CHAPTER – II

2.1. Introduction

Good, Barr and Scates (1935) state that as the competent physician must keep abreast of the latest discoveries in the field of medicine, the research worker and investigator should become familiar with the location and sources of educational information. Study of related literatures implies locating; reading and evaluating reports of researches as well as reports of casual observations and opinions that are related to the investigator’s planned research project.

Related literature includes theoretic discussions, reviews of the status of knowledge by authorities, philosophical papers, description and evaluation of current practices and empirical researches. Review of related researches is indispensable to get a clear-cut perspective of the problem.
In the words of Walter R. Borg (1965) the literature in any field forms the foundation upon which all future work will be built. Scanning of relevant research reports guides the researchers in the right direction, highlighting the pitfalls of the earlier studies and showing him the landmarks achieved. Also, a synthesised collection of previous studies helps the researcher to identify the significant overlaps and gaps among the prior ones. The investigator can probe into the neglected areas that need more concentration. Further, the review of related research enables the investigator to get to the frontier in the field of his problem. Until the investigator has learnt what others have done and what still remains to be done in his area, he can not develop a research project that will contribute to furthering knowledge in his field. It makes the researcher aware of the research possibilities that have been overlooked. His focus on these areas may pave the way to break new grounds and come out successful with new theories and principles, which may be of permanent value in the field of teaching and learning.

The literature so far available shows, that a good number of studies have been conducted on teaching and learning of physics in India and abroad. As for computer assisted instruction, there are adequate studies done abroad, but only a few studies have been carried out in India. So studies are warranted to establish the effectiveness of computer assisted instruction in teaching a particular subject. In this chapter, an attempt is made to present a summary of literature related to the research topic under two broad categories such as studies conducted in India and the studies done abroad.

2.2. **Studies Conducted in India**

The studies conducted in India are presented under the following sub-heads:

2.2.1. Studies on Achievement of Students in Physics

2.2.2. Studies on Computer Assisted Instruction.

2.2.3. Studies on High Achievers, Under Achievers and Low Achievers
2.2.1. Studies on Achievement of Students in Physics

Adequate numbers of studies have been made in this area of teaching and learning of physics. The studies reviewed are presented under this sub-head.

Agnihotri (1987) analysed the *influence of some of the methods of teaching physics on the achievement of students in physics*. The objectives of the study was to find out the significant difference between the mean achievement in physics of different groups of students taught by different methods viz. Lecture – cum demonstration method, laboratory method, programmed instruction and assignment cum-discussion method. The sample of the study consisted of five hundred and twenty students. Some of the major findings were:

a) The traditional method or the lecture cum demonstration method followed by the verification type of laboratory work was more effective than the assignment cum-discussion method but this method was less effective than the programmed instruction method in teaching physics.

b) With respect to achievement in physics, programmed instruction was less effective than the method of teaching physics systematically designed by the investigator, but this method was found to be more effective than the assignment cum-discussion method and the traditional method or the lecture cum-demonstration method followed by the verification type of laboratory work.

c) Out of all the four methods, the method of teaching physics systematically designed by the investigator was found to be most effective with respect to achievement in physics and the assignment-cum discussion method was found to be the least effective with respect to achievement in physics.

d) The relative effectiveness of all the four methods with respect to achievement in physics was the same, not only for all the schools but also for all the levels of students.
e) All the four methods selected for this investigation were ranked with respect to achievement in physics. It was found that the method of teaching physics systematically designed by the investigator was the first; the programmed instruction modified by the investigator for teaching physics was the second; the traditional method or the lecture demonstration method followed by the verification type of laboratory work was the third, and the assignment cum-discussion method was the fourth.

Basu (1981) studied the *effectiveness of multi-media programmed materials in teaching physics*. The main objectives of the study were: to prepare different types of programmed learning materials, semi programme, linear programme, branching programme, hybrid programme and compare their effectiveness in classroom instruction and to compare the relative effectiveness of different instructional strategies employing multi-media programmed class teaching on the criteria of immediate achievement, retention and delayed retention.

The findings of the study were: (i) There was significant difference among the means of different strategy on the overall achievement. Multi-media semi-programmed instruction was better than the strategy of programmed teaching, the multi-media linear programmed instruction and the multi-hybrid was better than multi-media branching programmed instruction. (ii) Multi-media programmed instruction enabled the learners to reach mastery level. The scores were between 80-86 out of 100. (iii) There was significant difference in the achievement when taught through different strategies due to difference in ability.

Bhargava (1981) undertook a *study of some cognitive process in science learning with reference to physics for students of higher secondary classes*. The objectives of the studies were: i) to identify significant process of science with special reference to physics and to deal with them in depth. ii) to develop and use the test processes of science incorporating the various processes identified for the study. iii) to develop and use a test of achievement in physics based on certain educational objectives. iv) to determine the interrelationship between the test scores of science process
and variables of SES, intelligence and achievement in physics in context to resistance and age level of the pupil and v) to study the longitudinal development of process of science as children grow up.

The study arrived at the following findings i) The scores on science process were found to be correlated with intelligence and also with the components of SES. ii) A moderate relationship of achievement in physics was observed with the three processes of science namely observing, measuring and drawing inferences and a low level correlation was observed with the remaining processes. iii) Boys were found to be superior to girls on the processes of observation and measuring and drawing inferences. iv) With growth in age a decline in ability to perform on science process was observed. v) Urban students outperformed their counterparts in rural areas on science process.

Desai (1986) conducted a study of effectiveness of programmed learning strategy in teaching of physics in the eleventh grade. The main objectives of the study were: (i) to prepare programmed material on heat in physics for pupils studying in standard XI (Science), (ii) to try out the programme on a sample of pupils and test its effectiveness as auto-instructional material and (iii) to ascertain the achievement of the pupils after the experiment through a teacher made test.

The study employed the experimental design. The method of cluster sampling was used for the selection of 200 pupils from 4 science classes of standard XI in Bombay and Greater Bombay. A pre-test was administered to a small sample to ascertain the pupils previous knowledge. The tools employed in this study were, (i) A questionnaire to ascertain the pupils previous knowledge (ii) S.S.L.C. marks obtained by the pupils in the subject of science at the S.S.L.C exam of March 1981. (iii) Science attitude scale.

The data wee analysed by using analysis of variance f-ratio, product moment of correlation and percentage rank. The major findings of the study were: (i) pupils take active interest in reading and learning through programmed material (ii) the programmed learning approach proved better than the lecture method in the study of physics.
Gangoli (1985) compared the **effectiveness of open-ended approach of doing physics experiments versus traditional approach at higher secondary stage**. The primary objective of the study was to compare the effectiveness of doing experiments in physics at the higher secondary level by the open-ended approach vis-a-vis the traditional approach. It was an experimental study with a sample of 92 students. The major findings of the study were: i) The students of the guided open-ended group showed better performance in the achievement test and in the skill test than those of the traditional laboratory group. ii) The major unwritten goal of laboratory work was however to prepare students for practical examinations held externally. iii) The main problems faced by the teachers were lack of free time for them to arrange for practical work laboratory assistants being busy elsewhere, the poor quality of equipment and chemicals supplied by firm offering lowest quotations and disciplinary problems of students. Results were quiet consistent with the concepts of intelligence and achievement.

Gangoli & Guru Moorthy (1981) carried out a **comparative study of the effectiveness of open-ended approach of doing physics experiment verses traditional approach at higher secondary stage**.

Primary objective of study was to compare the effectiveness of doing experiment in physics at the higher secondary stage by the open ended approach. The specific objectives of the studies were: (i) to compare the knowledge and understanding of concepts, principles and facts and the ability to apply knowledge and understanding developed by students conducting physics practicals by the guided open ended approach with those by the traditional laboratory approach. ii) to compare the skills in observation classifying, drawing, tabulating, computing etc., developed by the students following the above two approaches. iii) to compare some aspects of creative thinking ability like fluency flexibility, and originality of doing experiment by the above two approaches and iv) to compare within the group viz. The guided open ended group and traditional laboratory group, subgroup. (experimental study)
The study revealed the following findings: i) Students of the guided open-ended group showed better performance in achievement test and in the skills test than those of the traditional laboratory group. ii) Students of the experimental group were found to be superior to the students of control group. In both groups girls were found to be superior to boys.

Jain (1982) conducted a study of the problem solving behaviours in physics among certain groups of adolescent pupils. The purpose of the study was to point out the main educational implications for problem solving in curriculum reconstruction and methods of teaching based upon this study. One hundred and twenty students were the sample of the study.

Some of the major findings were i) For effective classroom instruction, curriculum and methods of teaching have to be planned in such a way that the structure of content is in accordance with the level of intellectual development of students. ii) Choice of curriculum and teaching method need to be matched so as to achieve the desired result in teaching science to adolescents.

Kamalakanthan (1968) undertook an experimental study of teaching physics by traditional and problem – solving methods to find out which of the two specific methods (traditional or problem solving) provided for students mean gain and retention of knowledge and abilities. Thirty two students of Xth standard were the sample of the study. It was found that the problem solving method had positive favourable points when compared to the traditional method of teaching.

Kasinathan (1992) analysed the revised physics text books prescribed for the second year of the higher secondary classes in Tamil Nadu. The major objectives of the study were: i) to find out whether the text books satisfy the objectives of teaching physics to the XIIth std students. ii) to find out whether the learning outcome of the textbooks caters to imaginative, creative and abstract thinking among learners and iii) To find out whether it promotes problem-solving ability.
This study was also based on survey method consisting of 30 P.G. teachers (Physics) as sample. The major findings of the study were: i) the aims and objectives of higher secondary education are well laid down in XIIth Std. revised physics textbook. ii) the revised physics textbooks provide accurate and current information. iii) 79.08% of the teachers expressed that the revised XIIth std physics syllabus was heavy. iv) the exercises given in the revised physics textbooks promote a better understanding of the subject and encourage critical thinking among the learners. All the units (except solids) in the revised physics textbooks possess adequate number of exercises and illustrations.

Krishnakumar (1991) conducted an analysis of physics textbook (revised) prescribed for IXth std matriculation schools. The objectives of the study were: i) to find out whether the revised physics textbook for matriculation students of IXth std is according to the objectives of matriculation level. ii) to see whether the content of revised physics textbook is suitable to the age and understanding level of students. iii) to assess whether suitable explanations and illustrations are provided in the revised physics textbook prescribed for IXth std. matriculation students. iv) to verify whether the adequate exercises are given in the IXth std revised physics textbook and v) to know whether the revised IXth std physics textbook has got physical features.

The investigation was based on survey method with the sample of all P.G. (Physics) teachers working in Pudukkottai District. The major findings of the study were: i) The aims and objectives of the matriculation level are well stated in physics textbook prescribed for IXth std. ii) The physics textbook is well organised and the topics are chosen according to the age group of students. iii) Teachers express the view that physics textbook contains modern ideas on every topic prescribed. A periodical addition or deletion may be carried out after a proper review from time to time. iv) Suitable explanations and illustrations are provided in the revised physics text-book. Diagrams are given adequately in the textbook. v) Exercises are given in the physics textbook to serve the needs and interest of the children and also to develop their power of thinking.
Kumarasamy (2008) studied the *effectiveness of computer assisted instruction on the achievement of students in physics at plus one level*. The study revealed that computer assisted instruction was very effective in teaching physics to the plus one students. The achievement of the experimental group students was higher than the achievement of the control group students. The rate of progress made by the experimental group students was the resultant product of the operative experimental factor, that is, the application of computer assisted instruction.

