Chapter 2

Review of the Related Studies
REVIEW OF THE RELATED STUDIES

Researchers take advantage of the knowledge which has accumulated in the past as the result of constant human endeavour in a particular field. The first step should be a careful presentation of the progress which has been made in the selected area. It enables one to estimate correctly one’s own place in the ever expanding ocean of knowledge.

Kerlinger (2002) has rightly opined that the underlying purpose of the related literature is to locate the present research in the existing body of research on the subject and to point out what it intends to contribute to the subject. A careful review of the journals, books, dissertations, theses, and other sources on the problem to be investigated is one of the important steps in the planning of any research study. It helps in designing the steps which are to be followed in the study of the proposed problem.

Science being the backbone of all the progress and development in modern society, the study of science has become more important as a subject at school level. It is a fact that all the students are not equally interested in the study of science, thus the achievement also differs. Therefore, it seems pertinent to study the attitude towards science and science achievement at the school level. Several studies in India and abroad have been conducted on attitude towards science and science achievement which have revealed interesting results. Some of the important studies, which have relevance to the present problem, are as follows:
Brown (1955) surveyed the science information and attitude possessed by elementary school students. The study revealed that the groups that had a significantly high science achievement also have a significantly high positive science attitude test score.

Dutton and Stephens (1963) conducted a study on attitude towards science of prospective elementary school teachers. They administered a self constructed attitude scale on 236 prospective elementary school female teachers (age group 20-24, enrolled at the University of California, Los Angeles) and concluded that the prospective elementary school teachers expressed considerable liking for elementary school science.

Wick and Yager (1966) attempted to know some aspects of the students' attitude in science courses. They selected 373 students of grade 7th to 12th from Laboratory School of the University of Iowa and used a part of a battery of standardized attitude tests. The results of the study indicated that the students' attitude towards science highly depend on the teachers in the classroom.

Lowery (1967) conducted a study to know the effect of a new curriculum material (Animal Colouration Unit) on attitude towards science of elementary school children. He administered self made Projective Test of Attitude (PTOA) on a sample of 335 students (165 experimental group and 170 control group) selected from 12 classes of 5th grade in Oakland, California. Descriptive analysis of the data showed that 5th grade children experiencing a particular new science material changed their attitudes in a positive way which was
significantly greater than the changes made by similar children who didn’t experience the material. The study further showed that the unit had a greater effect on boys’ attitudes than on girls’ and the change in attitude was independent of IQ.

Fulton (1971) conducted a study to determine the effect of two approaches - individualized and group approaches to teaching Biological Science Curriculum Study (BSCS) Biology on students’ attitude towards science. He randomly selected students from 8th grade classes at the University of Iowa laboratory school. During school year, in 1967-68, the students were taught by group instruction and during 1968-69, the students were taught by individual approach to instruction using the same instructor throughout the study. The students were administered the Science Attitude Scale (SAS) and the Prouse Subject Preference Survey (PSPS). By ANCOVA, the researcher concluded that students in self-pacing approach to science instruction develop better attitude towards science than do students in a group approach.

Desai (1973) conducted a study on attitude towards Mathematics of the high school students of Saurashtra, with respect to sex, grade and the area lived in. Self constructed attitude scale was administered on a sample of 3505 students (2280 boys and 1225 girls, 1821 rural and 1684 urban). The major findings of the study revealed that the students with favourable attitude towards Mathematics preferred to offer it at the Senior Secondary Certificate Examination. The boys did not differ from girls in their attitude towards Mathematics. Moreover, urban children had more favourable attitude towards Mathematics than the rural one.
Shrigley and Johnson (1974) investigated the status of science attitude of in-service elementary teachers. They administered a self constructed Likert type attitude scale to 114 in-service elementary teachers enrolled in 10 science education classes of Pennsylvania State University. Using F-ratio, they concluded that the male in-service teachers had more favourable attitude towards science than their female counterparts. There were no significant difference in the attitudes of the teachers with respect to age, faculty size and level of teaching classes.

Sood (1974) conducted a research on attitude towards science of students and teachers with respect to gender and socio-economic background. The sample of the study was comprised of 1000 students and teachers from seven schools of Delhi and Rajasthan. An Attitude Scale, the test on Understanding of Science, and Socio-Economic Status Questionnaire (Urban) were the tools of the research. Major findings of the study showed that the total sample had positive attitude towards science which was significantly related to the understanding of science. Sex differences were not significantly related to attitude towards science.

Andersen (1975) conducted a study to see the effect of a modular course in Biology on students' attitude towards Biology. The researcher selected 81 students from Blue Ridge Community College, Virginia and started a modular course of Biology on them in Jan 1973. A Semantic Differential was administered at this time as a pre-test inventory to measure students' attitude towards Biology. In June 1973, the same was again administered as a post-test inventory. Means, SDs and Pearson's correlation coefficients were calculated. The findings of the study
indicated that the students who had the modular course showed higher attitudinal gain scores than did students who had the traditional lecture classes. A significant interaction between students' sex and method of interaction was seen in the attitudinal gain scores.

Ayers and Price (1975) conducted a research on attitude towards science of a group of middle school children. They administered a self-made Science Attitude Inventory on 455 students (232 males and 223 females) from 4th to 8th grade students enrolled in elementary schools in Clay County of Tennessee. They reported that there were no major differences in the science attitudes of males and females. The 4th grade students were the most positive in their attitude towards science whereas the 6th grade students were the most negative in it.

Das (1975) conducted a research to find out factors responsible for students' low achievement in General Science in the School Final Examination (SFE) held by the West Bengal Board of Secondary Education (WBBSE). A sample of 985 students from 61 High Schools of West Bengal were administered the Culture-Free Intelligence Test of Cattell and Cattell, and Anxiety Scale Questionnaire of Cattell and Scheier. The study revealed that: i) the students who passed General Science possessed higher IQ than those who failed in the subject. A positive correlation existed between intelligence and achievement in General Science. ii) there was no significant difference between anxiety scores of those passing in General Science and those failed in the subject. iii) students' personality turns out to be most powerful component responsible for performance in General Science. iv) students who passed in General Science obtained higher marks in Mathematics.
than those who failed in the subject. v) IQ, marks in Mathematics and General Science showed highly significant and positive correlation. vi) students' personality, teachers' incompetence and socio-economic factors were the primary factors responsible for low achievement in General Science.

Lalithamma (1975) selected 732 students of standard IX and administered a standardized Achievement Test in Mathematics, a Study Habit Inventory, an Interest Inventory, a Socio-Economic Status Scale and Raven's Standard Progressive Matrices on them. The study revealed: i) there was significant difference in the performance of boys and girls in Mathematics, the difference being in the favour of boys. ii) urban students were superior to the rural students in Mathematics achievement. iii) intelligence and interest in Mathematics is higher in boys and urban students than their respective counterparts. iv) the achievement in Mathematics is positively related to intelligence, interest in Mathematics, study habits and socio-economic status. v) private tuition, electric light facilities, radio and equipments for study, etc. influenced the achievement in Mathematics. vi) achievement of Scheduled Caste (SC)/Scheduled Tribe (ST) students was lower than that of the total sample.

