudes of sixth graders towards the computer. They found that boys with higher achievement levels in mathematics also had high interest in computers. The boys with low scores had high interest in computers. This is the complete opposite of the females, with the low achieving female students having the most interest in the computers.

Most gender studies try to get at the reasons for males using the computer more than females. Collis and Ollila (1986) examined the gender differences in attitudes of secondary school students toward writing on the computer. Females were significantly less positive than their male counterparts on every item that related to computers.

2.11.7 Study related to CAI and Self-Esteem

Robertson et al. (1987) in his study found that CAI had a positive effect on the self-esteem of experimental group students. They felt that self-esteem might have also been enhanced as a result of students developing proficiency with the use of the microcomputers. Teachers related that the students were proud of their accomplishments in using the microcomputers.
2.12 CAI IN IRAN

As results show that each research The CAI is the modern means of education which can be effectively taught to the students of all countries. The peculiarities of imparting education however differ from one country to another. They mainly depend on the computer literacy of teachers and students and also the availability of the hardware and software. The CAI method can revolutionize the education if it is made available to students of all categories irrespective of standard of affluence. The method will have to be standardized depending on the requirements of the particular country and the province. The CAI will be as much applicable to students of all provinces of Iran as is applicable to those in Ahwaz City in Khuzestan province of Iran. A detailed study has to be undertaken to augment the existing study of CAI, this research work and application. It is possible that certain amount of study has already been done by various scholars in Iran which needs to be compiled and a consolidated research work is required to be undertaken. The Ministry of Education, Government of Iran may nominate a suitable organization and authorize them to consolidate the existing work and further streamline to suit the conditions of students and educational institutions in all provinces.


2.13 CONCLUSION

Over the past 20 years, the progression of technology has been slow in the classroom. But when CAI has been introduced, it has shown an improvement in student academic performance in science (Chang, 2002). Computers are a fact of life in schools and in the home, and their role will keep expanding. Teachers are faced with the task of deciding how best to integrate the many possible uses of the computer into the learning experiences. They must decide what type of computer based activity is relevant in a given situation. This will require some understanding of the range of possibilities computers and software can provide. This knowledge must also match with the understanding of the kinds of learning that using such applications can support (Parkinson, 1998). Computer usage has increased tremendously over the last several years (Market Data Retrieval, 1999). Computers have great promise in education. The area with possibly the most promise for academic achievement is CAI. CAI is an educational medium in which a computer delivers instructional content or activities to a level that is adaptive for each child’s needs (Mundane, 1996). A review of the literature yielded encouraging evidence as to the effectiveness of CAI to increase academic achievement of students. The results of numerous experimental and meta-analytical studies encompassing computer-assisted instruction are also
noteworthy. Also results of some studies were equivocal; they have been quantitatively synthesized and integrated by meta-analysts to obtain an overall conclusion. Generally, the meta-analyses have shown positive effects of CAI over traditional instruction but the magnitude of these effects varies according to features of the individual or primary studies.