Mahajan (1983) studied the *effect of Ausubellian Advance Organizers on the learning of formal operational students*. The sample consisted of 305 physics students. It was found that there was a significant interaction between the cognitive level and the absence or presence of organizers, at least as far as the composite scores and scores on the recall portion of the test were concerned.

Natarajan (2009) conducted an experimental study to verify the *efficacy of inductive thinking model of teaching on the achievement of various categories of students in physics at plus one level*. The study established that the applied strategy of inductive thinking model of teaching was very effective in teaching physics to all the categories of students. It was more effective to the below average students and the average students. Further, the applied strategy enabled the below average students to cope with the students of other two categories to a considerable extent.

Ponnambalam (1999) conducted an experimental study on *relative effectiveness of project method and video instruction in learning physics by the low achievers* with the following objectives. i) to find out whether there is any significant differences between the post-test mean scores of low achievers in the control group and low achievers in experimental video group. ii) to find out whether there is any significant differences between the post-test mean scores of low achievers in the control group and low achievers in experimental project group. iii) to find out whether there is any significant difference between the post-test mean scores of the low
achievers in the experimental project group and the low achievers in the experimental video group.

The main findings were: i) The achievement of experimental project group and experimental video group is higher than that of the control groups. ii) The achievement of experimental video group is better than the achievement of the experimental project group. iii) There is no significant difference between the post-test mean scores of low achieving boys and girls of all the groups. iv) Rajput et al. (1978) made a survey about science laboratories in Regional College of Education in the western region. The sample of this study was the science teachers in western region. Questionnaire was the tool used by the investigator.

The study concluded that the objectives of laboratory work outlined by the teachers were: to verify facts taught in theory classes, to develop habit of doing independent work among the students, to create interest in science, to prepare students for higher studies and ultimately to prepare students for higher studies and to make them ultimately good scientists for the country.

Sakila Banu (2008) studied the effectiveness of advance organizer model of teaching on the achievement of students in physics at plus one level. The study concluded that the advance organizer model of teaching was more effective than the traditional lecture method in teaching physics at plus one level. The achievement of the experimental group students was higher than the achievement of the control group students taught through the traditional lecture method.

Singh P.N.S. (2008) conducted a study on the effectiveness of practical experiments on the achievement of various categories of students in physics. The study concluded that the practical experiment had a positive effect on the students and it enhanced the achievement of students in physics to a considerable extent. The students secured higher marks in practical related units than in other units which had no related practical experiments.
Singhal (1983) conducted a study of physics education using non-formal methods. The objectives of the study were: i) to identify the academic problem of science students and teachers at higher secondary stage and first year of colleges. ii) to conduct action oriented programmes according to the requirements of the respondents.

The findings of the study were: i) Students did not read beyond the syllabus and did not cultivate the habit of understanding the basic concepts of physics. ii) Science students were found very weak in numerical work. iii) No logical and scientific way was found to improve the syllabus.

Subramanian (1989) undertook an experimental study on the effectiveness of Keller Plan personalised system of instruction in teaching physics at the higher secondary level. Sixty students were selected out of 97 students in the standard XI physics group. They were divided into two equivalent groups namely experimental group and control group. The control group was taught by the conventional teaching method and the experimental group was exposed to the Keller plan method. The two groups were taught for a period of fifteen working days. The study revealed that Keller plan as a teaching strategy is effective in improving the achievement of the learners in physics. And the Keller plan method of teaching is more effective than the conventional teaching method in improving the achievement of the learners in physics at the higher secondary level.

Sundarrajan (2008) made a study on the effectiveness of certain instructional and non-instructional strategies in enhancing the achievement of the students in physics at plus one level. The study revealed that the selected instructional and non-instructional techniques were very effective in teaching physics at plus one level. The applied strategy enabled the experimental group students to score higher marks in the achievement test than their counterparts in the control group.
Vardhini (1983) carried out the study of the development of a multi-media instructional strategy for teaching science (physics and chemistry) at secondary school level with the following objectives. i) to develop a validated multi-media instructional strategy for teaching science (Physics and Chemistry) in standard VIII, ii) to study the relationship between achievement using the strategy and intelligence and scientific attitude and iii) to study the feasibility of the strategy in terms of time and cost. The instructional strategy was validated on a sample group of 45 students of class VIII of an English medium school of Baroda city. The control group consisted of 47 students of another section of the same grade who were not exposed to the strategy. The investigator proposed criterion test and comprehensive tests, scientific attitude scale and reaction scale. Descriptive statistical techniques and t-test were used for analysis and hypothesis testing.

The study revealed that (i) almost all the units indicated high level of performance on the total tests. (ii) Intelligence and achievement using the strategy presented a significant relationship. (iii) a significant relationship was found between scientific attitude and achievement for the experimental group and control group. (iv) visual projections with teacher explanation and those with taped commentary were equally effective in terms of achievement.

**Critique of the Studies under this Sub-head**

Most of the studies under this sub-head have been carried out to verify the effectiveness of some specific teaching strategy or learning strategy on the achievement of students at various levels of education (Kumarasamy, 2008; Sundarrajan, 2008; Sakila Banu, 2008; Ponnambalam, 2009; Krishnakumar, 1991). Such studies are experimental studies. A few survey studies have also been conducted to assess the opinion, reaction and attitude of the physics teachers towards teaching and learning of physics, in terms of adequacy of infrastructure, coverage of content and level of difficulty (Gangoli, 1985; Singhal, 1983)
Some studies have been undertaken to make an indepth analysis of physics textbooks at various levels of education (Kasinathan, 1992; Krishnakumar, 1991) Quite a number of comparative experimental studies have been carried out to verify the relative effectiveness of different modes of instruction in teaching physics at higher secondary level. (Ponnambalam, 1999; Agniholri, 1987), Some studies focus on the impact of experiments and practicals on the achievement of students in physics (Gongoli, 1985; Gangoli and Gurumoorthy, 1981).

2.2.2. Studies on Computer Assisted Instruction

Computer education and computer assisted instruction have come into the arena only very recently in Indian context. Though India has marked a milestone in the computer field which is reckoned all over the world, researches on CAI are still of preliminary in nature. Only very recently this has attracted the attention of the researchers. Recently encouraging studies have been made on the attributes as well as on the effectiveness of CAI as instructional strategy. Such studies are listed out under this sub-head.

Jagiit K. Singh (1993) probed into Integrating Computers in Education. The main objectives of the study were, to provide prospective teachers with basic information about a range of computer application, to identify ways the computer may improve the teaching-learning process, to introduce and build on the concept of integrating computers in the classroom and to emphasise the idea of co-operative learning culture within a technological environment. The study concluded that, it is important that technology be used to help children think critically and creatively and to engender a co-operative learning environment. By teaching the education students to use technology wisely, it is hoped that future teachers will successfully incorporate technology into their classrooms practices and add to that definite push that the teachers in educational institutions are already experiencing.
Kannan (2009) conducted a study on effectiveness of tutorial CAI on achievement of various categories of students in maths at plus one level. The study established that the applied strategy of tutorial CAI was effective in teaching maths to various categories of students at plus one level. Further, the tutorial CAI enabled the under achievers and the low achievers to cope with the average students and the above average students to a considerable extent. The gulf of difference between the control group and the experimental group in the post-test performance substantiated the advantage of the applied strategy over the traditional lecture method.

Latha (2009) studied the effectiveness of computer assisted instruction in teaching physics among plus two students. The main objective of the study was to apply CAI in teaching physics to the plus two students and to verify the advantage of CAI over the traditional lecture method. It was an experimental study with two group design. The study concluded that the applied strategy i.e. the computer assisted instruction was very effective in teaching physics to the plus two students. The applied strategy was effective not only in term of instruction but also in terms of retention.

Madhur Gupta (1989) studied two strategies of computer assisted instruction in chemistry. The main objectives of the study were, to design two strategies of computer – assisted instruction, to study the relative effectiveness of the two strategies of computer assisted instruction in teaching chemistry and to compare the mean retention scores of the two strategies of computer assisted instruction in chemistry. The study concluded that the students under the first strategy scored significantly higher than the students under the strategy II in terms of their mean gain scores and mean retention scores in the criterion test.

Rajalingam (2008) made a study on effectiveness of drill and practice CAI on achievement of low achievers in chemistry at plus one level. The study concluded that the drill and practice CAI was very effective in teaching chemistry to the low achievers at plus one level. Further, the study revealed that the applied strategy enabled the low achievers in the experimental group to cope with the normal students to a considerable extent. The mean difference between the control group low achievers and
the experimental group low achievers in the post-test performance established the advantage of drill and practice CAI over the traditional lecture method.

Reddy and Ramar (1995) undertook a study to assess the effectiveness of computer assisted instruction in teaching science to slow learners. After the experiment, the slow learners in the experimental group evinced better mean gain than the control group slow learners. Also, they could narrow down the gap between them and the normal group students. The narrowed down gap between both the groups may be ascribed to the effectiveness of CAI. But the authors are silent over the feasibility of CAI in Indian school setting where most of the schools do not have even a single computer.

Stella (1993) conducted a study on effectiveness of computer assisted instruction with special reference to underachievers. The objectives of the study were, to find out the effectiveness of the CAI software with special reference to underachievers, to find out the impact of the teacher support system on the achievement of underachievers, to find out the relationship between the achievement of the experimental group and the variables like sex, locale, study habit, maths study attitude and achievement (over, under) level and to find out the interaction effect of treatment and the variables on the achievement of the experimental group students. The study concluded that the teacher effectiveness is an important criterion that would affect the success of the teacher support system. Since the study has established the significant impact of teacher support system on the underachievers, CAI may further be used for those with poor study habits, and low and average IQ. The study has shown a favourable result with regard to these.

Sivakumar, Arunkumar and Sundaramoorthy (1994) conducted a study on effectiveness of computer assisted instruction, laboratory centred instruction and conventional classroom teaching in technical education. The objective of the study was to compare the relative effectiveness of CAI, LCI and classroom teaching in terms of the achievement of polytechnic students. The main finding was that the direct learning experience given through laboratory centred instruction is far superior to
self-instructional strategy and conventional classroom teaching. As students remember the experience gained through the direct experience for a longer period of time, it is recommended that the teachers adopt such strategies in regular classroom teaching.

Vijayan (2008) studied the effectiveness of CAI on achievement of various categories of students in maths at plus one level. The study revealed that the applied strategy of computer assisted instruction was effective to various categories of students. It enabled all the categories of students to show a better performance in the post-test. Moreover, the study pointed out that the applied strategy enabled the below average students to cope with the average students to a great extent. The gulf of difference between the control group and the experimental group in the post-test performance substantiated the advantage of computer assisted instruction over the traditional lecture method. Further, the study suggested that, if the strategy is properly applied in teaching learning process, it will increase the achievement of the students and thus it will diminish wastage and stagnation in our schools to a considerable extent.