Sharma (1975) conducted a study to compare the achievement of delta class in General Science and Mathematics using the self constructed tests in General Science and Mathematics. He selected 24 institutions comprising each of the four types rural, urban, boys' and girls' of Rajasthan. The study revealed that there was a significant difference between the performance of boys and girls in General Science
and Mathematics, the girls being superior to the boys in both the subjects. The urban students were found to be superior in the performance in General Science in comparison to their counterparts whereas no significant difference was found between the rural and urban students in the performance of Mathematics.

**Wright (1976)** studied the effect of the Science Curriculum Improvement Study (SCIS) on the process skills and attitudes exhibited by 7th grade students. The researcher selected 63 students (32 boys and 31 girls) in the experimental group from two school in Minnesota, who had 2 years exposure to SCIS, and 63 students (32 boys and 31 girls) in control group who were taught by traditional textbook methods. The researcher used Science and Scientists Attitude Inventory developed by La Moine Motz and the self-made Process Skill Inventory. He concluded on the basis of t-test that 7th grade students who had been taught elementary science by traditional method had more favourable attitude than do the students who were taught via SCIS. No significant difference was found in attitudes of boys and girls either in experimental or control group.

**Dederick (1977)** conducted a study to evaluate photomicrographs as a means of improving students' ability in associating the meaning of scientific terms that describe anatomical structures of plants with actual structures. A control group of 171 students was instructed by conventional methods and an experimental group of 250 students was instructed by the same conventional methods but supplemented with photomicrographs of the anatomical features. A 2x2x4x5 multifactor analysis of variance revealed that the experimental students were
superior by the treatment. The students of higher ability level generally expressed favourable reactions to the slide projectors and indicated a preference for them over conventional instruction alone.

M*anley (1977) studied the relationship of the learning environment and attitude towards chemistry of the students. The sample consisted of 80 Inter disciplinary Approaches to Chemistry (IAC) classes selected from a population of IAC classes in the New England area. The Student Opinion Survey in Chemistry (SOSC) and Learning Environment Inventory (LEI) were used to provide data for the study. The chi squire indicated that the overall learning environments for the two groups $Q_1$ (strong attitude towards chemistry) and $Q_2$ (weak attitude towards chemistry) were significantly different. The $Q_1$ group students viewed their classes as being significantly less difficult, having a significantly slower rate of progress, having a significantly better physical environment, being significantly more goal-directed and having less favouritism. Finally, the result suggested that the teacher's behaviour in interpreting curriculum was considerably more important in determining students' attitudes than the IAC curriculum material themselves.

Chhaya (1978) conducted a research on achievement in physics of the students of central and public schools of CBSE and schools of CISCE of Bombay, Delhi, Calcutta and Madras. The sample of 1200 students of classes VIII and X selected randomly was administered the standardized tests of achievement. The major findings of the study revealed that there was no significant difference in physics achievement of the students of central and public schools. The physics achievement
of the students of central schools was more than that of the students of CISCE schools.

**Fraser (1978)** constructed four science attitude scales namely enjoyment of science lesson, interest in science outside lessons, fluidity of science and social implication of science, which possessed satisfactory statistical characteristics and were highly economical. He administered the scales on 302 Australian students of 9\textsuperscript{th} grade and reported that boys expressed significantly more favourable attitudes than girls on the enjoyment of science lesson scale, the interest in science outside lessons scale and the attitude to the fluidity of science scale.

**Aiken (1979)** conducted a research to know the attitude towards Mathematics and science of Iranian middle school students. The researcher administered the Mathematics Attitude Scale (MAS) and Science Attitude Scale (SAS) on a sample of 50 boys and 50 girls of grades 6\textsuperscript{th}, 7\textsuperscript{th} and 8\textsuperscript{th}, randomly selected from middle school in Tehran. The results of the study showed that the girls are significantly less positive than boys in their attitude towards Mathematics although the difference in attitude towards science was not significant. The attitude towards Mathematics declined as a function of increasing grade level but attitude towards science improved.

**Srivastava (1980)** conducted a study on scientific attitude of teachers and students. A self constructed attitude scale was administered on a sample of 50 science and 50 non-science teachers, 100 science and 100 non-science students from the population of Madhya
Pradesh. The main findings of the study showed that the amount of scientific knowledge or general exposure to science course made positive impact on scientific attitude. The boys and girls differed in scientific attitude whereas male and female teachers did not differ in their scientific attitude.

**Hough and Piper (1982)** studied the relationship between attitude towards science and science achievement. They administered Hough Student Process Test to assess science achievement and Hough Attitude Inventory to assess attitude towards science on a sample of 583 intermediate elementary students enrolled in Hounstan area of Texas. They used residual gain score to minimize measurement errors and to remove individual differences. By calculating Pearson Product Moment correlation coefficient, the researchers claimed that there exist a significant and positive relationship between attitude towards science and science achievement.

**Shinde (1982)** conducted a research to study the scientific attitude of secondary school students. The sample comprised of 1600 secondary school students of Maharasthra. The tools used were a scale to measure involvement in scientific activities, scientific attitude scale and a checklist. The study revealed that the scientific attitude of the students differed from region to region. The boys and girls from the same cultural groups did not differ significantly in their scientific attitude. Moreover, there was a significant positive relationship between academic achievement and scientific attitude.
Bhargava (1983) conducted a research to identify the significant processes of science with special reference to physics and its relationship with socio-economic status, intelligence, and achievement in physics. A sample of 944 boys and 403 girls of classes XI and XII were administered Jalotas Mental Ability Test, a Battery of test of Science Processes, a SES Scale and a bio data form. By using ANOVA, t-test, product moment correlation coefficient and factor analysis, the researcher concluded that science processes were found to be positively correlated with intelligence and SES. A moderate relationship of achievement in physics was observed with three processes of science namely observing, measuring and drawing inferences. The boys were found to be superior to girls on the processes of observing, measuring and drawing inferences. The urban student out performed rural ones on science processes.

Favazza (1983) selected 235 gifted 12 to 15 years old adolescents voluntarily enrolled for fast-paced Mathematics course work during a three week summer residential program, and administered five evaluative measures from the Cooperative Mathematics Test Series to measure mathematical achievement. By using the multiple regression analysis, the researcher reported that Scholastic Aptitude Test in Mathematics (SAT-M) entered more frequently as the significant predictor of mathematical achievement. SAT-M and SAT-V (Scholastic Aptitude Test Verbal form) were significant predictors for 8th grade males. SAT-V alone was the best predictor for 8th grade females. Also sex and grade level were eliminated from the equations as the grade level advanced.
Khanam (1983) conducted a research to study the effect of three instructional designs namely programmed instruction, structural communication and teacher-directed structured information on students' performance in Biology with respect to personality of the students. A sample of 510 students selected from High School was administered Chatterji and Mukerjee Scientific Knowledge and Aptitude Test, Mohan et al. Juniors Personality Inventory, the test of entering behaviour and the achievement test. On the basis of 3x4x2 and 3x4x3 factorial designs, the main findings of the study revealed that the mixed program was found less effective than the teacher-directed structured lessons. The extroverts, introverts, high on neuroticism and low on neuroticism groups did not differ in their performance in Biology.

Mukhopadhyay (1983) reported that comprehensibility of language used in the science text book was significantly related to different levels of science achievement like recall, recognition, translation, interpretation and extrapolation. He administered self constructed Comprehensibility of Language Test and Science Achievement Test on a sample of 400 children of sixteen primary schools in Jaipur. By using chi-square test, product moment correlation, multiple correlation and ANOVA, he further concluded that there was no significant difference in science achievement between boys and girls. There was a significant difference in science achievement between rural and urban children, the difference being in the favour of urban children.

