CHAPTER-II

REVIEW OF RELATED STUDIES

2.1 INTRODUCTION :

We live in a technologically developed society and computers have become an essential part of our life. The use of computers is increasing day by day in almost all the fields of human life. Skills to use computers have become as basic as those of reading and writing, so much so that the public's ignorance of the subject constitutes a real crisis (Leubramann, 1980). As reported in the Trend Report for the area of Educational Technology in Third Survey of Research in Education (1987), there are many areas where almost no attempt has been made for any research. Among them, the first instance is the use of Computer Assisted Instruction or Computer Managed Instruction. The country is already flooded with computers. The possible use of microprocessors for instruction is a reality now because India has already about 6000 microprocessor systems in operation and has authorities established for facilitating the manufacturing of microprocessors. It might have great potential for literacy programmes. India has a good number of highly trained people in this area but so far, beyond a bit of data processing, the computer has not been used for instructional purposes.

As reported in the Fourth Survey of Research in Education, (NCERT, 1991) under Educational Technology Section - A Trend Report that, till recently computers were used in

India - mainly for storage and processing of data. Computer Aided Instruction has not attracted any large group of learners or teachers. In 1984, the Computer Literacy And Studies in Schools (CLASS) project was initiated for senior secondary students. It has been mainly received as an awareness programme, starting with 250 schools. Till 1988, computers were installed in 1200 schools and it was projected that by 1995, 50,000 secondary schools and 60,000 primary schools will have computers. Most of the efforts as at present, are invested in providing computers, training teachers and producing softwares. Few research studies have been conceived to investigate its actual use or effect on teaching-learning process. Considering the money that is being or planned to be invested in computers, researches need to be undertaken regarding the use being made of this costly technology. Taking this argument as the basis, most of the research studies have been conducted with the basic assumption that computer literacy could not be neglected in any educational system. Most of the researchers in the past have asked a question about the effectiveness of CAI. The definition of effectiveness vary from the "amount of learning that takes place initially" to the "change in attitude of learners towards the computer as an instructional medium" (Foreman, 1990). Thus, in order to find out the effectiveness of CAI, investigator has carried out a review of related studies in this area. This chapter presents the review of related studies in a systematic way by dividing it into three sections viz.

(i) Use of Computers in the instructional process

(ii) Effectiveness of CAI

(a) CAI and it's effectiveness

(b) CAI and learners' characteristics.

(iii) Teaching of Chemistry through computers at secondary school and college level.

2.2 USE OF COMPUTERS IN THE INSTRUCTIONAL PROCESS :

The 20th century has witnessed an entry of computers in the field of education for serving different purposes. Computers have great potential for computation, analysis work as well as for instructional purpose. Computers are increasingly being used as media for imparting instructions to the learners at different levels in different subjects. Studies have been undertaken during the last few years on how effectively computers have been used in education. There are several research evidences to show the effective use of computers in classrooms in India and abroad.

This section deals with the use of computers in the teaching - learning process and contribution of various strategies for effective use of computers in the instructional process.

Shayer (1970) and Swetman (1972) in their studies regarding the use of computers in instructional process at school level found that computer enhanced the learning process of children.

Singh (1993) reported that introducing computers in school was not to teach about computers as a separate subject like Physics, Mathematics, Languages etc. but could be used as an integrating tool for combining Mathematics, Social Studies, Languages etc. in one lesson.

Wells (1981) studied the relationship between the processes involved in problem solving and the processes involved in computer programming at higher secondary level. He found that same processes were used in computer programming and in problem solving. Computer programming was found as an effective problem solving process and was more effective way than the use of traditional problem solving situation. It was because persistence and working back techniques were more widely used in computer programming.

McDonald (1984) studied the effect of supplemental microcomputer instruction on the achievement of university level students. The purpose of this study was to determine the effectiveness of supplemental microcomputer instruction in a Keller plan remedial/developmental mathematics classroom. This study further investigated the effect of this instructional combination on the achievement of students according to their preferred learning style. It was found that there was no significant difference in achievement of control group and experimental group on the basis of learning style. But students with low scores had a better opportunity to show improvement.