**Critique of the Studies under this Sub-head**

Adequate number of studies have been conducted on CAI in India. (Sivakumar et.al 1994, Stella 1993, Jagiit K. Singh 1993) It has been confirmed that computer assisted instruction is effective with regard to achievement of cognitive objectives mostly at knowledge, understanding and application levels as well as development of certain teaching skills. Immediate gain and retention of newly acquired information have been found up to expected level among students exposed to CAI. (Subramania Pillai, 1992; Ramar, 1994; Reddy and Ramar 1994, 1995, 1996). Most of the studies under this sub-head are experimental studies conducted to verify the efficacy of CAI in teaching specific subjects. (Kannan, 2009; Latha, 2009; Madhur Gupta, 1989; Rajalingam, 2008; Reddy and Ramar, 1995). Impact of CAI with special reference to low achievers, under achievers and slow learners has been verified by Ramar (1996), Reddy and Ramar (1995) and Stella (1993). There is still much scope for further research in this area.
2.2.3. Studies on High Achievers, Under Achievers, Low Achievers etc in India

Quite a few studies have been conducted on low achievers, under achievers, slow learners, learning disabled in Indian context. Such studies are enumerated here.

Arumugam (2009) conducted a study on *effectiveness of concept attainment model of teaching on the achievement of high achievers and low achievers in maths at plus one level*. It was a two group experimental study. The control group and the experimental group consisted of 10 high achievers and 15 low achievers. The study concluded that the concept attainment model of teaching was effective to both the high achievers and the low achievers. In terms of relative effectiveness it was more effective to the low achievers and it enabled them to reduce the gap that existed between them and the high achievers before the experimental treatment. The reduced gulf difference between the high achievers and the low achievers can be attributed to the effectiveness of the applied strategy. The significant difference between the control group students and the experimental group students vouches for the advantage of concept attainment model of teaching over the traditional lecture method.

Deka (1985) conducted a *casual comparative study of high and low achievers* to find out the causative factors behind the academic success or failure of the students by mainly comparing the characteristics of the high and low achievers.

The major findings were: i) Low achievers always performed poorly in their school examinations and had greater incidence of school failures. Low proficiency in certain basic subjects such as vocabulary, spelling, arithmetic and general knowledge was significantly and positively related to school failure. ii) School failure was significantly and positively related to general mental ability, intelligence of high and low achievers, was not affected by residence and sex. Low scholarstic achievement was
significantly and positively associated with inferior leadership quality and less adventurousness. iii) School success and failure were significantly and positively related to family income, involvement in domestic activities and home study, while they were unrelated to parental education and occupation. iv) School failure was positively associated with school attendance, preparation of school work, understanding of lesson, preparation for examinations, favourable attitude of teachers and early school leaving. v) School failure gave rise to unfavourable attitude towards teachers and two major subjects of study – English and Mathematics.

Hebsy Helen (2008) studied the efficacy of modular instruction on achievement of low achievers in botany at plus one level. It was an experimental study attempted to establish the efficacy of modular instruction in teaching botany to the low achievers at plus one level. The study evinced that the modular instruction was effective in ensuring mastery learning on the part of low achievers at plus one level. The modular instruction enabled the low achievers in the experimental group to improve upon the pretest performance to a great extent. The mean difference in the performance of the experimental group low achievers between the pre-test and the post-test can be attributed to the efficacy of the applied strategy i.e. modular instruction

Jose (2009) probed into the effectiveness of team teaching strategy on the achievement of high achievers and low achievers in zoology at plus one level. This study was a two group experimental study with high achievers and low achievers in both the control group and the experimental group. The control group was taught through the traditional lecture method and the experimental group was taught through team teaching strategy. The study concluded that the team teaching strategy was equally effective to both the high achievers and the low achievers. Both of them improved upon their pre-test performance to a great extent. The significant difference in the post-test performance between the control group and
experimental group established the advantage of team teaching strategy over the traditional lecture method.

Kaul (1978) conducted a study on personality needs of high and low achievers in mathematics. The major findings of the study were: i) The high achievers in mathematics differed significantly from low achievers on eight of Murrays needs. ii) Several scales of EPPS discriminated between the high and low achievers in mathematics and could be used as possible non-academic predictors of achievement in mathematics.

Mariappan (2008) made a study on effectiveness of memory training model of teaching on achievement of low achievers in accountancy and auditing theory at plus two level. The main objective of the study was to apply memory training model of teaching to teach accountancy and auditing theory to plus two students. This two group experimental study established that the memory training model of teaching was effective in enhancing the understanding and the achievement of the students especially the low achieving students in accountancy or auditing theory subject. The difference between the control group and the experimental group in the post-test performance testified to the advantage of the applied strategy over the traditional lecture method.

Mishra (1978) conducted a comparative study of high and low achievers in science, commerce and arts on creativity intelligence and anxiety. The findings of the study were: i) The high achievers in arts were higher on the level of creativity than the low achievers in arts. ii) The high achievers in commerce were higher with regard to the level of creativity than the low achievers in that stream. iii) The high achievers in science were higher on the level of creativity than their low achieving counterparts.

Similarly the high achievers in arts, commerce and science groups were higher in their level of intelligence than their low achieving counterparts. The science students were more creative, intelligent and low in general anxiety than their counterparts in other streams. The arts students were low in creativity and intelligence but high in general anxiety.
The science students exhibited more creative talent and low general anxiety.

Radhakrishnan (2009) probed into the *effectiveness of modular instruction on the achievement of low achievers in accountancy and auditing theory at plus two level*. The study concluded that the applied strategy of modular instruction was very effective in teaching accountancy and auditing theory to the low achievers at plus two level. Further, the study pointed out that the strategy enabled the low achievers to cope with the normal students to a considerable extent. The significant difference between the control group and the experimental group in the post-test performance after the experimental treatment substantiated the advantage of modular instruction over the traditional lecture method.

Reddy and Ramar (1994) studied the *effectiveness of multimedia-based modules in teaching social science to low achievers*. The study concluded that the multimedia-based modules enabled the experimental group low achievers to show a significantly higher performance in the post-test. While the rate of progress shown by the control group was 14.9%, the rate of progress shown by the experimental group low achievers was 70.3%. Though there existed a gulf of difference between the experimental group and the normal group in the pre-test, the gap was narrowed down to a very great extent by the experimental group low achievers in the post-test. It signifies that the multimedia-based modular approach could enable the experimental group low achievers to cope with normal students to a considerable extent.

Reddy and Ramar (1995) assessed the *effectiveness of multimedia-based modular approach in teaching of maths to low achievers*. After analysis, the study arrived at the following conclusions. Though the control group and experimental group low achievers were alike in the pre-test, the experimental group low achievers could surge far ahead of control group low achievers in the post-test. While the control group low achievers could not narrow down the gap that existed between them and the normal group students, the experimental group low achievers could narrow down
the gap to a considerable extent due to multimedia modular treatment. This substantiates the advantage of multimedia-based modular approach over traditional lecture method. In terms of progress and rate of progress, it is the experimental group low achievers who excelled the other two groups. It testifies to the effectiveness of multimedia-based modules in teaching maths to low achievers.

Reddy and Ramar (1997) undertook an experimental study to measure the effectiveness of multimedia-based modular approach in teaching science to low achievers. The detailed analysis of the study gave the following conclusions. The low achievers found the multimedia-based modules very effective in learning science. The modules very much catered to individual differences. It enabled the experimental group low achievers to evince a performance par excellence in the post-test. Their post-test performance was far ahead of control group low achievers. The experimental group low achievers showed a better rate of progress than the control group low achievers and the normal group students. This fact vouches for the effectiveness of multimedia-based modules. The control group low achievers could not diminish the gulf of difference that existed between them and the normal group students. But, the experimental group low achievers could, not only, narrow down the gap that existed between them and the normal group students, but also they could reach the pre-test mean score of the normal group students. This exalts the advantage of multimedia-based modular approach over the traditional lecture method.

Ramar (1996) in his study effectiveness of multimedia based modular approach with special reference to slow learners points out how the slow learners and children with learning difficulties can be taught in an inclusive setting. His study concludes that the inclusive setting provides a better exposure to these students besides creating a conducive classroom environment which enables the slow learners and children with learning difficulties to cope with normal students to a considerable extent. The study also establishes the effectiveness of multimedia strategy as well as modular strategy in reaching out to all the learners in the inclusive setting.
Reddy, Ramar and Kusuma (2000) in *Education of Children with Special Needs* describe how the students with special needs can be placed in an inclusive classroom. They make a distinction between inclusive education and exclusive education. The chapter on inclusive education expounds the concept of inclusive education and the need for inclusive education in the present era. They further list out the educational programmes that will reach out to all the learners in the inclusive setting.

Saini (2006) made a *study of inclusive education for the disabled in union territory of Chandigarh*. The study reveals that education, which is a primary tool to equip to meet the challenges of life, plays a crucial role in social and economic development of all societies. The disabled children need all the more education so as to supplement their latent talent. But the situation is quite glaring in our country; as there is widespread illiteracy in India among the persons of school going age. Within the persons of school going age, the disabled persons are lagging much behind when compared to their able bodied peers. In India, it is estimated that 100 million children have no access to schooling. Despite major emphasis on education with zero rejection, only a small fraction of the disabled children get mainstreamed. Most of the schools, irrespective of their ownership, do have a number of constraints. In such a situation, providing inclusive education to them at primary and secondary level schools has become a challenging issue.

Saun (1980) made a study on *pattern of disclosure and adjustment among high and low achievers*. The important findings were: i) Self disclosure pattern of the high and the low adjusted male adolescents was significantly different in three areas namely money, study and interest. ii) High and low achieving adolescents showed different adjustment pattern in home, social and emotional areas. iii) The female high and low achievers were more or less equally communicative except in the areas of study.

Singh (1983) made a *comparative study of high and low academic achievers in self concept formation*. The findings of the study were: i) A
positively significant relationship was found between self concept and academic achievement of arts, science and commerce students. ii) The relationship between academic achievement and self concept of art students was significantly higher than that of science and commerce and total students. iii) There was a significant difference in the self concept of high and low academic achievers in favour of high achievers. iv) No significant difference was found in the self concept of urban male and female high achievers. v) Urban girls belonging to low academic achievement were found to have a better self concept than their male counterparts. vi) Self concept and academic achievement were significantly better in the case of female than of male students. vii) Urban students had better academic achievement than rural students, whereas, they were at par in self respect.

Singh (1986) made a study of some possible contributing factors to high and low achievement in Mathematics of the high school students of Orissa. The main findings were: i) Achievement in mathematics was positively and significantly related to intelligence, SES and study attitudes. ii) Intelligence, study attitude and SES contributed in this order of importance to discrimination between the higher and low achieving groups.

Singh (1984) conducted a survey of the study habits of high, middle and low achieving adolescents in relation to their sex, intelligence and socio economic status. The main findings of the study were: i) Adolescent boys had significantly better study habits than adolescent girls. ii) Study habits were significantly related to academic achievement. High achieving adolescents had significantly better study habits than middle achievers who, in turn, had significantly better study habits than low achievers. iii) Study habits of adolescent boys and girls differed significantly at different levels of intelligence i.e. high, middle and low. iv) Study habits of adolescent boys and girls differed significantly at different levels of socio economic status, i.e. high, middle and low. v) Intelligence and socio
economic status did not interact significantly in relation to the study habits of either adolescent boys or girls. vi) The triple interaction among academic achievement, intelligence and socio economic status was not significant in relation to the study habits of either adolescent boys or girls.

Somasundaram (1980) conducted a comparative study of certain personality variables related to over-normal and under achievement in secondary school mathematics. The study shows that the variables of social standards, introversion, family relations, test anxiety and community relations discriminated between under achievers and non under achievers.