Raveendranathan (1983) conducted a research on science achievement, science interest and mental health status of secondary
school students in relation to medium of instruction. He administered Achievement Test in Biology by Chandrika, Achievement Test in Physical Science by Vimla, Science Interest Inventory by Pillai, Mental Health Status Scale by Abraham, Raven's Standard Progressive Matrices and the Socio-Economic Status Scale by Kuppuswamy on a sample of 890 secondary school students. He reported that science achievement, science interest and mental health status of students of English medium classes were higher than those of students of Malayalam medium classes.

Sarah (1983) by using achievement test in general science, attitude scales and socio-economic status scale on a sample of 3000 students reported that the attitude towards science and science education of High School students in Tamil Nadu was generally favourable but there was a wide disparity in their attitudes. She further reported that: i) when the effects of students' attitude towards science education and their socio-economic status were partialled out, the coefficient of correlation between their attitude towards science and their achievement was found to be 0.07661 which was not significant. ii) it was found that about 30% of the variance in science achievement was accounted for by ones' attitude towards science, ones' attitude towards science education and ones' socio-economic status.

Shaughnessy, Haladyna and Shaughnessy (1983) conducted a research on attitude towards science in relation to student, teacher and learning environment variables on male and female students of 7th and 9th grades. Using Product Moment correlation, they reported that there was a significant correlation between attitude towards science and
students, teachers and learning environment variables at each grade level. The teacher variables are highly correlated with science attitude for girls than for boys in grade seven, but the opposite is true in grade nine. The management and organizational variables are stronger indicators of attitudes for boys than for girls. School environment appears to be more strongly related to boys' attitudes.

Singh (1983) conducted a study on achievement in chemistry of the undergraduate students in relation to their mental abilities. A sample of 400 students was administered an achievement test in chemistry. Major conclusions drawn were: (i) the mental abilities selected viz. numerical ability, reasoning ability, memory and symbolic representation showed a positive influence on the students' achievements in chemistry. (ii) the reasoning and symbolic representation abilities contributed much to the criterion. (iii) the forecasting efficiency of the regression equation pointed out that the subsets of mental abilities could be used in predicting the performance of boys and girls in chemistry at graduation level.

Singh (1983) conducted a research to study the effect of deprivation on achievement in science and aspiration of High School science students in relation to urban and rural areas. The Prolonged Deprivation Scale by Misra and Tripathi, Level of Aspiration Test by Shah and Bhargava and the self constructed Achievement Test in Science were administered on a sample of 450 students from 15 randomly selected institutions in rural and urban areas of Eastern Uttar Pradesh. The main findings revealed that the deprivation had negative effect on achievement in science and level of aspiration. The rural
students achieved less in science than the urban students and there was a positive correlation between level of aspiration and achievement in science.

**Srivastava (1983)** conducted a research to study the scientific attitudes of the students in relation to subjects’ stream, sex and caste category. A sample of 480 students were administered Scientific Attitude Scale. The findings of the study showed that the science students had higher attitude towards science than art students. The boys scored high as compared to girls on attitude scale. Moreover, non-SC/ST students had a more positive scientific attitude than their counterparts SC/ST.

**Ansari (1984)** administered the standardized achievement tests in science on 1702 students of class V, 1462 students of class VI and 1391 students of class VII studying in municipal and non-municipal schools in the city of Greater Bombay. He reported that the performance of boys was better than that of girls in science. The students of non-municipal schools had a better performance in general science than those of municipal schools.

**Bandyopadhyay (1984)** conducted a research to see the effect of environmental and academic factors on students’ attitude towards science by taking a stratified random sample of 420 students (221 boys and 199 girls) from 21 schools of Calcutta. He administered a self-made information schedule, sub tests of DAT Battery and Science Attitude Scale by Grewal; and achievement in school subjects was obtained from the annual examination records for the last three years. By using t-test,
ANOVA and Chi Square test, the researcher reported that the parents' education and socio-economic status led to favourable attitude towards science. Moreover, teacher's influence, peer's influence, vocational values of science and future aim of life were other contributing factors. Students who had favourable attitude towards science possessed higher ability in mechanical comprehension and visualization of objects in space. They were higher achievers in physical and life sciences.

Banu (1984) randomly selected 452 students from six public boarding schools to study their attitude towards science by using self-developed questionnaires and attitude towards science scale. The researcher reported that 69% of the students preferred science courses to other subjects while 70% of the students would like to join science related careers/professions on completion of their studies. Male students had more positive attitude towards science than female students. The students in special science schools had more positive attitude towards science than the students in general secondary schools. Female students in the single-sex school possess more positive attitude towards science than female students in mixed schools. The literacy status of parents, grade levels of students, religion and age did not have significant effect on the attitude towards science of secondary school students in boarding schools.

Dani (1984) conducted a study to measure the scientific attitude of higher secondary students. He selected a sample of 1265 students (804 boys and 461 girls) by stratified, cluster and purposive sampling techniques. The tools used were Scientific Attitude Study (SAS) constructed by the investigator and Group Embodied Figures Tests by
Ottman et al. By using analysis of variance, regression and factor analysis, he reported that about 80% of the students had positive scientific attitude. Boys and girls did not differ in their scientific attitude. The scientific attitude of the science students was higher than that of the arts and commerce students. The rural students were found to have low level of scientific attitude as compared to the urban students. The scientific attitude decreased significantly with an increase in age.

Dennis (1984) conducted a study to see the effect of advance organizer and repetition models on cognitive skills of four groups of 10th grade students enrolled in advance Biology classes. The researcher used Lindquist Type I research design in which first three groups were experimental groups and the fourth one control group. Results from multivariate analysis of variance indicated no significant interaction between treatments on the two dependent variables, i.e., lower and higher cognitive skills. The findings suggested that all the three independent variable, i.e., advance organizer, repetition and the combination of advance organizer and repetition produced equally effective results on both the dependent variables.

Hamrick (1984) conducted a study to know the effect of experiencing resequenced and not resequenced science content on science achievement, attitude towards science, and interest in science. The data was collected from 203 students of 6th grade by using a standardized achievement test and two Likert-type instruments. The results indicated that the students experiencing resequenced general science content were significantly more positive in terms of science
achievement, attitude towards science and interest in science within both levels of treatments.

**Kern (1984)** conducted a study to determine the effect of field activities on students' values, interests and attitudes in earth science. The teaching of one section was conducted in the traditional manner and a field oriented approach was employed for the second section. In the end of the term, post-tests revealed highly significant difference between the two groups. Students under the field oriented approach left the course feeling much higher levels of importance, interest and enjoyment associated with the learning experience than did students in the traditional class.

**Patel (1984)** conducted a research on mathematical ability considering sex, grade, attitude towards Mathematics and anxiety for Mathematics. A self constructed Mathematical Ability Test, Mathematical Attitude Scale (MATS) and Mathematical Anxiety Scale (MANS) were administered on a sample of 1250 students of Class IX and 1035 students of class X. The findings of the study revealed that there were no significant sex differences in Mathematical ability of the students. The students possessing favorable attitude towards Mathematics were found better in Mathematical ability than those with a less favorable attitude. The students possessing high anxiety were inferior in mathematical ability to students having low anxiety.