Scibetta (1985) carried out an evaluation of a curriculum unit designed to teach file writing as a part of a secondary school computer programming course. This study centered around the development of a file oriented computer course and the correlation between results of the course and various indicators available as predictors for the students' successful completion of the tasks.

The results showed clearly that high school students were capable of learning to program data files and closely integrated structure of hierarchy was responsible for the success in this endeavour. Verbal scores were consistently better indicators of success in learning to program data files than were the traditional mathematical indicators.

Joseph (1985) used the new interactive medium CATI (Computer Assisted Televised Instruction) to teach techniques used in the visual art namely sculpture, plaster and related material. It was found that due to significant capacity of CATI to deliver high resolution pictures and to provide the user with interactive instruction, CATI was found to have considerable potential for art making instruction.

Parry, et al (1985), have reported from their survey on the use of computers that there were five main areas of contribution of Computer Based Instruction (CBI) in education.

(1) As measured by student's achievement alone, CBI was best used as a supplement to the regular curriculum.

(2) When CBI was used alone, students' achievement was almost equal to that achieved with traditional instruction mode.

(3) Teachers' and students' attitude towards CBI was positive.

(4) CBI resulted in saving of instructional and learning time.

(5) CBI was particularly effective with low achievers.

Leila (1987) conducted a study on the use of computers in teaching Biological Sciences in selected secondary schools. The study was conducted to find out; (1) the extent of computer use in teaching Biological Sciences in selected public high schools in Los Angeles (2) the changes that had taken place in the related curricula as a result of computer technology instruction and (3) the attitude of teachers towards the integration of computers in Biology teaching. The study revealed that :

1. there was no change in the curriculum as a result of using computers.
2. Biology educators believed that computer could not replace the teacher or the textbook in the classroom.
3. Secondary schools should adopt the computer in teaching Biological Sciences.

Tombs (1990) investigated into the effect of computer symbolic modes on learning processes. The study focused on the symbol mainpulating properties of man and the computer. The results of the study indicated that computer symbol

structure can facilitate the learning process and it characterized an active learning environment.

Cutlett (1990) studied the effect of pictures in computerized instruction at university level. The primary purpose of this study was to examine the effect of the representational pictures on the immediate and delayed recall. The secondary focus was to explore the impact of pictures on the application of content and on interest in the lesson. The results of the study showed that pictures had a significant effect in immediate recall and had effect on delayed recall but did not have an adverse effect on interest.

Raghavan and Dharmaraja (1991) have found from their study that the use of computer software produced a significant difference in the students' achievement between the experimental and control group. They also emphasised the need to test computer educational software packages in school before releasing them for publication. Teachers must evaluate the usefulness of package before buying or recommending them for school.

James (1987) carried out a study to see the effect of computerized tutorial programme on high school juniors and seniors. The results of the study showed that the experimental group scored higher than the control group. A significant relationship was found to exist between students' background in mathematics and their scores in mathematics.

Gibbs (1992) studied the effect of self-evaluation during computerised answer judging of constructed responses on achievement, attitude and instructional time. The analysis of collected data revealed that the achievement and attitude were unaffected by self-evaluation. A significant effect was found about the instructional time. Instructional time increased with self evaluation as learners were forced to interact more with CBI lesson.

Further on the instructional use of computers in education, Lutfiekhatib (1993) reported various instructional use of computers i.e., drill and practice, simulation programme as a tool for word processing, data base management, spread sheets, telecommunications and graphics etc. Using these, children could learn necessary skills.

CONCLUSION :

It can be seen that the number of researches have increased only in last few years in this field. Most of the studies have been conducted abroad and very few studies amongst these have been conducted at college/ university level.

It can be infered from the findings of these studies that computers are useful in the instructional process as follows (1) An attainment of lower level objectives of cognitive domain (2) To enhance learning process among school children (3) Using computer as an integrating tool for

combining subjects such as Mathematics, Social Studies and Languages etc. (4) Using it for problem solving purpose at higher secondary level (5) It can be utilized for various instructional purposes and with their help, students can acquire different skills. (6) Computers are also useful for students of visual arts with the help of computer graphics.