Sontakey (1986) conducted a comparative study of personality factors and achievement motivation of high and low achievers in natural and biological sciences. The major findings of the study were: i) High achievers were more intelligent, less excitable, tough minded, self reliant and realistic than the low achievers as groups in biological sciences. ii) High achievers were more intelligent and less excitable than the low achievers. iii) The achievement motivation as measured by G.Rao's Achievement Motivation Test was a poor predictor of achievement in biological and natural sciences. iv) The socio-economic status and sex of high and low achievers did not interact with each other to bring about differences in achievement motivation of the subject. v) The socio economic status and high achievement motivation had positive association with achievement in both biological and natural sciences. vi) Personality factors were consistently associated with achievement in natural as well as biological sciences. vii) Education of mothers was found particularly operative in bringing about high achievement.

Stella (1993) conducted a study on effectiveness of computer assisted instruction with special reference to under achievers. The study revealed that: i) Both the CAI strategies, viz. CAI with teacher support system and CAI without Teacher Support System (TSS) were superior to the traditional method of instruction. ii) In the case of under achievers,
though both the CAI strategies were superior to the traditional method in enabling the under achievers to achieve higher, CAI with TSS was still more effective than CAI without TSS in improving their achievement score.

**Critique of the Studies under this Sub-head**

Most of the studies on low achievement and high achievement are survey studies. These studies can be categorised into two broad types as studies related to the personality factors of high and low achievers and studies related to factors contributing to high and low achievement. Some survey studies indicate that educationally backward pupils are more reserved, less intelligent, more emotionally unstable, more excitable and impatient, more internally reflective and less motivated (Khan, 1983; Singh, 1995; Sontakey, 1986; Subramaniam and Ramadevi, 1991). The comparative studies made on high and low achievers are mostly in agreement with one another. The studies show that social standards, introversion, family relations, test anxiety, community relations, creativity, intelligence and self-concept discriminated between high and low achievers (Mishra, 1978; Somasundaram, 1980; Subramaniam and Ramadevi, 1991; Sumangala, 1995). The second category studies indicate that intellectual, personal, social factors, study attitude, interest and involvement were some causative factors for high and low achievement (Deka, 1985; Saun, 1980; Singh, 1986; Singh, 1995). Only a few experimental studies have been carried out to assess the efficacy of certain instructional strategies with special reference to low achievers (Janakumar, 1996; Ramar, 1994; Reddy and Ramar, 1995, 1996, Mariappan, 2008; Radhakrishnan, 2009; Jose, 2009).

**2.3. Studies Done Abroad**

The studies conducted in foreign countries are presented under the following headings:

- **2.3.1. Studies on Achievement of Students in Physics**
- **2.3.2. Studies on Computer Assisted Instruction**
- **2.3.3. Studies on High Achievers, under Achievers, Low Achievers etc.**
2.3.1. Studies on Achievement of Students in Physics

A good number of studies have been done in teaching and learning of physics in foreign countries and some related studies are appended under this sub-head.

Ahtee, Maija; Johnston, Jane (2006) made a study on primary student teachers' ideas about teaching a physics topic. This study examines Finnish and English primary student teachers' ideas when planning to teach a physics topic during their science education studies. Many primary student teachers lack sufficient subject knowledge, which prevents them from constructing the scientific pedagogical content knowledge that enables them to concentrate on pupils' thinking and process skills needed in a physics topic. Therefore they will have problems constructing learning environments that encourage pupils to take active control of their learning. In order to develop effective pedagogical content knowledge it is of the utmost importance that the science educators responsible for physics courses pay special attention to the promotion of favourable attitudes towards the teaching of physics topics. This can be done by focusing on how to teach some basic familiar topics. Quality, not quantity, is important in focusing on both subject knowledge and pedagogical content knowledge. The construction of pedagogical content knowledge is a complex interrelationship of attitudes, subject, and pedagogical knowledge. All three of them need to be developed to enable students to confidently and effectively teach young children.

Briscoe, Carol; Prayaga, Chandra (2004) made a case study of collaboration and change in university physics teaching. This interpretive case study describes a collaborative project involving a physics professor and a science educator. The study reports what was learned about factors that influenced the professor's development of teaching strategies, alternative to lecture, that were intended to promote prospective teachers' meaningful learning and their use of canonical ways of communicating physics concepts. It describes how the professor's beliefs influenced the pedagogy that he used to communicate the language of physics and the nature of what was communicated. The authors report how their collaboration fostered change as they developed a shared language that allowed them to discuss how students learn and to explicate the
referent beliefs that supported the professor's practices. They found that focused reflection on referent beliefs led to a change in the manner in which the professor communicated with the prospective teachers. Classroom interactions were increased with a primary goal of orchestrating a discourse of physics initiated in the language already accessible to the prospective teachers. This change in the manner that classroom interactions occurred provided opportunities for the prospective teachers' language to evolve toward eventually communicating their ideas in canonical physics language.

Cataloglu, Erdat (2006) made a study on open source software in teaching physics: a case study on vector algebra and visual representations. This study aims to report the effort on teaching vector algebra using free open source software (FOSS). Recent studies showed that students have difficulties in learning basic physics concepts. Constructivist learning theories suggest the use of visual and hands-on activities in learning. The study reports on the software used for this purpose. The effect of FOSS on students understanding of vector algebra was determined by a non-equivalent control group design. A total number of 113 freshman students from two classes of introductory level physics courses were involved. The experimental group's students learning processes were supplemented by instruction utilizing FOSS while the control group was taught in traditional manner. A significant difference in students' performance was found that could be attributed to the treatment. Consequently, visualization of vector and related concepts by FOSS simulations helped students to understand them well and contributed to shorten the time needed to learn these concepts.

Chyuan, Jong Phing Michael (1991) conducted a study of concept learning and teaching approach to the instruction of linear motion introductory college physics. In the instruction of linear motion in introductory college physics many students use concept that is unaccepted by scientist to interpret the phenomenal of linear momentum and motion graphs. In fact, these students possess a set of misconception for explaining linear motion before the physics teaching. Thus there is a need to i) develop an instructional design in accordance with physics concept teaching model derived from learning theories and teaching models that is
related to motion topic in introductory physics for college level students. ii) test whether the design can improve student’s concept learning about motion and iii) learn if it can be used as an instructional system for introductory college physics.

The physics concept teaching method designed is based on Ansabal’s theory of meaning for learning and then combined with Novice’s concept map instructional strategy. Tennyson and Gocchierella’s concept teaching model and Berlin and write’s general instructional model. The groups of non science students studying introductory college physics. 101 are randomly assigned to additional teaching method an example non-example teaching method and the concept teaching method. There are four instruments in this study.

1) Physics concept map pre and post-test used to test student’s learning physics concepts.
2) Physics misconceptions pre and post-test used to test students physics misconceptions.
3) Physics achievement test
4) Physics learning attitude test

The result of this study shows that the concept teaching method effectively improves students’ cognitive structures and the student’s misconceptions attitude is correlated with their misconception test. Moreover, all those groups have positive attitude towards learning physics concepts but negative attitude towards using the concept map. Therefore, the concept teaching method is worthwhile as a method of physics instruction when a sufficient number of lecture sessions are offered to teach motion concept and concept map.

Chang, Kuo-En; chen, yu-lung; lin, he-yan; sung, yao-ting (2008) studies the effects of learning support in simulation-based physics learning studied. The paper describes the effects of learning support on simulation-based learning in three learning models: experiment prompting, a hypothesis menu, and step guidance. A simulation learning system was implemented based on these three models, and the differences between
simulation-based learning and traditional laboratory learning were explored in the context of physics studies. The effects of the support type on learning performance were also quantified. In second-year junior high school students it was found that the outcome for learning about the basic characteristics of an optical lens was significantly better for simulation-based learning than for laboratory learning. The paper also investigated the influences of different learning models on the students' abstract reasoning abilities, which showed that the different learning models do not have different effects on individuals with different abstract reasoning abilities. However, it was found that students who are better at higher abstract reasoning benefit more from simulation-based learning, and also that the learning results are better for experiment prompting and a hypothesis menu than for step guidance.

Danielsson, Anna Teresia; Linder, Cedric (2009) made a study on learning in physics by doing laboratory work: towards a new conceptual framework. This article outlines a proposed conceptual framework for extending the exploration of the gendered experience of learning. In this framework situated cognition and post-structural gender theory are merged together. By drawing on data that aim at exploring the gendered experience of learning in physics in the laboratory setting, a case is made for the proposed conceptual framework to facilitate an analysis of gender as an active process that relates the dynamics of this process to the emerging physicist identities of the students. In other words, this framework allows for an analysis of the gendered learning experiences in a context such as physics education that goes well beyond the usual "women-friendly" teaching approaches.

Elsenkraft, Arthur (1986) analysed the effects of computer simulated experiments on subsequent transfer tasks in a high school physics course. He concludes that achievement test scores were higher for students with high mechanical comprehension if they performed the traditional laboratory experiment but low if they performed the computer simulated experiment.

Geelan, David; Wildy, Helen; Louden, William; Wallace, John (2004) attempted a study on teaching for understanding and/or teaching for the
examination in high school physics. Research Report This case study is part of a larger project spanning 5 years and eight case investigations in Perth schools. While the pedagogical style of the teacher studied could be labelled as 'transmissive', the authors tentatively assert that his practice exemplified high-quality physics teaching and led to high-quality understanding on the part of the students. The study suggests that prescriptions for quality teaching must be sensitive to issues of context and content, and that further study in a variety of school contexts is required to expand their understanding of what constitutes good teaching and learning in physics.

Freitas, Isabel M.; Jimenez, Roque; Mellado, Vicente (2004) made a study on solving physics problems: the conceptions and practice of an experienced teacher and an inexperienced. Teacher the studied describes two case studies on the conceptions and classroom practice of two Portuguese physics and chemistry teachers on the role of problem solving in the teaching/learning of science. One of these teachers was a novice and the other had about 20 years of teaching experience. The data were obtained from a questionnaire, a semi-structured interview, classroom observation, personal documents, and stimulated recall. The analysis was carried out with instruments organised into categories and specific indicators. The results showed there to be major differences between the intention behind the new curricula, the teachers' conceptions, and their practice. Some suggestions are put forward on the basis of these results for the initial and ongoing education of secondary education teachers of physics and chemistry in Portugal.

Karamustafaoglu, Orhan (2009) studied active learning strategies in physics teaching. The purpose of this study was to determine physics teachers' opinions about student-centred activities applicable in physics teaching and learning in context. A case study approach was used in this research. First, semi-structured interviews were carried out with 6 physics teachers. Then, a questionnaire was developed based on the data obtained from the interviews. This questionnaire was implemented to 40 physics teachers in Amasya, a small provincial city in Turkey. Finally, a
A semi-structured observation chart was used in physics lessons to determine how these activities were demonstrated. In this way, the relation between teachers' views about active learning techniques and their actual implementation were compared. The findings indicated that although teachers were aware of student-centred physics instruction, they were still using traditional techniques widely.

Ke, Jiun-Liang; Monk, Martin; Duschl, Richard (2005) probe into *learning introductory quantum physics: sensori-motor experiences and mental models*. This paper reports a cross-sectional study of Taiwanese physics students' understanding of subatomic phenomena that are explained by quantum mechanics. The study uses students' explanations of their answers to items in a questionnaire as a proxy for students' thinking. The variation in students' explanations is discussed as is the development in the way in which students link different concepts. A discussion of the source of students' ideas turns to the way schema contain mental models that derive from sensori-experiences. The principal recommendation for teaching is the need to include practical activities on a range of precursor phenomena so as to extend the students' repertoires of mental models. This advice is different from that given in previous studies.