**Rajput (1984)** conducted a research to study the impact of intelligence, achievement motivation and socio-economic status on achievement in Mathematics of the students. A sample of 435 students
was administered standardized test in Mathematics, Raven's Standard Progressive Matrices, Bronzon Graphic Expression Test, Kuppuswamy's Socio-Economic Status Scale. With the help of 3x3x3 ANOVA, the researcher reported that intelligence affected the achievement of students in Mathematics significantly at all the three levels, i.e., high, average and low. There was the superiority of high intelligent group of students over the average and low intelligent groups. The achievement of students in Mathematics was not affected by their achievement motivation. Moreover, the achievement of the students of high socio-economic status was found to be high as compared to the lower one.

Walberg (1984) on the basis of his study reported that the correlation of IQ with science achievement was 0.48. He further explained that only 23% of the variance in science achievement was predictable by IQ and that of 77% of the variance was due to the other factors, some known and some unknown.

Yadav (1984) conducted a study to see the effect of mastery learning strategy on students' achievement in Mathematics, their self-concept and attitude towards Mathematics. The study employed a pre-test control group design involving two groups of students, the experimental group using mastery learning strategy and the control group using the conventional method of teaching Mathematics. The experimental group had 173 students and the control group had 189 students, all from grade IX. The students were administered Mathematics Attitude Scale, Mathematics Achievement Test and Sirtva Bodh Parikshan. The findings of the study revealed that the use of
Mastery Learning Strategy enhances the achievement in Mathematics, attitude towards Mathematics and self concept of the students.

Chitkara (1985) conducted a research to see the impact of teaching strategies, intelligence and personality factors on achievement in Mathematics. A sample of 300 students of grade IX was randomly selected from four schools of Chandigarh and was administered Mathematics Achievement Test, Jalota Group Test of Mental Ability and Eysenck Personality Inventory. The data was analyzed through 3x2x2x3 analysis of variance. The findings of the study showed that all the three strategies (lecture-discussion, inductive-drill and auto-instruction group discussion) were found to be equally effective in terms of achievement in Mathematics. The lecture discussion strategy found favour with average ability students whereas inductive-drill and auto-instruction group discussion strategies were most suited to the students having above average intelligence in terms of achievement in Mathematics. The lecture-discussion was more suited for below average ability extroverts and introverts, inductive drill for high ability extroverts and auto instruction group discussion for high ability introverts in terms of achievement in Mathematics.

Dalton (1985) conducted a study on 171 tenth grade Biology students to determine the influence of gender, aptitude, engagement on task and computers assisted instruction (CAI) on achievement in Biology and attitude towards computer of secondary school students. Achievement and attitude were measured at the end of ten days treatment whereas the retention data were collected seventeen weeks after the treatment from the exam. By using the ANCOVA and
Newman Kel's procedure, the researcher concluded that CAI appears to be effective for increasing Biology achievement. No sex differences were found in Biology achievement and attitude towards computers. Moreover, no differences in attitudes were found among higher, middle and lower aptitude students.

**Friend (1985)** conducted a study to determine the effect of integrating science and Mathematics in a 7th grade physics unit on students' attitude towards and achievement in science. The Science Attitudes Appraisal and a teacher constructed Test of Physics, Facts and Principles were administered to a sample of 108 New York City 7th graders. By using t-test, the researcher claimed that integrating science and Mathematics did not result in a more positive attitude towards science but the students who were taught by it achieved better than the other students.

**Ghosh (1985)** conducted a study to see the effect of gender, living area, intelligence, academic motivation and SES on achievement in Chemistry on a sample of 450 students studying in nine schools in West Bengal. A self constructed achievement test, Bhattacharya’s Academic Motivation Test, Group intelligence Test, Kuppuswamy’s (Urban) and Pareek’s (Rural) SES scales were used to collect the data. By using ANOVA, Mann-Whitney U test and correlation, the researcher found no significance difference in chemistry achievement with respect to gender and living area (rural/urban). There was a positive correlation of chemistry achievement with academic motivation, intelligence, and income of the parents for the total sample. The rural students' chemistry achievement was positively correlated with the education and
occupation of the parents. Moreover, the achievement in chemistry could be significantly predicted from academic motivation, intelligence and SES through the multiple regression equation.

Harty, Beal and Scharmann (1985) conducted a study on science achievement in relation to attitude towards science, reactive curiosity and scholastic aptitude on 293 (144 males and 149 females) 5th grade Caucasian students. The collected data were treated by the way of analysis of linear multiple regression and the Pearson Product Moment correlation technique. The analysis of the data revealed a potential relationship between the criterion variable science achievement and the predictive variables attitude towards science, relative curiosity and scholastic aptitude. The magnitude of this relationship as represented by multiple regression factor appears to be moderate with 47% of the variance in science achievement being accounted for by the six predictive variables and 44% of the variance is attributed to scholastic aptitude (verbal, non-verbal and quantitative).

Kolhe (1985) investigated the influence of sex and urban-rural location on the attitude towards Mathematics of the students of class X. A self constructed Attitude Towards Mathematics Scale was administered on a sample of 2000 students (1000 boys, 1000 girls) from urban and rural secondary schools of Jalgaon district of Maharashtra State. By applying t-test, the investigator reported that all the students had favourable attitude towards Mathematics. The urban students had more favourable attitude towards Mathematics than the rural students irrespective of their sex. Moreover, the boys had more favourable
attitudes towards mathematics than the girls irrespective of the area they lived in.

Salters (1985) administered Remmers' Purdue Masters Attitude Scale, Brookover's Science Self Concept of Ability Scale and a self made personal information questionnaire on a sample of 410 black undergraduate science and non-science students of Morgan State University. By using the multiple regression analysis, the researcher concluded that the science self-concept, presence of role model, attitude towards science and high school science background had sizeable contribution on the selection of science as a course. The science self concept and role model explained 21% and 11% of the variance in science as a course respectively. All the four variables collectively accounted for 42% of the variance.

Bartos (1986) conducted a study to know the effects of use of calculators in Mathematics computational process on students' attitude towards and achievement in Mathematics. The subjects of the study included two third grade classrooms using calculators as the experimental group and two third grade classrooms as control group, not using calculators in Mathematics period during the study. The findings of the data indicated no significant differences between the experimental and control groups in Mathematics achievement in the areas of addition, subtraction, and division or in attitude towards Mathematics. A significant difference between the control and experimental group was found in the area of multiplication, the difference was in favour of the control group.
Blatnick (1986) selected 152 students of 9th grade chemistry and divided them into two groups experimental and control. The experimental group received verbal instruction, watched demonstrations with molecular models and assembled the same models themselves. The control group received verbal instructions only. The researcher concluded that no difference was found in chemistry achievement between the students who used three dimensional models and those who did not. The study does not preclude the use of models in similar instructional programs. It is possible that the use of models contributes to instructional outcomes that were not measured in the present study.

Chiang (1986) conducted a study to determine the effects of individualized instruction (II) and conventional instruction (CI) on physics achievement and the growth of scientific ability of the students of 8th grades. A sample of 164 students selected randomly from two secondary schools representing different geographical locations in southern Taiwan was administered 2Q test, reasoning ability test, Physics aptitude test, achievement test and follow up (the growth of scientific ability) test. A pre-test post-test equalized experimental design was used. By using ANCOVA, the findings of the study showed that the II group was superior to the CI group in achievement and growth of scientific ability.