Thus, one can say that computers play a very vital role in present educational set up and it is being proved very useful in classroom instructional process especially at school level.

2.3 EFFECTIVENSS OF CAI :

Computer simulated instructions and CAI accounts for much of the instructional use of computers in teaching-learning process. Under this head, the studies are classified into two categories.

a. CAI and it's effectiveness.

b. CAI and learners' characteristics.

2.3 (A) CAI AND ITS EFFECTIVENESS :

Many studies have been conducted to find out the effectiveness of CAI in terms of achievement of the students in learning as a subtitute for traditional method of teaching, attitude of students towards CAI, use of CAI for remedial instructions by Bennett (1986), Crockett (1980), Romero (1980), Knerr (1983), Wright (1984) and Hugh (1988).

The findings of the studies indicate the following trends :

i. Achievement and attitude were positively enhanced when regular activities were supplemented with computer based material and constant reinforcement schedules.

ii. There was positive shift in students' interest and behaviour pattern.

iii. CAI can be used very well for remediation purpose.

vi. CAI had a significant effect on the academic gains of students when considered in conjunction with the grade level, ability level, sex, ethinicity and socioeconomic status.

Some Studies have been conducted in India at secondary stage about the effectiveness of CAI by Pravakar (1989), Bharadwaj (1990), Adhikari (1992) Shantha (1987), Raghavan and Dharmaraja (1991), Stella (1992), Stella (1993), Joshi and Mahapatra (1994). These studies revealed the following :

i. CAI was found to be effective in terms of achievement of students and was superior to the traditional method.

ii. Students found CAI solftware as interesting and had favourable attitude towards CAI.

iii. CAI helped students to understand the concept of limit, continuity, derivative, due to incorporation of graphical and numerical approach.

iv. CAI was found to be an effective individualized instructional technique.

v. CAI was found to be effective in improving achievement of the students with teachers support.

These studies also supported that CAI helped students' learning through interactive teaching & learning process. It was also observed that teachers' role in the learning situation could be neglected (Stella, 1993), but CAI was found to be superior when supported by teacher.

While there are several studies conducted to find out the effectiveness of simulated experiments at secondary level using the attributes of microcomputer, use of computer simulation for problem solving, by Choi (1985), Barbacci (1992), Rivers and Vockell (1987), Woodword (1988) were noted. The following conclusions were drawn from the above studies :

i. Computer simulated experiments were found to be as effective as hands on laboratory experiences and there was no significant difference in the retention scores of computer simulated experimental group and control group students.

ii. Students had favourable attitude towards (CAI) and computer simulated instructions (CSI).

iii. CSI was also found to be effective for learning problem solving situations.

iv. Computer simulation was found to be effective in teaching not only the factual knowledge but higher cognitive skills as well.

Nachmias and Linn (1987) examined evaluations by students of computer presented information on temperature, heat and energy concepts in the science laboratory at secondary level.

In phase one, Nachmias and Linn found significant decrease in the willingness of students to accept inappropriate graph scaling, probe setup and probe calibration but not probe sensitivity. After enhanced instruction in phase two, which emphasized graph scaling, experimental variation, probe calibration and graph validity, students in phase two, increased their performance on graph scaling and experimental variation, showed no significant difference in probe setup and calibration and decreased in probe sensitivity relative to their counterparts in phase one.

In another study Niemice and Walberg (1987) carried out a critical examination of CAI. The findings were as follows :

1. Learning through CAI is comparable to learning that takes place through the live teachers' teaching.
2. Learning through CAI is time saving.
3. Students responded favourably towards Computer Aided Instruction because computers could be used to accomplish impossible versatility in branching and individualizing instruction, where true and natural instructional dialogue was possible.
4. Computer could virtually perform miracles in processing performance data. The most valuable finding was that

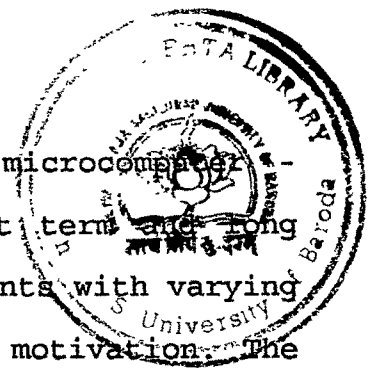
many students gained mastry status in a short period of time.