Lee, Yu-Fen; Guo, Yuying (2008) attempted to *explore effective use of computer simulations for physics education*. The dual purpose of this article is to provide a synthesis of the findings related to the use of computer simulations in physics education and to present implications for teachers and researchers in science education. The paper establishes a conceptual framework for the utilization of computer simulations as a tool for learning and instruction in physics education and explore effective approaches to integrate computer simulations into physics education. To achieve these goals, the paper first reviews studies pertaining to computer simulations in physics education categorized by three different learning frameworks and studies comparing the effects of different simulation environments presents the learning context and factors for successful use of computer simulations in past studies and to learn from the studies which
did not obtain a significant result. Based on the analysis of the reviewed literature, the authors propose effective approaches to integrate computer simulations in physics education, together with the discussion of implications for future research in the field.

Likens (1990) made a study to determine if the laboratory significantly enhanced the learning of cognitive lecture concepts. Data were collected from the students by use of a demographic survey, a pre-test a post-test at mid quarter, and a post-test at the end of the course. The study was concluded with the findings that laboratory instruction covering the topic of mechanics in the traditional physics laboratory does not aid in understanding the mechanics lecture cognitive concepts.

Marrongelle, Karen A. (2004) probed into how students use physics to reason about calculus tasks. The present research study investigates how undergraduate students in an integrated calculus and physics class use physics to help them solve calculus problems. Using Zandieh's (2000) framework for analyzing student understanding of derivative as a starting point, this study adds detail to her paradigmatic physical context and begins to address the need for a theoretical basis for investigating learning and teaching in integrated mathematics and science classrooms. The main result of this study is the Physics Use Classification Scheme, a tool consisting of four categories used to characterize students' uses of physics on tasks involving average rate of change, derivative, and integral concepts. Two of the categories from the Physics Use Classification Scheme are elucidated with contrasting student cases in this paper.

Ogan-Bekiroglu, Feral; Sengul-Turgut, Gulsen (2008) enquired into does constructivist teaching help students move their epistemological beliefs in physics through uppers levels. The purpose of this study was to investigate the effects of constructivist teaching on students' epistemological beliefs in physics. One-group pretest-posttest research design was utilized for the study. The participants were 15 nine-grade students. The participants were interviewed before and after the instruction where constructivist teaching was employed. Results indicated that
teaching methods and strategies based on constructivist approach helped the students move their epistemological beliefs in physics through upper levels.

Podolefsky, Noah S.; Finkelstein, Naoh D. (2006) made a study on use of analogy in learning physics: This study attempts to explore the use of analogy by students in a large introductory college physics course. In the first large-scale study of its kind, the authors demonstrate that different analogies can lead to varied student reasoning. When different analogies were used to teach electromagnetic (EM) waves, they found that students explicitly mapped characteristics either of waves on strings or sound waves to EM waves, depending upon which analogy students were taught. They extend these results by investigating how students use analogies. Their findings suggest that representational format plays a key role in the use of analogy.

Rivers (1986) assessed the effective teaching techniques employed by physics teachers. To secure the data seven hundred questionnaires, with five point Likert type scale were mailed to a random sample of teachers, administrators, students, and parents in each of the seven geographical regional areas of the state of Virginia.

The following conclusions seem to be justified. i) Physics teachers in the commonwealth of Virginia are not adequately prepared for the very real challenges which they face in teaching science. ii) Physics teachers are not renewing their teaching certificates with science courses. iii) Student involvement in laboratory experiences was rated as low to moderate. iv) The effective use of informal modes of teaching science through clubs and science fairs was not being achieved and v) Using effective instructional techniques, identifying and reacting to the special needs of students, and involvement in professional organisations were rated low to moderate in achievement.

Theyssen, Heike (2007) made study on towards targeted labwork in physics as a subsidiary subject: enhancing the learning efficiency by new
didactical concepts and media. Physics as a subsidiary subject has to match very different objectives and to cope with a variety of students' learning conditions. Targeted labwork means that a careful choice among these objectives is made according to research outcomes. For medical students, a targeted labwork course in physics was developed. Essentially, the development was based on research outcomes from surveys among experts and investigations on the learning processes during labwork. The research outcomes were the guidelines for the development of a new didactical concept and 11 labwork sessions. They also set the benchmarks for the evaluation of the labwork course. Evaluation results gained with various methods prove the adequacy of the newly developed concept. Subsequently and closely based on the new labwork course, a hypermedia learning environment (HML) was developed and implemented in physics education for medical students. The essential differences compared to the labwork course are the media for the representation of experiments and that the HML allows for a more individual time structure of learning. Several comparative studies prove that the HML is a suitable surrogate for labwork sessions.

Toczek, Marie-Christine; Morge, Ludovic (2009) studied effects of evaluative vs. co-constructive interactions on learning in physics. This paper assesses the effects of two physics-learning situations that differed in the type of teacher-student interactions that took place: evaluative or co-constructive. As found in various studies on physics teaching and social psychology, the results showed that co-constructive interactions generated a more effective learning context for students than evaluative ones did.

Ward Mark (1991) studied the structuring effective worked examples in physics. Previous studies suggest that under certain conditions the substitution or worked example for problems or exercises enhance learning and subsequent problem solving. Under other conditions, worked examples are no more effective and possibly less effective than solving problems using cognitive load theory, the research conducted in this
thesis, hypothesis that the critical factors are whether various categories of worked example can direct attention, aptly and can reduce cognitive load. It is suggested that worked example which requires students to mentally integrate multiple sources of information are not effective because they fail in both these criteria. It is important that information directs attention towards relevant problem feature and also it must not in itself require significant cognitive resources for effective processing.

A series of five experiments using geometric optics and kinematics under classroom conditions provided evidence to support these hypotheses. It was found that worked examples which were formatted to reduce the need for students to mentally integrate multiple sources of information, regulated in superior test performance compared to either conventional problem or worked examples requiring students to split their attention between for example text and equations or text and diagram. It was concluded that the traditional worked example formats usually are random with respect to cognitive factors; that may be in effective in some areas and require restructuring.

Willis Country (1993) investigated how students’ conceptual understanding is correlated with their achievement on a traditional physics examination. The purpose of this study was to investigate the relationship between students conceptual understanding and their achievement on a traditional standardised multiple choice examination in physics. The additional factors of gender, reasoning level and mathematics ability and their effects on the above relationship were also studied. Students participating in the study were from four different introductory levels of physics; high school physics, college level physical science college level non calculus based physics and college level calculus based physics. Each participating student was required to complete four instruments.
The instrument used to measure the conceptual understanding was developed specifically for this investigation. A review jury of eight physics educators reviewed and rated items that have been developed for the conceptual understanding instrument. Fifteen of the highest rated items were selected for the conceptual test. Each item included demonstrations followed by a question to which students were asked to respond by selecting an answer from a provided list and then to explain their answers. The results of the study showed that cause and effect would be difficult to predict because of the strong inter correlation between the measured variables.

When variables were individually removed from the full model, only measured conceptual understanding and mathematics ability significantly reduced the predictive ability of the model. A backward elimination regression procedure using conceptual understanding and reasoning level to predict performance on the multiple choice test found that reasoning level did have a significant unique contribution. It was found that gender did not produce a significant unique contribution. The results indicated that students measured conceptual understanding correlated well with the performance on standardised multiple choice physics test.

**Critique of the Studies under this Sub-head**

Most of the studies have been undertaken to establish the efficacy of some teaching methods or some instructional strategies in teaching physics at various levels of educational (Chyuan, 1991; Danielsson et al, 2009; Elsekraft, 1980; Geelan et al, 2004). Some studies focus on the opinion and the attitude of the physics teachers with regard to the content of the syllabus, method of teaching and level of difficulty (Karamustafaoglu, 2009; Rivers, 1986; Ahlu and Johnson, 2006). Some studies have been conducted to bring to light the effect of experiments and lab works on the scholastic achievement of students in physics (Danielsson et al, 2009;
Likens, 1990; Theyssen, 2007) There are studies which concentrate on learner centered techniques and active learning strategies on the achievement of students in physics (Briscue et al 2004; Karamustafaoglu, 2009) Various studies have been attempted to verify the efficacy of teaching aids and educational technologies in teaching and learning of physics (cataloghu, 2006; changet al, 2008; Elsenkraft, 1986; Lee and Guo, 2008).

2.3.2. Studies on Computer Assisted Instruction

A good number of studies have been conducted on computer assisted instruction in foreign context. Most of the studies have made an in-depth analysis. Such studies are enumerated under this sub-head.

Benaloh, Lauril Anne Blake (1994) conducted a study entitled teachers, students and instructional software: What works well when and why. This research was an exploratory study based on teacher and student evaluations of different teaching styles while using instructional software. Three teaching styles (monitoring, co-ordination and mediating) were used with each of three software packages in three grade 5 classes. The classroom teachers and 18 students, selected to represent different preferred learning styles were interviewed as to what they felt were the advantages and disadvantages of each style / software dyad. Contrary to expectations, the effectiveness of the three styles did not seem to depend on the primary instructional style of the teacher or on the preferred learning styles of the students. Rather, these results suggested that, for optimal effectiveness, all three styles should be used with every instructional software programme. The mediating style provides demonstration of software, allows the teacher to highlight the important concepts, and shows the students what achievement is possible. Co-ordinated activities provide additional time and contexts for students to learn the concepts. The monitoring style shows students to work with the concepts at their own pace. Demonstrating these styles to teachers in their classes seemed very useful for encouraging them to use the styles themselves.
Blecha (1991) lists out some common design problems with CAI software: tedious keystrokes, unnecessarily repetitive operations, software that is difficult to use, and minimal pedagogical value of programs that hide the inner workings of models. He is of the opinion that CAI programs lack any advantage over printed materials and do not take advantage of the feedback potential of computers.

Camnalbur, Mucahit; Erdogan, Yavuz (2008) made a meta analysis on the effectiveness of computer-assisted instruction: In this research, quantitative studies comparing the effectiveness of computer-assisted instruction to traditional teaching method and conducted between 1998 and 2007 are studied by meta analysis. Seventy eight studies that have eligible data were combined with meta analytical methods by coding protocol from the 422 master's and doctoral degree and 124 articles. As a result for the study, the effect size of computer-assisted instruction method for academic achievement calculated 1.048. This is large scale according to Thalheimer and Cook, large and Cohen, Welkowitz and Ewen (2000). Recommendations were made based on the results of the study.

Canham and Dickie, (1986) have reported that computer assisted instruction has been very effective in enhancing the academic achievement, improving student attitudes and reducing the timing needed for mastering the prescribed course materials. They point out that the computer assisted instruction is very effective in terms of instruction as well as retention. Also, they indicate that the students like the different modes of computer assisted instruction.