Donnelly (1986) conducted a study to determine the effect of computer course on Mathematics achievement and Mathematics anxiety. A sample of 177 students of 10th grade was pre-tested and post-tested with California Arithmetic Test (CAT) and Mathematics
Anxiety Rating Scale (MARS). The experimental group received instruction in the use of micro computer and related areas of Mathematics while the control group was not exposed to any treatment. The study revealed that boys scored higher than the girls in Mathematics achievement.

Ganguli (1986) conducted a study to investigate the effect of the use of the micro computer as a demonstration tool on achievement and attitude of the college students. A sample of 118 students enrolled in an Intermediate Algebra Course offered by General College, University of Minesota were selected. Two sections as experimental group received the instruction with the micro computer as a teaching aid and two sections as control group received the traditional instructions. The results indicated that the students in the experimental group achieved better than the students in the control group in all the five sets of achievement scores. The students in the experimental group indicated a significant improvement in the positive attitude towards Mathematics whereas the control group failed to show that. Moreover, the medium ability students were benefited most from the micro computer demonstration.

Ghosh (1986) conducted a study on aptitude in science, scientific attitude and academic motivation of the students. A sample of 620 boys and girls selected from 13 schools situated in urban and rural areas in different districts of West Bengal was administered self constructed Scientific Aptitude Test and Scientific Attitude Test, Bhattacharya’s Academic Motivation Test, Kuppuswami’s (Urban) and Pareek’s (Rural) SES scales to collect the data. By using ANOVA, correlation,
F-test and t-test, findings of the study revealed that the students of high scientific attitude were superior in their scientific aptitude to those having low scientific attitude. The urban students belonging to the high SES group had more scientific aptitude than urban students belonging to low SES group. There was a positive relationship between scientific attitude, scientific aptitude and academic motivation of the students.

Golwalkar (1986) conducted a research to explore the scientific attitude, creativity and science achievement of tribal and non-tribal students studying science in secondary schools. A sample of 270 tribal and 270 non-tribal students of classes IX and X living in a tribal area was administered Scientific Attitude Scale, Thinking Creativity with Words, and Thinking Creativity with Figures. The main findings of the study showed that the non-tribal students were found to be superior in scientific attitude, creativity and scholastic achievement in science subject than the tribal students.

Harpole (1986) conducted a study on achievement in physics and chemistry of secondary school students in Mississippi in relation to teacher, student, school and district characteristics variables. Subjects were 39 physics and 32 chemistry teachers who completed a questionnaire and responded to a semantic differential on their attitude towards science. The MSU achievement test to 616 physics and the Chem 13 News 1982 Exam to 512 chemistry students were administered. Simple correlation and multiple regression analysis were used. Positive correlation of achievement in physics with physics teaching experience and equipment available for physics experiments were found. Achievement in Chemistry was positively correlated with
the students' participation in science fairs, class size, school size, chemistry teaching experience, teachers' age and gender.

**Mehna (1986)** administered Nafde’s Non-verbal Test of Intelligence, Bennett’s Mechanical Comprehension Test, Mascarenhas Interest Inventory, Chatterjee and Mukherjee Test of Scientific Knowledge and Aptitude on a sample of 376 boys and 308 girls of class IX of English medium schools of Greater Bombay to find out the predictors of achievement in science. By using the stepwise multiple regression analysis, the researcher concluded that verbal intelligence, motivation for learning general science and interest in medicine were significant predictors of achievement in general science. The significant predictors of achievement in general science for boys were scientific knowledge and aptitude, motivation for general science, verbal intelligence, numerical ability and liking for science teachers. The significant predictors of achievement in general science for girls were verbal intelligence, motivation for general science, scientific knowledge and aptitude, liking for teachers and numerical ability.

**Odafe (1986)** conducted a study to determine the effect of mathematical problem solving method on students' achievement in Mathematics. A problem solving model developed by Krulik and Rudnick and a self constructed achievement test in Mathematics were used for the research. By applying ANCOVA the researcher concluded that there was no significant difference in achievement in Mathematics between the students taught by the problem solving method and the student taught by the lecturer method.
Sexena (1986) made an investigation of students’ attitude towards physics in relation to type of school, classes and sex. The findings of the study clearly showed that the different groups possessed favourable attitude towards physics. The type of school and classes were found to have significant effects on attitude towards physics of the students. Moreover, the sex differences were not found in attitude towards physics of the students.

Singh (1986) conducted a study to know the relationship of achievement in Mathematics with intelligence, interest, attitudes, family relationship, social relationship, emotional stability, conformity, adjustment to reality and study habits. A sample of 370 students were administered a self constructed Achievement Test in Mathematics, Cattell and Cattell’s Culture Fair Intelligence Test, Samal Vocational Interest Inventory, Samal Socio-Economic Status Scale, Minnesota Counseling Inventory (MIC) and Survey of Study Habits and Attitudes (SSHA). The Findings revealed that the achievement in Mathematics was positively and significantly related with intelligence, socio-economic status, study habits and attitudes. The students achieving high in Mathematics were found to be more intelligent, of higher SES, having good study habits and having positive attitudes than the low achievers.

Singh (1986) conducted a study on achievement motivation, intellectual efficiency, introversion-extroversion, socio-cultural status and Mathematics achievement of students studying in Delhi and Haryana schools. A sample of 368 students selected from the schools of Delhi and Haryana was administered Mukherjee’s Sentence
Completion Test (SCT), Raven’s Progressive Matrices Test, Kundu’s Introversion-Extroversion Inventory (KIEI), Daba’s Socio-Cultural Scale and a self constructed achievement test in Mathematics. By using product moment correlation coefficient, t-test, multiple regression analysis and analysis of covariance, he concluded that the correlation of n-ach with intellectual efficiency, introversion-extroversion, socio-cultural status and Mathematics achievement were found to be significant. The difference in Mathematics achievement was significant for low and high groups on n-ach in case of Delhi schools but not significant for Haryana schools. The difference in Mathematics achievement among boys of Delhi and Haryana schools was significant.

Sontakey (1986) conducted a research to study the high and low achievers in natural and biological sciences in relation to sex, personality factors, socio-economic status and achievement motivation. A sample of 482 boys and girls (251 high achievers and 231 low achievers) were administered Cattell’s H.S.P.Q, Achievement Motivation Test by Mehta and Rao, self constructed Socio-Economic Index and Raven’s Progressive Matrices. By using 2x2x2x2 factorial design, t-test and multiple regression analysis, the researcher concluded that the high achievers were more intelligent, less excitable, undisciplined, having self-conflict, relaxed and unfrustrated than the low achievers in natural science. The achievement motivation was a poor predictor of achievement in biological as well as natural sciences. High achievers came from higher socio economic status background. Factors E; G; I+ Q³, Q⁴ and Neuroticism+ came out as predictors of
achievement in biological science whereas $E^+, G^+, I^-, Q^3, Q^4$ and Neuroticism could predict achievement in natural sciences.