CONCLUSION :

The studies reviewed with regard to the effectiveness of CAI revealed that with regard to different subjects like Sciences and Mathematics, CAI was found effective in terms of students' achievement at school level. Further, it is worth noting that CAI was found effective not only for cognitive aspects but also for affective dimensions such as attitude, interest and behaviour pattern. CAI also helps students in saving time and enables them to gain mastery status in short duration, compared to the traditional teaching. Even computer simulated instructions were found to be as effective as CAI and also for actual hand on experience. Although, very large majority of the studies have reported higher achievement in different school subjects at secondary level, it needs to be noted that the studies were mainly confined to the science subjects.

2.3 (B) CAI AND LEARNERS' CHARACTERISTICS :

One of the aims of CAI is to meet the needs of individuals. Meeting individual needs of students is a complex task. Learners' achievement is usually affected by learners' characteristics such as intelligence, motivation, aptitude, personality etc. Some studies have been reported hereunder in this regard.



Waugh (1984) studied the effect of microcomputer-administered diagnostic testing on the short term and long term achievement of high school biology students with varying levels of academic aptitude and achievement motivation. The findings of the study were; (a) microcmputer administered diagnostic testing could positively influence short term but not long term Biology achievement, (b) students of varying levels of achievement motivation did not exhibit differences in Biology achievement. (c) The effects of microcomputer-administered diagnostic testing were consistent, across the levels of achievement motivation.

Carrier (1985) studied microcomputer programmed remediation of specific reading and writing skills deficiences in secondary school students. The results of the study indicated that the microcomputer treatment evoked significantly greater gains than the non-reinforcing treatments.

Collins (1985) found the effectiveness of computer-delivered correction procedures on low-performing secondary school students' reasoning skill. The study compared two types of corrective feedback for teaching a complex cognitive skills. One, receiving elaborated corrections and two, receiving basic corrections i.e., receiving correct answers for their feedback. The results indicated that students in the elaborated correction group felt that they could analyse arguments better than the basic correction group.

Perkins (1985) studied the effect of microcomputer on the critical thinking skills of middle school students. The purpose of this study was to determine whether teaching critical thinking skills with the micro-computer produced a greater increase in the thinking skills of middle school students than teaching critical thinking skills with conventional methods. The findings of the study indicated that students in treatment group who received instruction in verbal analogies achieved significantly higher gains than the control group. No significant difference was found between control, microcomputer and conventional groups on logical reasoning, inductive/deductive reasoning or problem analysis skills. Further, no significant difference in scholastic aptitude were found between the three groups as a result of instruction in critical thinking skills.

Meyer (1986) studied the effect of word processing on students' writing and their cognitive development at college level. Results of the study showed that there was no significant difference between word-processing and non-word processing students in writing quality, frequency of revision and type of revision used. But it had some effect on cognitive development and students of different cognitive stages used the word processor differently.

Jaon (1987) carried out a study to observe the relationship among the cognitive styles of reflection impulsivity and field independence, working styles on

computerized language lessons and second language learning. It was found that good language learners had the following characteristics : field independence, efficiency, fast working, accuracy and did not listen repeatedly. The poor language learners showed opposite characteristics.

Johnson, Johnson and Stanne (1986) studied the effect of computer assisted cooperative, competitive and individualistic instruction in terms of achievement, student interaction and attitude of eight grade students. It was found that computer assisted cooperative learning promoted the ability to apply facts in test questions requiring higher level reasoning and problem solving and more success in complex problem solving tasks, involving mapping and navigation.

Meyer (1986) carried out a comparative analysis of the value of intrinsic motivation in computer software in the mathematics achievement, attitude, and depth of involvement of underachieving students at secondary stage of education. The study reveals that there was no significant difference in the academic achievements & attitude between the control and experimental group.

Use of CAI with or without graphics did not substaintially improve the achievements & attitudes of underachieving students significantly than other intensive remedial instructional technique.