Clarke, Thomas; Clarke, Elizabeth (2009) conducted a study on born digital? pedagogy and computer-assisted learning. The study concluded that Students need to master higher-order cognitive, affective, and social skills not central to mature industrial societies, but vital in a knowledge based economy that include "thriving on chaos" (making rapid decisions based on incomplete information to resolve novel situations); the ability to collaborate with a diverse team--face-to-face or across distance--to accomplish a task; creating, sharing, and mastering knowledge through filtering a sea of quasi-accurate information. Originality/value: These skills, according to Galerneau and Zibit, are "the skills for the twenty-first century", as they are "the skills that are necessary to succeed in an ever changing global society where communications is ubiquitous and
instantaneous, and where software tools allow for a range of creative and collaborative options that yield new patterns and results that we are only beginning to see”.

Clarebout, Geraldine; Elen, Jan (2009) analysed the complexity of tool use in computer-based learning environments. This study addresses tool use in a computer-based learning environment. In line with Perkins, first the effects of tool use on performance were investigated to gain insight into the functionality of the tools. Next, the influence of advice was studied to identify whether this advice could make students more knowledgeable with respect to the tools, and hence encourage them to make more (adequate) use of the tools. A third research question addressed learner related variables. The influence of metacognitive skills, goal orientation, and instructional conceptions on students' tool use was investigated. An experimental design was used to address these research questions with one control group and two experimental groups, one with advice and one without advice. Results reveal that the tools were functional, the two experimental groups outperformed the control group. With respect to advice, the group of students receiving advice used tools more frequently and spent more time on their use. Finally, the study reveals mastery orientation to be an important variable. The more students are mastery oriented, the less they use tools.

David Collins and Alan Deck and Myra McCrickard, (2009) in their paper computer aided instruction: a study of student evaluations and academic performance. describe the educational use of CAI in two different courses at a small, private university and the implementation and use experiences of the instructors. One instructor used Homework Manager in Principles of Financial Accounting and the other instructor used Aplia in Principles of Microeconomics. It is shown that the use of CAI is pedagogically effective and that currently available applications are easy to integrate into the student’s in-class experience. The paper also reports on the impact that using CAI has on student evaluations of both the course and the instructor and on student grades. For student evaluations, mean responses were compared on ten questions believed to be influenced by the switch from traditional homework assignments to CAI-based homework
assignments. While differences were generally in the expected direction, it could not be shown that CAI had a direct impact on student evaluations of either the course or the instructor. For student grades, final exam grades were compared before and after the adoption of CAI. It is shown that the use of CAI significantly increased student final exam grades.

Ding (2009) made a study on visualizing the sequential process of knowledge elaboration in computer-supported collaborative problem solving. This case study illustrates the sequential process of the joint and individual knowledge elaboration in a computer-supported collaborative learning (CSCL) environment. The case comprised an Internet-based physics problem-solving platform. Six Dutch secondary school students (three males, three females) participated in the three-week experiment. They were paired based on self-selection. Each dyad was asked to collaborate on eight moderately structured problems concerning Newtonian mechanics. Their online interactions, including their textual and pictorial messages, were categorized and sequentially plotted. The three dyads showed three different collaboration patterns in terms of joint and individual knowledge elaboration.

Dobbins, E.Renee, (1994) undertook a study to measure the effectiveness of math computer assisted instruction with remedial students and students with mild learning / behaviour disabilities. The purpose of the study was to compare the performance of third and fourth grade students with mild learning / behaviour disabilities and selected third and fourth grade students without mild learning / behaviour disabilities when using the computerized programme. “math concepts and skills” as measured by the in-line analysis provided by the programme. The major findings of the study were: There was a statistically significant difference between the gain scores of students with mild learning / behaviour disabilities and students in the chapter I programme when repeated measurement of gain scores were analysed over the three month period. There was a statistically significant difference within the group of students in the Chapter I programme when repeated measurement of gain scores were analysed over the three month period. There was no statistically significant
interaction between the two groups of students and time when repeated measurement of gain scores were analysed over the three month period.

Elmore, Patricia Venshew (1992) made an analysis of fifty one computer modules designed to enhance the knowledge, skills, and attitudes needed by teacher education students. This study analyses and report the findings of students’ reactions to a set of 51 computer modules called Performance Element Modules (PEMs). These modules focussed on selected knowledge, skills and attitudes needed by teacher education students. The main objective was to assess whether students will accept the 51 computer – assisted modules as viable instructional tools. The major findings revealed a mean scores of 7.73 for “user friendliness” of the computer. For involvement and interaction of the computer programme (modules) a mean score of 7.3 was reported. Did the modules help students correct a lack of information or improve a skill? A mean of 7.12 was reported which was interpreted as an indication that the modules were viable instructional aids.

Hohenwarter, Judith; Hohenwarter, Markus; Lavicza, Zsolt (2009) probed into introducing dynamic mathematics software to secondary school teachers: the case of geogebra. This paper describes a study aimed to identify most common impediments related to the introduction of an open-source mathematical software package GeoGebra. It reports on the analysis of data collected during a three-week professional development programme organised for middle and high school teachers in Florida. The study identified challenges participants face during workshops and evaluated the difficulty levels of GeoGebra tools. Findings of the study, complexity criteria of software tools and commonly occurring difficulties, provided the basis for the development of several new materials assisting workshop activities and contributed to the improvement of introductory GeoGebra workshops.

Heift, Trude (2009) studied modeling learner variability in call this article describes challenges and benefits of modeling learner variability in computer-assisted language learning. It discusses the learner model of "E-Tutor," a learner model that addresses learner variability by focusing on certain aspects and/or
features of the learner's interlanguage. Moreover, the author introduces the concept of phrase descriptors, the means by which the student model of "E-Tutor" captures very detailed linguistic information on the learner's performance and progress. Finally, the paper provides longitudinal data that emphasize the importance of monitoring fine-grained information and underline the dynamism and non-linearity of the SLA process, as also described by Dynamic Systems Theory (DST).

Ingerman, Ake; Linder, Cedric; Marshall, Delia (2009) conducted a study on 'the learners' experience of variation: following students' threads of learning physics in computer simulation sessions'. This article attempts to describe students' process of learning physics using the notion of experiencing variation as the basic mechanism for learning, and thus explores what variation, with respect to a particular object of learning, that students experience in their process of constituting understanding. Theoretically, the analysis relies on analytic tools from the phenomenographic research tradition, and the recent group of studies colloquially known as the variation theory of learning, having the notion of experiencing variation as a key for learning at its core. Empirically, the study relies on video and audio recordings of seven pairs of students interacting in a computer-simulation learning environment featuring Bohr's model of the atom. The data were analysed on a micro-level for the emergence of student-recognised variation, depicted in terms of "threads of learning". This was done by linking variation around aspects of the object of learning present in the situation, and attended to by the students, to new ways of seeing--characterised as an expanding anatomy of awareness, and hence as learning. The students' threads of learning are characterised in terms of two stages of learning progress: (1) discerning variation, and (2) constituting meaning from this experience of variation (experienced as holistically relevant in the students' conceptual domain of physics and the Bohr model). Two groups of threads of learning were identified: one where the variation experienced by students was within an aspect of the object of learning, and one where variation was across several aspects.

Lavicza, Zsolt (2009) examined the use of computer algebra systems in university-level mathematics teaching. In this paper, the author reports on a questionnaire study enquiring about mathematicians' use of CAS in mathematics
teaching in three countries; the United States, the United Kingdom, and Hungary. Based on the responses from 1100 mathematicians, the author gives an overview of the current extent of CAS use in universities and offer some examples of mathematicians' classroom use of CAS. The study particularly focusses on responses from participants who reported employing CAS in their teaching practice. In addition, the study attempts to explain the reasons behind these practices and highlight the importance of further research on university-level mathematics education.

Liao, Yuen-kuang Cliff; Chang, Huei-wen; Chen, Yu-wen (2008) studied the effects of computer applications on elementary school students' achievement: a meta-analysis of students in Taiwan. A meta-analysis was performed to synthesize existing research comparing the effects of computer applications (i.e., computer-assisted instruction, computer simulations, and Web-based learning) versus traditional instruction on elementary school students' achievement in Taiwan. Forty-eight studies were located from four sources, and their quantitative data were transformed into Effect Size (ES). The overall grand mean of the study-weighted ES for all 48 studies was 0.449. The results suggest that computer application instruction is more effective than traditional instruction for elementary school students in Taiwan. However, none of the 14 individual variables, conjectured to be related to achievement, had a statistically significant impact on the mean ES.

Liu, Han-Chin; Andre, Thomas; Greenbowe, Thomas (2008) studied the impact of learner's prior knowledge on their use of chemistry computer simulations. This study documented cases that show how college students' prior chemistry knowledge level affected their interaction with peers and their approach to solving problems with the use of computer simulations that were designed to learn electrochemistry. Students with different prior knowledge levels were found to use different approaches to solving problems with the use of computer simulations. In particular, the cases showed that students with a high level of prior knowledge tended to use the equations and formulae to accomplish the learning tasks and then use the computer simulations to confirm their predictions. Students with a low level of prior chemistry knowledge used the computer simulations as the main resources to accomplish their tasks. Considerations of individual differences
and the integration of learning materials were suggested for further research on instructional use of computer simulations.

McNulty, John A.; Sonntag, Beth; Sinacore, James (2009) made an evaluation of computer-aided instruction in a gross anatomy course. This multi-year study investigated the effectiveness of CAI and the factors affecting level of individual use. Three CAI were tested that differed in specificity of applicability to the curriculum and in the level of student interaction with the CAI. Student personality preferences and learning styles were measured using the Meyers Briggs Type Indicator (MBTI) and Kolb's Learning Style Inventory (LSI). Information on "computer literacy" and use of CAI was collected from student surveys. Server logs were used to quantify individual use of respective CAI. There was considerable variability in the level of utilization of each CAI by individual students. Individual use of each CAI differed and was associated with gender, MBTI preferences and learning style, but not with "computer literacy." The majority of students found the CAI useful for learning and used the CAI by themselves. Students who accessed the CAI resources most frequently scored significantly higher on exams compared with students who never accessed the resources. The results show that medical students do not uniformly use CAI developed for their curriculum and this variability is associated with various attributes of individual students. The data also provide evidence of the importance of understanding student preferences and learning styles when implementing CAI into the curriculum.

Nishino, Alan Koki (1994) undertook an exploratory investigation to determine the effects of a multimedia computer-based science learning environment and gender differences, on achievement and attitudes and interests of students in an eighth-grade science classroom. This study employed an exploratory investigative approach which utilized a quantitative two-by-two experimental factorial design. An analysis of co-variance was utilised to adjust for any initial differences. The purpose of the study was to determine the relationship of a multimedia computer based science learning environment and gender differences on achievement and attitudes and interests of students in an eighth grade
science teaching methodologies while the experimental group received instruction. The experimental group received instruction using a multimedia computer based science learning environment. The relationships found were, students in the experimental classroom had a significantly higher post-test mean score in ‘self concept’ than the students in the traditional science classroom. Female students in the experimental classroom had a significantly higher post-test mean score on “self perception as a student” than both the males and females of the traditional sciences classroom and the males of the experimental classroom. Students in the experimental classroom had a significantly higher post-test mean score on the Hueneme Computerised Instruction Test on science than the students in the traditional classroom.

Regser, Gail Renee (1991) conducted a study on effects of computer education on students achievement, attitude and self-esteem. This study was designed to a) examine the effects of computer education on students’ achievement, attitude and self-esteem and b) investigate the relationship between success with computer instruction and personality characteristics, IQ, age and attitude towards school. The major findings of the study were, there were interesting students gains in effective areas such as attitude and self esteem. Students receiving computer instruction agreed more strongly with positive attitude statements. There were no sex related differences in achievement, attitude and personality characteristics.