**Stringfield (1986)** examined the effect of two different sets of instructional materials (computer based and print based) on the achievement in and attitude towards Biology of the students. A sample of 121 students was randomly assigned to one of two treatment groups: computer and print. Achievement Test in Biology and Moore’s Science Attitude Inventory were administered after the treatment. By using ANOVA, the researcher reported that no significant difference between computer and print groups were found for either achievement in or attitude towards Biology.

**Tunhikorn (1986)** conducted a study on attitude towards and achievement in science of the students of lower secondary education in Thailand. A sample of 374 boys and 335 girls of grades 7th to 9th was administered a self developed attitude towards science test. By using two-way analysis of variance, the researcher reported that the boys had more positive attitude towards science than the girls. Girls’ attitudes decline and boys’ attitudes improved when grade level increased. The difference in achievement between boys and girls increased in Physical Science and decreased in Biological Science as grade level advanced.

**Agnihotri (1987)** conducted a research to see the effectiveness of different teaching methods on the achievement in Physics of secondary school students. He selected a sample of 520 students of grade X from ten schools of Delhi. After the treatment, their achievement gain in Physics was measured. He concluded that the programmed instruction
method was the most effective one followed by the traditional or lecture cum-demonstration method in comparison to the assignment cum-discussion method for the teaching of Physics.

Gogolin (1988) investigated the attitude towards science of science and non-science students. The Attitude Towards Science Inventory (ATSI) was used for the quantitative investigation on a sample of 83 science and 102 non-science students. The multivariate and univariate statistics showed a highly significant difference in attitudes between the two groups. The difference was in favour of science students. Moreover, 25 non-science students were interviewed for the qualitative area of investigation. The interviews suggested that attitude towards science were formed by interactions of both school and non-school variables. The family environment and peer relationships also played a significant role in the development of attitude towards science.

Smith (1988) conducted a study to see the effect of school and non-school factors on students’ attitude towards science at Junior High School level. A two-part attitude scale was used on a sample of 1288 students of grade 7th and 8th. The major findings of the study revealed that the non-school factors (race and gender) and parent’s level of education significantly affect students’ attitude towards science. Several school factors including grade level, teacher characteristics, materials learned and class activities show strong relationships to students’ attitude towards science. The teacher variables were the most frequently identified school factor variable.
Darchingpui (1989) conducted a research on attitude towards and achievement in science in relation to sex, location and type of schools of secondary school students. He administered a self constructed Science Test and Grewal's Science Attitude Scale on a randomly selected sample of 812 students of class IX. He reported that there was a significant relationship between attitude towards science and science achievement. Also significant sex differences in science achievement and problem-solving ability was found, difference was in favour of boys. The study further revealed that the students of high socio-economic status, good family facility and of good school were found to be high achievers in science, more favourable attitude towards science and good problem-solving ability in comparison to their counterparts, i.e., students of low SES.

Ghosh (1989) conducted a study on a sample of 613 students selected from 13 schools. He administered self constructed Scientific Attitude Test, Scientific Aptitude Test, Academic Motivation Test by Bhattacharya, and Socio-Economic Status Scale by Kuppuswammy alongwith structured interview. By using ANOVA and regression analysis, the findings of the study revealed that the scientific aptitude was significantly related to scientific attitude and academic motivation. Moreover, there was no significant difference in scientific attitude and academic motivation with respect to sex, socio-economic status and place of habitation.

Phalachandra (1989) found a positive relationship between concept-based achievement in chemistry and environment. Sex differences in achievement favouring boys existed. Parents’
qualifications, sex and place of birth (urban areas) contributed substantially to the achievement in Chemistry.

**Alexander (1990)** conducted a research on achievement in science of college students of science discipline studying in Bangalore. He administered Chatterjee’s Scientific Aptitude and Scientific Knowledge Test, Kerala Cognitive Reasoning Test Series and Kuppuswamy’s Socio-Economic Status Scale (Urban) on a sample of 400 college students. The marks obtained in public examination were taken as the measure of science achievement. By using ANOVA and multiple regression techniques, the researcher reported that critical thinking, scientific aptitude and socio-economic status contributed 8%, 15.4% and 5.36% of the variance in achievement in science respectively. Moreover, the study further revealed sex differences in achievement in science, the difference being in favour of boys.

**Hofstein, Maoz and Rishpon (1990)** reported that students who were exposed to extra curricular science activities had a more positive attitude towards science than the students who were not. They took a sample of 3153 students (153 students were enrolled in extra curricular activities) and administered a Likert-type attitude questionnaire. Chi-square analysis further showed that the students involved in extra curricular science activities found learning science more enjoyable, more interesting and more attractive while the students who were not enrolled in extra curricular activities found learning science less enjoyable and less interesting.
Kar (1990) examined the relationship between attitude towards and achievement in science of the secondary school students. He administered a questionnaire, interview schedule, achievement test in science and science attitude scale on a sample of 700 students of class IX. By using correlation techniques, he reported that there was a positive and significant relationship between attitude towards and achievement in science. The boys were found to be more favourable attitude towards science than the girls.

Rao (1990) conducted a research on scientific attitude, scientific aptitude and achievement in Biology at secondary school level. He administered Scientific Attitude Scale by Sood and Sandhya; and Kerala University Science Aptitude Test on a sample of 600 students studying in class IX. With the help of t-test, the findings of the study revealed that there was no influence of sex on scientific attitude. The students studying in private schools, rural schools, English medium schools and residential schools had relatively better scientific attitudes and achievement in Biology than their respective counterparts. A high significant positive relationship was found among the variables scientific attitude, scientific aptitude and Biology achievement.

Sharma (1990) administered Scientific Literacy Scale, Attitude Towards Science Scale and Cattell’s 16 PF Questionnaire on a sample of science students and teachers. By applying ANOVA he reported that the total sample had a favourable attitude towards science. Moreover, there was significant positive effect of school type and sex on attitude towards science of the students and teachers.
Gupta (1991) compared the effectiveness of Concept Attainment Model of Brunes et al. and Inductive Thinking Model of Hilda on achievement, self-concept and attitude towards science. A sample of 64 students of class IX was administered Jalota’s General Mental Ability Test, Grewal’s Science Attitude Scale and Sarswat’s Self Concept Questionnaire after the treatment. By using ANOVA and ANCOVA, the findings of the study showed that achievement of the students in science by Inductive Thinking Model was found to be better than the achievement by Concept Attainment Model. Inductive Thinking Model of teaching was found superior to the Concept Attainment Model in promoting the right attitude towards science. Moreover, both the Models of teaching was failed to bring significant change in self-concept of the students.

Kishore and Aggarwal (1991) studied the comparative effect of Individually Guided System of Instruction (IGSI) and conventional method of instruction on scientific attitude of the students. They selected a sample of 50 students (25 for control group and 25 for experimental group) from Haryana and administered Cattell and Cattell’s Culture Fair Intelligence Test, Sood’s Scientific Attitude Test and a self-made Knowledge Test in Physics. The researchers, by using t-test, showed that the scientific attitudes of the students taught Physics through IGSI improved significantly as compared with the group taught through the conventional method. The students with low previous knowledge in Physics showed a significant improvement in their scientific attitude due to the treatment.
Kumar (1991) attempted to examine the development of scientific attitude of secondary school students in relation to achievement in science. He administered Scientific Attitude Test (SAT) by Phateed and a self constructed Students’ Perception of Teaching Science on a sample of 402 students of Tamil Nadu. By using t-test, correlation and chi-square techniques, the findings of the study revealed that there was no significant difference between the scientific attitude of boys and girls in the high effective group with respect to the perception of teaching science. The scientific attitude of boys was found to be more than the girls in the average effective group. The scientific attitude of the students of urban area was more as compared to the students of rural area in the high effective group. The scientific attitudes of boys and girls did not differ significantly in the low effective group.