Liabre (1987) studied the effect of a computer administered test on anxiety and performance of students at college level. The results on test anxiety scale indicated significant differences in anxiety level. It was concluded that the computer administered testing could potentially increase test anxiety and depress test performance of examinees who were relatively unfamiliar with computers.

Wilson (1995) examined the relationships among learning - style, attitude and outcomes of computer assisted instruction at university level. The findings of the study revealed that attitude of students towards CAI was positive and no significant relationship was found between attitude towards CAI and gained scores. These findings suggest that significant learning occurs regardless of students, attitude towards CAI. However, one does not find any significant impact that CAI makes on certain characteristics of learners such as their attitude, attendance, writing quality, type and frequency of revision used, logical reasoning, inductive/deductive reasoning, problem analysis skills etc. While on the other hand, it was found that anxiety increased and it cured depression and poor results (this happened with those who were relatively unfamiliar with computers).

2.4 STUDIES RELATED TO TEACHING OF CHEMISTRY :

This section deals with studies conducted in the area of teaching of Chemistry at school and college level. Majority of the studies have been conducted at the school level. Findings of these studies have been reported here.

Jones (1980) studied teaching of Chemistry by means of video cassetes by employing computer graphics. The results indicated that the instructional videotapes, employing computer animated graphics could be used to teach Chemistry if presented under conditions which are conducive to learning and if subjected to developmental testing, to assure student learning. The abstract atomic scale concepts of Chemistry might also be related to their concrete, macroscopic representations by the combination of live action scenes and computer animation. The algorithms involving chemical calculations might be taught via these media, where they were used to model mental processes for the students.

Kolz (1980) evaluated the effectiveness of several CAI programmes in General Chemistry. He tried to find out whether two sets of Computer Assisted Instruction (CAI) programmes - one in Chemistry and the other in Mathematics had any effect on students' performance. The Analysis of Covariance indicated that there was no significant differnce in students' performance in Chemistry through CAI.

Tauro (1981) made a study of academically superior students' response to particular computer-assisted programme in Chemistry. The purpose of this study was to determine if classroom instruction which utilized computer-assisted programme, was more effective than instruction based on a traditional approach to teach Chemistry and to document the students evaluation to particular computer assisted

programmes in introductory chemistry. It was found that the students exposed to the CAI method of instruction, scored higher in the university final chemistry examinations. Students exposed to the CAI method of instruction had a greater positive attitude towards the study of Chemistry. The study also reveals that : (1) CAI programmes in Chemistry was an effective mode of instruction (2) CAI programmes in Chemistry increased their enthusiasm for the study of Chemistry. (3) drill and practice with CAI helped them to solve numerical problems in Chemistry.

Bobbert (1983) studied the effects of interactive computer simulated laboratory experiments in college Chemistry courses. The main aim of the study was to investigate the use of interactive computer simulated Chemistry experiments as an effective alternative to actual hands-on-laboratory exercises for those students who need not gain extensive manipulative laboratory skills. It was found that the interactive computer simulated experiences were as effective as an instructional activity as actual laboratory experiences. In an attitude survey of these students, it was noted that most of the students considered interactive computer simulated exercise as an acceptable learning methodology.

Slick (1990) carried out a comparative study of two computer assisted methods of teaching introductory Chemistry problem solving. The purpose of this study was to evaluate

the effectiveness of mathematical chemistry problem solving stages that required students to formally define given and derived data (i.e., quantity unit and type of mixture or substance) in mathematical chemistry problems.

The result indicated that the treatments demonstrated significant gain. The experimental group showed a significant gain in attitude towards Chemistry while control group showed significant gain in attitude towards computers.

Mahapatra (1991) developed a software package for teaching Chemistry to the standard IX students and compared it with the traditional teaching. Results of the study indicated the following : (1) CAI was effective in terms of students' achievement. Seventy percent students achieved more than 60% marks on criterian test. (2) The CAI material was found to be effective in terms of achievement as compared to the traditional method of teaching by taking intelligence as covariate. (3) Abstract reasoning score of the students studying through CAI was not found to be significantly higher than the traditional method of teaching by taking intelligence as covariate, (4) The extrovert and introvert students have no significant change in their reactions towards CAI.