Rasanen, Pekka; Salminen, Jonna; Wilson, Anna J.; Aunio, Pirjo; Dehaene, Stanislas (2009) conducted a study on computer-assisted intervention for children with low numeracy skills. This paper presents results of a computer-assisted intervention (CAI) study on number skills in kindergarten children. Children with low numeracy skill (n = 30) were randomly allocated to two treatment groups. The first group played a computer game (The Number Race) which emphasized numerical comparison and was designed to train number sense, while the other group played a game (Graphogame-Math) which emphasized small sets of exact numerosities by training matching of verbal labels to visual patterns and number
symbols. Both groups participated in a daily intervention session for three weeks. Children's performance in verbal counting, number comparison, object counting, arithmetic, and a control task (rapid serial naming) were measured before and after the intervention. Both interventions improved children's skills in number comparison, compared to a group of typically performing children (n = 30), but not in other areas of number skills. These findings, together with a review of earlier computer-assisted intervention studies, provide guidance for future work on CAI aiming to boost numeracy development of low performing children.

Robert, Michael (1994) made a comparison in the effectiveness of the delivery of an interactive computer – assisted instruction module to a traditional lecture / lab delivered module. This study examined the use of a computer based multi-media interactive learning system to determine if the learning of a conceptual predictive technological concept was more effective with interactive computer assisted instruction (ICAI) or with traditional instruction (TI). The main finding was, that learners in the experimental group (ICAI) that scored 3 or 37.3% (19/51) on the pre-test had a significantly higher adjusted mean post-test score than learners in the control group.

Schmidt, Susan Carol (1991) made a study on technology for the 21st century: The effects of an Integrated distributive computer network system on student achievement. The effects of an integrated distributive computer network system with Wasatch ILS courseware on reading, math and language achievement of sixth grade students were investigated over a period of eight months. Major conclusions reached were that the integrated distributive computer network system was more effective than traditional instruction in increasing reading, math and language achievement for low achieving students. It was as effective as traditional instruction in increasing achievement for high achieving students. It has had positive effects on student motivation, attitude, instructional task persistence, and the organisation, quantity and quality of student writing.
Seo, You-Jin; Bryant, Diane Pedrotty (2009) made an *Analysis of Studies of the Effects of Computer-Assisted Instruction on the Mathematics Performance of Students with Learning Disabilities*. The purpose of this study was to conduct a meta-study of computer-assisted instruction (CAI) studies in mathematics for students with learning disabilities (LD) focusing on examining the effects of CAI on the mathematics performance of students with LD. This study examined a total of 11 mathematics CAI studies, which met the study selection criterion, for students with LD at the elementary and secondary levels and analyzed them in terms of their comparability and effect sizes. Overall, this study found that those CAI studies did not show conclusive effectiveness with relatively large effect sizes. The methodological problems in the CAI studies limit an accurate validation of the CAI's effectiveness. Implications for future mathematics CAI studies were discussed.

Tenyankam Mc Donald (1994) made a study on *learner controlled lessons in co-operative learning groups during computer based instruction*. This study investigated the effects of studying alone or in co-operative learning groups on the performance of high and low achievers. The study also examined the effects of computer based instruction using either learner or programme control. This study concluded that both high and low achievers in the co-operative treatment increased achievement on programme controlled and learner controlled computer lessons. The learner controlled co-operative learning group made more options while checking their concept learning, and spent more time interacting with the learner controlled computer based tutorial, than the learner controlled individual learning group.

Tuzun, Hakan; Yilmaz-Soylu, Meryem; Karakus, Turkan; Inal, Yavuz; Kizilkaya, Gonca (2009) studied *The Effects of Computer Games on Primary School Students' Achievement and Motivation in Geography Learning*. The implementation of a computer game for learning about geography by primary school students is the focus of this article. Researchers designed and developed a three-dimensional educational computer game. Twenty four students in fourth and fifth grades in a private
school in Ankara, Turkey learnt about world continents and countries through this game for three weeks. The effects of the game environment on students' achievement and motivation and related implementation issues were examined through both quantitative and qualitative methods. An analysis of pre- and post-achievement tests showed that students made significant learning gains by participating in the game-based learning environment. When comparing their motivations while learning in the game-based learning environment and in their traditional school environment, it was found that students demonstrated statistically significant higher intrinsic motivations and statistically significant lower extrinsic motivations learning in the game-based environment. In addition, they had decreased focus on getting grades and they were more independent while participating in the game-based activities. These positive effects on learning and motivation, and the positive attitudes of students and teachers suggest that computer games can be used as an ICT tool in formal learning environments to support students in effective geography learning.

Winter, Christina Surrency (1994) devised a strategy for identifying when interventions should occur in computer assisted instruction. The main purpose of the study was to develop, describe and demonstrate a system for assessing the normative or expected progress of pupils who are engaged in learning through computer – assisted instruction. A model is built which would enable an instructor to intervene as needed in the students' learning, thus encouraging early intervention of pending learning problems.

**Critique of the Studies under this Sub-head**

Quite a number of indepth studies on CAI have been carried out in the western countries. A number of studies have established that CAI can be successful in enhancing exam scores, improving student attitudes and reducing the time needed for mastering the course material (Canham and Dickie 1996). The effectiveness of CAI in terms of instruction and retention has been established by some researchers. (Height, 2009; Ingerman,
2009; Liu et al, 2008) There are studies which focus on different modes of CAI and substantiate their efficacy in teaching various subjects at various levels of education. (Lavieza, 2009; Liao et al, 2008; Nishino, 1994;) There are a few studies which have brought to light the viability, the application and the widespread use of CAI in classroom instructional presentation (Schmidt 1991; Menutty et al, 2009; Hohenwarter et al, 2009; clavebout, 2009) The impact of CAI in inclusive setting has been verified by some research studies (Dobbins, 1994; Rsanar et al; 2009; Seo and Brifant, 2009).

2.3.3. Studies on High Achievers, Under Achievers, Low Achievers etc.

Quite a number of studies have been attempted on special education in foreign countries and a few studies have been attempted on low achievement and under achievement. The scholars have been paying more attention to such studies for the last ten years or so. Such studies are listed under this sub head.

Barak ; R. Yehiav ; N. Mendelson (1994) conducted a study on advancement of Low Achievers within Technology Studies at High School Upper secondary education in Israel is divided into a 'general track' and a 'technological track'. About half the students in the 'technological track' sit matriculation examinations. Mechanics studies, at the non-matriculating level, suffers from a negative image and poor students' motivation. A 3 year experiment was carried out with the goal of helping low achieving high school students progress to matriculation level. The results showed a change in the class atmosphere and students' self image and motivation improved. In parallel to the growth in the number of students participating in the programme, the number of high achievers in technology studies in mechanics at the same schools rose, and the number of non-matriculating students decreased. The technology studies united the class as a group and affected their motivation at general studies like Hebrew and English studies.
Bernadette M. Gadzella, Mustafa Baloglu (2003) made a study on high and low achieving education students on processing, retaining, and retrieval of information. The results showed that the High Achievers reported significantly higher scores on DP and FR scales. A study (Schmeck & Grove, 1979) on relationships (for 790 college students) between GPAs and ILP scores showed that students with high GPAs reported high scores on DP, EP, and FR scales. Similar results were found in another study (Schmeck, 1983) in that, high academic achievers tended to score high on DP, EP, and FR scales of the ILP

D. Betsy McCoach, Del Siegle (2001) made a comparison of high achievers' and low achievers' attitudes, perceptions, and motivations. The purpose of this study was to compare high achieving and low achieving adolescents' attitudes toward school, attitudes toward teachers, goal-valuation, motivation, and general academic self-perceptions. The study sought to determine whether high achievers really differed from low achievers on these five factors, and to ascertain which of the five factors were the best predictors of students' status as either a high achiever or a low achiever. The comparison of the scores of high achievers and low achievers on attitudes toward school, attitudes toward teachers, goal-valuation, motivation, and general academic self-perceptions revealed large differences between high achievers and low achievers on all five factors. However, two factors, academic self-perception and motivation/self-regulation, predicted students' achievement status as well as the five-factor model did. Using logistic regression, these two subscales were able to classify students' achievement status correctly over 85% of the time. These results suggest that high achievers and low achievers differ in both their motivational patterns and their academic self-perceptions.

Cartner and Lipskey (1987); Jenkins, Pious and Peterson (1988) report only equivalent results regarding the differences between the students with mild disability and low achieving students. A particular subject of much controversy and debate is the apparent lack of any major differences in education related characteristics or outcomes for students classified as learning disabled and students with low academic achievement.
Farrha Addiba (1965) made a study of attributions of low achievers and high achievers about the perceived causes of their success and failure. The study reveals that causal attributions of students about the perceived causes of their success and failure significantly differ in all the cases except urban and rural groups. Particularly, in case of high achievers and low achievers it was found that the high achievers pervasively attributed their success and failure outcomes to effort and ability and the low achievers to luck and task difficulty. The highest attribution was in favor of effort and second highest response was ability. The comparison of high achievers and low achievers showed that high achievers attributed their success and failure mostly with effort and ability. While, on the other hand, the low achievers associated their outcomes with luck and task difficulty. In the light of the conclusions of the study, it was recommended that teacher's be trained to understand the causal attributions, so that they can apply it in classroom situation for betterment of the students. It was suggested that measures should be taken to shift attributions of the low achievers from external factors to internal factors, so that they may become enthusiastic and motivated learners. Parents were also suggested to come forward to improve the causal attributions of their children regarding their success and failure. As far as the researcher knows, little research on the topic seemed to be carried out earlier in Pakistan. So it was recommended that further researches should be conducted on the different educational levels of students, students having different medium of instructions etc.

Farideh Salili and Po Ha Tse Mak (2002) probe into subjective meaning of success in high and low achievers. The purpose of this study was to explore differences between high and low achievers in the meaning of success. Subjects were 80 Chinese female high school students aged 14 to 17, selected from eight high school classes. They were classified into high and low achievers according to their examination results. Success was defined in terms of the affective meaning of success goals as well as the antecedents and consequents of success. Subjects rated 10 success goal concepts on Cantonese Semantic Differential Scales. They also selected from a list of concepts, the antecedents and consequents of the success goals. Results indicated that while success was
equally important to both high and low achievers, the two groups attached different values to achievement goals. However, overall results showed some interesting similarities between high and low achievers. These are discussed in terms of cultural and developmental factors.

_Fehrenbach, Carolyn (1993) conducted a study on underachieving gifted students: intervention programs that work._ This article reviews the causes of underachievement in gifted students and discusses two successful intervention programs, a secondary program with individualized goals to meet the needs and interests of the students, and an elementary program which focused on active parental support and the services of a psychologist. Case studies of underachievers are presented as examples.

_Fuchs, Douglas; Fuchs, Lynn S.; Mathes, Patricia G.; Lipsey, Mark E.; Eaton, Susan (2000) made a “meta-analysis of reading differences between underachievers with and without the learning disabilities label.”_ A meta-analysis of 79 studies of reading performance of low achievers with and without learning disabilities found students with the learning disabilities label performed considerably worse on reading measures. Use of timed tests greatly increased the difference in reading performance between underachievers and students with the learning disabilities label.