Masih (1991) conducted a research to see the effectiveness of Hoshangabad Science Teaching Project (HSTP) and NCERT (adopted) curriculum in terms of attitude towards science, understanding the nature of science and concept-attainment in science. A sample of 1147 students of class VIII (HSTP-564 and NCERT-583) was selected from 28 Government Middle Schools from three districts of Madhya Pradesh and administered Fraser’s Science Related Attitude Test (TOSRA), Klopfer, Carrier and Geis’ Test of Understanding Science, Jalota’s Group Test of Mental Ability and self developed Test of Concept Attainment in Science. The study revealed that the students who followed HSTP curriculum performed better in science concept attainment, had significantly more favourable attitude towards science
than the students who followed NCERT curriculum. Moreover, both the groups lacked sound understanding of the nature of science.

**Malviya (1991)** studied the attitude towards science of adolescent students of Madhya Pradesh. A sample of 820 students of class X were selected from twenty schools of Madhya Pradesh and administered a Likert type Attitude Scale and Interest Inventory by Singh. The collected data were analyzed by t-test, ANOVA and correlation techniques. The major findings of the study showed that the boys had more favourable attitude towards science than their counterpart girls. The socio-economic status of the students was found to be positively and significantly related with attitude towards science.

**Sinha (1991)** conducted a research to see the impact of scientific attitude, motivation and self concept in science on science achievement of the students of secondary school stage. A sample of 594 students of class IX selected from twelve schools was administered Self-Concept in Science Questionnaire, Motivation Science Questionnaire and Achievement Test in Physical Science. With the help of ANOVA and regression analysis, he reported that the urban students achieved better than rural students in Physical Science. There was no difference in the achievement in Physical Science of boys and girls. There was no difference in the self-concept in science between urban and rural students.

**Krishna and Rao (1992)** studied the attitude towards science of male and female teachers. They administered Science Attitude Scale developed by Grewal on a sample of 108 teachers (52 males and 56
females, 61 science and 47 non-science) who attended various orientation programs by the Extension Service Department of Andhra Pradesh. By calculating the critical ratio, they found that the male teachers expressed more favourable attitude towards science than the female teachers. The teachers teaching science subjects expressed more favourable attitude towards science than the teachers teaching non-science subjects.

Lata (1992) conducted a study to determine the predictive power of the basic cognitive factors for achievement in science and Mathematics. A sample of 420 students, selected from six Intermediate Colleges of Aligarh and Badaun cities, was administered a set of twenty verbal tests. The marks obtained by the students in the subjects in Board examination was taken as the measure of achievement in the respective subjects. The collected data were treated with variance and regression. The researcher reported that only the two factors word fluency and verbal relations were found to be significant predictors of achievement in science and Mathematics. Word fluency played the most important role.

Narain (1992) studied the effect of lecture demonstration and small-group laboratory teaching methods on chemistry achievement and attitude towards science. The sample of 91 boys and 79 girls, randomly assigned to two groups for the treatment (intelligence, age and socio-economic status were controlled) was administered a self constructed Chemistry Achievement Test and Fisher's Attitude Survey. By the help of pre-test, post-test and t-test, the researcher concluded that there was no significant difference in attitude towards science of
the students of the two groups. There was no significant effect of sex on achievement in chemistry. A significant positive relationship was found between achievement in Chemistry and attitude towards science.

Srivastava (1992) investigated creativity and attitude towards science of the students of higher secondary classes. A sample of 1200 students (600 boys and 600 girls) was administered Creativity Test by Chauhan and Tiwari, and Science Attitude Scale by Grewal. By using mean, SD and critical ratio, the major findings of the study showed that the girls had more favourable attitude towards science than the boys. The boys having favourable attitude towards science were found to be more creative than those having unfavourable attitude towards science whereas this difference was not found among the girls having favourable and unfavourable attitude towards science.

Usha (1992) attempted to study socio-familial correlates of science achievement of secondary school students. She administered General Data Sheet, Kerala Socio-Economic Status Scale, Socio-familial Inventory, Family Acceptance of the Child Rating Scale, Parents Sex Bias in Education Questionnaire and Achievement Test in Physical Science on a sample of 850 students studying in class IX selected from fourteen secondary schools of four districts of Kerala. By applying stepwise multiple regression analysis, the researcher reported that the best social correlates of achievement in Physical Science were found to be income level of father, educational level of mother, occupational level of mother, educational level of father and occupational level of father respectively. The best familial correlates of achievement in Physical Science were found to be home learning facility, family
acceptance of the child, size of the family, parents’ sex bias in education, family achievement and order of birth.

**Bagchi (1993)** compared achievement in Biology and attitude towards science of students learning different Biology curricula. The random samples of 296, 304 and 300 students of grade XII selected from CBSE, CICSE and Intermediate Boards respectively were administered Content Mastery Test in Biology, Scientific Attitude Inventory (SAI) and Test on Understanding Science (TOUS). The data were analyzed by ANCOVA. The findings of the study revealed that in first three levels of content mastery in Biology, i.e., functional information, understanding and application, the Intermediate Board students showed better performance over the students of CBSE and CICSE Boards. In the higher cognitive process, the situation was reversed. Intermediate Board students were superior to CBSE and ICSE students in attitude towards science.

**Fontana and Fernandes (1994)** conducted a study to see the effect of regular use of students’ self-assessment techniques on the performance in Mathematics. A sample of 667 students selected from 25 primary schools was administered Mathematics achievement test after the treatment. By applying ANCOVA, the study showed that the students in experimental group manifested significant improvements in Mathematics achievement when compared to the control group.

**Padhi (1994)** conducted a study on Science Classroom Environment (SCE) and attitude towards science of High School students by taking a stratified random sample of 200 students of class
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IX from Orissa. The findings of the study revealed positive and significant relationship between perceived SCE and students' attitude towards science. The difference in attitude towards science is caused by their varied perceptions of the SCE and not by their gender.

Skaalvik (1994) examined 6th (N=350) and 9th (N=352) grade Norwegian students' attributions of their perceived results in school in general and in mathematics and language arts (Norwegian) in particular. By using standardized tools; and chi-square and ANOVA, the researcher reported that strong self-serving attributional biases were found both for perceived results in school in general and for results in Maths and Norwegian. Also students who had high Maths self-concept and low verbal self-concept or low Maths self-concept and high verbal self-concept attributed their perceived results in the two school subjects differently and according to a self-serving prediction. Sixth grade students with low academic self-concept had higher self esteem if they attributed their results in school to effort or external causes than if they attributed their results to ability. Among 9th grade students, attributions were not systematically related to self-esteem.

Skaalvik and Rankin (1994) examined gender differences in Mathematics achievement, Mathematics verbal self-concept, self-perceived Mathematics skills and Mathematics motivation. A sample of 356 sixth grade and 353 ninth grade Norwegian students was selected for the study. The data were analyzed by ANOVA and ANCOVA. The findings of the study showed that there were no sex-differences in Mathematics achievement. Moreover, the boys were found to have
higher Mathematics self-concept, self-perceived Mathematics skills and Mathematics motivation than the girls.