Copolo (1992) conducted a study on the use of hand held and computer models as manipulatives to teach organic isomers in three dimensions. He compared the effects of using two and three dimensional model representations of molecular

structure on students' learning of organic chemical structure. It was found that students in combination group of using both models, scored significantly higher on retention test of isomeric identification, compared to other group. This study demonstrated the effectiveness of using the computer models for instruction of organic molecules and isomers as computer provides a focused and easily manipulated simulations.

Douglas (1992) studied the effectiveness of hypermedia-based, Learner Controlled (LC) instruction on atomic structure at junior high school level. In this study, students were assigned one of the two treatments. First was programme control (PC) instruction. It was modeled on typical CAI design. Second was Learner Control (LC) which gave freedom of forward and backward branching, common to hypermedia designs. The results of the study suggested that a structured instruction approach was more appropriate for junior high school science students, particularly when subject matter places a higher cognitive load on students.

Williamson (1992) found the effects of computer animation, emphasizing the particulate nature of matter, on the understandings and misconceptions of Chemistry students at College level. The experimental group was compared to a control group. The four dependent variables were conceptual understanding, number of misconceptions, course achievement and attitude towards instruction. It was found that experimental group had higher conceptual understanding score

and fewer misconception than the control group. No difference was found with course achievement or attitude. The results of the study suggested that the treatment with animation may increase conceptual understanding by promoting the formation of dynamic mental models of phenomenon. Static mental models may fail to provide adequate understanding of these chemical processes.

Waddick (1994) studied the use of computer learning environment as an alternative to traditional lecturing methods in Chemistry. It was found that the students could work at their own pace and constant feedback could be provided on progress. It helped in increasing the mastery - especially incase of weaker students. It increased attainment of students in experimental group in comparison with the students in control group.

CONCLUSION :

On the whole, it can be inferred that majority of the studies have indicated that teaching through computers is effective in terms of students' academic achievement and it helps in increasing conceptual understanding. Moreover, it was found that the students could learn at their own pace and they could get constant feedback which helped weaker students to increase mastery. Thus, computers seems to be acquiring increasingly vital role in the classroom instructional process. Teaching through computers have been found effective, not only for academic achievement but also for some other aspects like interest and attitude etc.

The review of studies presented under the section of teaching of chemistry with the help of computers reveals the following trends from the point of view of methodology adopted by the researchers :

1. Most of the studies were experimental in nature, following pretest-posttest and control group design.
2. Most of the studies have tried to establish the effectiveness of CAI for teaching of chemistry in terms of clarity of concepts, retention level and attitude of the students towards learning through CAI.
3. The studies conducted have used statistical techniques like t-test, ANOVA and ANCOVA for finding out the effectiveness of CAI in terms of students' achievement.
4. It was also found that for finding out attitude of students towards CAI, the researchers have used questionnaires & attitude scales as the tools.
5. Students' achievement tests were used as major tool in order to study the effectiveness of CAI.
6. Most of the studies were conducted abroad and very few studies have been conducted in India.

Further one can hardly find any study in the area of teaching of chemistry through CAI at higher secondary level. Therefore the investigator undertook the study to develop a software package for the three units of chemistry for standard XI. These units were taken from textbooks published by Gujarat State Textbook Board (1994). The software was

implemented in the classroom to evaluate its' effectiveness in terms of scholastic achievement of learners and instructional time taken by learners. Although in such studies one can follow single group pretest post test design to study the effectiveness of CAI package, but in this study since the focus of the study was to see the effectiveness of CAI package in terms of instructional time and scholastic achievement of learners, it was decided to take Pretest - Post test control and experimental group design. This helped the investigator to compare the effectiveness of teaching through CAI over teaching through traditional method. Further from the qualitative data related to the attitude of students and teachers regarding the developed and implemented CAI package and in the present study, it was also necessary to know as to how learning through CAI was more interesting and helpful to the learners.

The details regarding plan and procedure of the present study have been discussed in the next chapter.