_Jenson (1958) observed that with certain exception there was a general tendency throughout the study for non achievers of low scholastic ability to encounter more adjustment problems than other students, with whom they were compared. The general trend was for gifted achievers to express themselves as having fewer adjustment problems._

_A series of researches over a period of four years conducted at the University of Okalahama (1952) showed that an over achiever is characteristically more self aware and willing to take responsibility. On the other hand, an under achiever is guided by mutually contradictory motives and is not aware of his conflicting nature. The investigator concluded that intellectual variables can function effectively only when the personality function is properly integrated._
Julie Willson (1999) made a study on high and low achievers’ classroom interaction patterns in an upper primary classroom. This study sought to examine if students’ achievement level influenced their interaction levels in the classroom. It used qualitative data gathering methods of semi-participant observations, field notes and semi-structured interviews to describe and investigate the nature and frequency of the interaction patterns of three high and three low achieving students in one upper primary classroom. Significant factors influencing high and low achievers’ willingness to initiate interactions in the classroom were also investigated. Findings revealed that the high achieving informants initiated more interactions than the low achievers. Such a finding differed when the teacher initiated interactions with students. When the teacher called randomly on students, the inequity between the two achievement levels balanced out and the low achievers, due to the teacher’s intervention, became more active, though still unwilling participators. The nature of the high and low achievers’ interactions in the study also varied. The high achievers were found to initiate interactions to volunteer answers, whereas one of the low achievers interacted purely for the purpose of help-seeking. Significant factors influencing the interaction patterns of the study’s high and low achievers were being uncertain of the answer, just not wanting to be involved, getting teased by other students, feeling embarrassed, concerned about being wrong and lack of enjoyment for a particular subject. These findings showed that no one factor alone influenced high or low achievers’ interaction patterns. Past and present successes and relationships in classrooms were seen as being responsible for students’ willingness to initiate interactions in this classroom.

Kristina Juter1 (2007) studied Students’ Conceptions of Limits: High Achievers versus Low Achievers. The study concluded learning paths and results. Students’ learning developments of limits were studied in terms of concept images (Tall & Vinner, 1981) in the sense that their actions, such as problem solving and reasoning, were considered traces of their mental representations of concepts. High achievers’ developments were compared to low achievers’ developments to for the duration of a semester to reveal differences and similarities.

Lav, Kit-Ling; Chan, David W. (2001) made a study Identification of Underachievers in Hong Kong: Do Different Methods Select Different Underachievers? The study compared different selection methods in the
identification of underachievers: (1) absolute split method; (2) simple difference score method; (3) regression method; and (4) nomination. Focuses on 12- to 15-year-old Chinese students (n=126) in Hong Kong. The study concluded that the statistical methods had the highest congruence for selecting underachievers.

Mary Wong Siew Lian (1998) made an investigation into high-achiever and low-achiever knowledge organisation and knowledge processing in concept mapping. The study found that there were differences in the way they processed knowledge during concept mapping. The high-achievers were more thorough than were the low-achievers in cognitive processing of knowledge, taking time to make sense of concepts, sort and group concepts, form relevant links between concepts, and organise concepts hierarchically. Active cognitive processing of knowledge seems to be related to more complex, well-integrated cognitive structures for the material learned.

Simmons, George; And Others (1995) studied The Effects of a Freshman Seminar on At-Risk Under-, Over-, and Low Achievers. The study investigated the academic achievement of 390 students in a freshman seminar designed to enhance academic success of three risk groups (underachievers, overachievers, and low achievers). The populations responded to seminar content in distinct ways. Comparison with a control group showed the only gain was in retention of low achievers. Underachievers performed less well than controls.

The Open University of Hong Kong, (1999) conducted a study on high achievers versus low achievers. The results indicated that the high-achieving students were more likely than the low-achievers to try to understand meanings thoroughly, to regulate their learning strategies to fit the purpose of the study, and to link new knowledge to their previous learning.

Troyna, Barry (1991) conducted a study on Underachievers or Underrated? The Experience of Pupils of South Asian Origin in a Secondary School. The paper discusses the allocative and selective procedures of a multiracial British comprehensive school. It argues that future studies should consider which students attend which schools and take which courses. Further, the paper addresses student placement based on English, mathematics, and social studies test results. It concludes that the term "underachiever" is a less appropriate term than "underrated."
Critique of the Studies under this Sub-head

Some of the studies point out that there are considerable similarities between learning disabled students and low achieving students. Also, no significant difference is found in education related characteristics or outcomes between learning disabled students and low achieving students (Allington and Johnson, 1986; Cartner and Lipskey, 1987). Some other studies point out there are marked differences between learning disabled students and low achieving students in variety of information processing variables, including efficiency of learning, prior knowledge, information processing strategies, and meta cognitive operation (Conner, 1983; Damberg, 1984; Hallahan and Sappona, 1984). Peterson (1989) stresses that academic performance of low achievers can be enhanced when they are instructed in a group that includes high achievers. Similarly, Bob Lumpkins et.al. (1991) report that their innovative programme designed to help low achieving fourth and fifth grade students to increase their achievement in mathematics has been effective with both low and normal achievers. These two above studies lend a great theoretical support to the inclusive education concept of Mel Ainscow (1997, 1998). This emphasises the need to design specific instructional strategy that can reach out to all learners.

2.4. An Overview of Research Reviewed

Computer aided instruction has a rich history and developed concurrently with the development of electronic computers (Daniel, 1999). CAI began in the mid-1950s as a collaboration between Stanford University and IBM but grew slowly until the arrival of personal computers in the 1980s. Today there are few schools in any country that do not have computers available for student use, and don’t use some form of CAI on those computers.

While educational effectiveness and implementation issues have been common, CAI has remained popular among educators who maintain a belief that it is a useful supplement to classroom activities. A number of studies have reported that it can be successful in raising exam scores, improving student attitudes, and reducing the time needed to master course materials (Canham and Dickie, 1986;
Collis, Obserg, and Sherra, 1988-89; Nipp and Straub, 1986). It also has been shown that students like the mode of presentation (Anderson-Harper, Mason, and Popovich, 1988; Brown, 1995), that it is viewed as a positive experience (Deardoff, 1986), and that it is suitable for individual learning needs (Dobson, 1995).

The efficacy of computer assisted instruction, as an instructional strategy has been established in teaching various subjects (Reddy and Ramar, 1995; Kumarasamy, 2008; Kannan, 2009, Latha, 2009; Heift, 2009, Ingerman, 2009; Liu et al, 2008). Likewise, the different modes of CAI have been applied at various levels of education and their effectiveness have been substantiated by various researchers (Lavicza, 2009; Liao et al, 2008; Nishino, 1994; Stella, 1993; Vijayan, 2008). The viability, the application and the widespread use of CAI in classroom instructional presentation have been brought to light by some researchers. (Schmidt, 1991; Nishino, 1994; Mcnutty et al, 2009; Hohenwarter et al, 2009; Clarebout, 2009) Further, the effectiveness of CAI in inclusive setting and special education has been verified by some scholars and they have established the efficacy of CAI with reference to LD students, (Dobbins, 1994; Rasanen et al, 2009; Seo and Bryant, 2009; Thalamalai, 2007).

However, Kulik and Kulik (1989) concluded that more well-designed research is needed before any real conclusions about the effectiveness of CAI can be drawn. Bork (1991) suggests that much of what is available is of little use. Cherry (1991) found that there was no significant difference between CAI and lectures as an effective teaching technique and Garrett (1995) reported mixed results when comparing CAI and lectures. Thus, while educational effectiveness may exist for specific applications, it is difficult to conclude that such effectiveness is common across a large range of disciplines.

Criticism about software design and implementation is well expressed by Walbert (1989), who stated that the majority of CAI applications are naïve and mundane. Blecha (1991) lists common design problems with CAI software: tedious keystrokes, unnecessarily repetitive operations, software that is difficult to use, and minimal pedagogical value of programs that hide the inner workings of models. Harrington (1989)
concludes that CAI programs lack any advantages over printed materials and do not take advantage of the feedback potential of computers.

The studies on high achievers, under achievers and low achievers are very limited. There are only a few comparative studies (Singh, 1983; Saun, 1980; Jothimani, 2009; Jose, 2009) Most of the studies on high achievers and low achievers are survey studies which either highlight the characteristic features and causative factors or focus on the impact of various variables on their achievement. (Deka, 1985; Kaul, 1978; Mishra 1978; Singh 1986; Somasundaram, 1980; Jason, 2000; Cartner, 1987) There are a number of experimental studies which have tried to establish the effectiveness of some strategy or the other with special reference to high achievers and low achievers (Ramar, 1994; Reddy and Ramar, 1995; 1996; Helen, 2008; Mariappan, 2008; Radhakrishnan, 2009, Rajalingam, 2008).

As for studies on teaching and learning of physics, most of the studies are experimental in nature. These studies establish the efficacy of some teaching methods or some instructional strategies in teaching physics at various levels of education (Ponnambalam, 1999; Salina Bai, 2008; Kumarasamy, 2008; Natarajan, 2009; Chyuan, 1991; Danielsson et al, 2009; Elsekraft, 1986; Geelan et al, 2004) Some studies on physics are related to the opinion and attitude of the physics teachers with regard to the content of the syllabus and method of teaching (Karamustafaoglu, 2009; Rivers, 1986; Ahlee and Johnson, 2006) Some of the physics studies establish the effectiveness of experiments and lab works on the achievement of students in physics (Danielsson et al, 2009; Likens, 1990; Theyssen, 2007).

While most of the studies are related to teaching methods, some studies concentrate on learner centred techniques and such studies bring to light the effect of learner centred techniques and active learning strategies on the achievement of students in physics (Karuppasamy, 2008; Sundararajan, 2008; Salina Bai, 2008; Briscoe et al, 2004; Karamustafaoglu, 2009). Various studies have been attempted to establish the effect of teaching aids and educational technology especially
the audio and video instruction, multimedia instruction, modular instruction and different modes of CAI in teaching and learning of physics at various level of education (Ponnambalam, 1999; Kumarasamy, 2008; Natarajan, 2009; Catahoghu, 2006; Chang et al, 2008; Elsenkraft, 1986; Lee and Guo, 2008).

Though quite a number of studies are available on multimedia in education, only a few studies are available on computer assisted instruction. Likewise, only a few Indian studies are available on under achievers and low achievers. The University Grants Commission has been concerned with the problem of high percentage of low achievers in the form of third divisioners especially at the post graduate level, and has suggested abolition of third class, more stringent admission policy, and allowing third divisioners to improve their division by taking the examination again.

The review of related researches revealed that the efficacy of computer assisted instruction as well as multimedia approach on the scholastic achievement of students has been established, in both formal and non formal system. However the studies to verify the effectiveness of computer assisted instruction on the scholastic achievement of normal students and low achievers are found inadequate and are more warranted.

Moreover, we are passing through an era of auto instruction and sophisticated educational technology. To keep pace with the developed countries we have to accentuate the human resource development to a great extent and, that too, at the earliest possible time. This envisages special instructional strategies to boost up the performance of students especially in science subjects. Since auto instruction is the trend of the time, it will be very much in the interest of the student population to undertake more researches on media application in teaching science subjects, particularly physics which remains to be the base of technological sciences. The present study is an earnest attempt to develop and/or apply two different modes of computer assisted instructions, to teach physics to
various categories of students at higher secondary level and to assess their advantages over traditional lecture method.

The statement of the problem of the study is presented in the forthcoming chapter - III.