**Kishore (1995)** compared students' performance on recall and recognition tests in Physics. A sample of 60 secondary school students of CBSE Board was administered recall and recognition test for the same questions. By treating the collected data with t-test, the researcher reported that the students performed better on the recognition of factual information rather than its recall.

**Kumar (1995)** studied the attitude towards Mathematics on its various value dimensions of secondary school students. He administered self-developed Attitude Towards Mathematics Inventory on a sample of 100 male and 100 female students. By using t-test, he concluded that the attitude towards Mathematics of male and female students was expressed to the same extent on its utilization, aesthetic and intellectual value dimensions. The female group expressed more favourable attitude towards Mathematics on its social value dimension than the male group. There were no sex-differences in the attitude towards Mathematics as a whole.

**Moriarty, Douglas, Punch and Hattie (1995)** conducted a research to investigate the extent to which self-efficacy acts as a mediating variable between the learning environment and achievement. A sample of 179 students was allocated randomly to cooperative and individualistic environments for the treatment. The data collected on self-efficacy and achievement after five and ten weeks indicated that the cooperative environments led to higher self-efficacy and achievement as
well as more appropriate behaviour. On the basis of MANCOVA and Scheffe test, the researcher concluded that the performance of particular tasks under competition appears to be enhanced when students have previously worked cooperatively, but may be difficult to sustain as self-efficacy and behaviour standards decline.

**Budhdev (1996)** studied the attitude towards various school subjects including science and Mathematics of the secondary school students. The researcher administered Desai-Bhatt Group IQ Test, Desai SES Scale and self developed attitude scale on a sample of 2258 students (1293 boys and 965 girls) of classes 8th to 10th from 46 secondary schools. By using t-test, F-test and Product Moment correlation techniques, the researcher concluded that attitude towards science of the boys were more positive than the girls. The students of high IQ group had more positive attitude towards science. A positive and significant correlation was found between achievement in and attitudes towards Mathematics and attitude towards science.

**Crane (1996)** conducted a study to see the effect of home environment, socio economic status and maternal cognitive test scores on Mathematics achievement of the students. A random sample of 12686 students was selected from the entire USA. By using the weighted regression analysis, the effect of home environment on the students' Mathematics achievement was found to be significantly large even when SES and maternal test scores were controlled. The effects of SES and maternal test scores were smaller but no ways trivial.
Khatoon (1996) studied the attitude towards and achievement in science of Muslim minority and Hindu majority students. She administered Science Attitude Scale by Grewal on a sample of 550 senior secondary school students selected from twelve colleges of U.P. The marks obtained by the students in Board Exams were taken as the measure of their science achievement. She concluded that the Hindu students had significantly more favourable attitude towards science than the Muslim students. There was no significant difference between the attitude towards science of Hindu and Muslim female students. The most important factor which affects the attitudes and achievement of the Muslim students in science is their socio-economic status.

Kishore (1996) conducted a study to find out the effect of Rate Centered Learning Approach (RCLA) on achievement in science of the students. The sample comprised of 100 students of class VI studying in Kendriya Vidyalaya. The data was analyzed by using chi-square and t-test. The researcher reported that the students' achievement scores improved after the treatment of RCLA. The students were found to be very much in favour of RCLA as compared to the conventional method of teaching.

Rech and Stevens (1996) conducted a study on 251 black students of fourth and eight graders to examine the effects of gender, economic status, self-concept learning style and attitude towards Mathematics on Mathematics achievement. By using multivariate analysis of variance (MANOVA), the researchers claimed that the black students were found to be mostly from economically stressed families and generally possessed negative attitude towards Mathematics. Among fourth
grades, attitude towards Mathematics and economic status contributed significantly to the prediction of achievement. For eighth graders, the significant predictors were learning style and gender of the students.

Young, Reynolds and Walberg (1996) studied achievement in science in relation to individual and school level factors on a national sample of 2000 students of tenth grade participating in the longitudinal study of American youth. Hierarchical linear analysis showed that the individual measures accounted for most of the variance in science achievement. The initial science attitude, instructional time, home environment and exposure to mass media were also significant individual measures which influenced science achievement.

Alka and Maitra (1997) studied attitude towards laboratory and other practical work in science of students and teachers. They selected 296 students and 20 teachers from Delhi. The tools used were attitude scale and interest inventory for the students and questionnaire for the teachers. The findings of the study suggested that the boys had more positive attitude towards the practical aspects of science than the girls. 75% of the students opt for science because of their inclination whereas some go by their parental pressure. The most of the teachers were lacking the constant upgrading of their knowledge and 95% of them were not the member of any scientific organization.

Bhattacharya (1997) attempted to find out the correlation between cognitive, affective and psychomotor domain of scientific attitude and academic achievement of higher secondary students. He administered Scientific Attitude Scale by Singh on a random sample of
120 male students selected from five schools. By using Product Moment correlation, the researcher reported that the cognitive, affective and psychomotor domains of scientific attitude are significantly related with academic achievement. The development of cognitive, affective or psychomotor domains of scientific attitude would help in higher achievement in various academic disciplines among the students of higher secondary level.

Blatchford (1997) examined ethnic and sex differences in academic self assessments of the students. A sample of 416 white and black students was drawn from inner London schools. By using z-scores and chi square, the investigator concluded that the white students were less positive about their own attainments. The black girls showed confidence in their attainments and had the highest attainments in reading and English whereas white girls tended to under estimate and have little confidence in their school attainments.

Brookhart (1997) investigated the effects of classroom assessment environment on achievement in the Mathematics and science. Data were obtained from the longitudinal study of American Youth in two cohorts each containing 3000 students. By using stepwise regression analysis, the investigator claimed that gender, socio-economic status and reading ability were found to have significant and positive effects on the achievement of the students. Also the effect of homework on Mathematics achievement and the effects of homework and assessment format on science achievement of the students in both the cohorts were found to be positive and significant.
Ma (1997) conducted a study on a sample of 1044 High School students selected from the Dominican Republic through stratified random sampling and was administered student questionnaire and Mathematics achievement test. By using Structure Equation Modeling, the investigator concluded that a reciprocal relationship existed between every attitudinal measure and Mathematics achievement. The feeling of enjoyment was found to have direct effect on Mathematics achievement. The perception of Mathematics as important subject was independent of other attitudinal measures. The findings suggested that the reciprocal nature between attitude towards Mathematics and achievement in Mathematics could subsequently modify their casual relationship.

Naik and Pathy (1997) studied the attitude towards teaching science of secondary school science teachers. They selected a sample of 256 secondary school teachers and divided into sub samples on the basis of sex, place of living, age, educational qualification, training and teaching experience. The researchers used a self developed scale to measure the attitude of the teachers. They reported that the science teachers were found to have positive attitude towards teaching science. The urban secondary school teachers had more favourable attitude towards teaching science than the rural ones. The female science teachers had significantly positive attitude towards teaching of science than their male counterparts.

Tinajero and Paramao (1997) examined the relationship between academic achievement and field dependence-independence cognitive styles. The researchers analyzed various subjects of the school
curriculum on a sample of 408 students. The results obtained by multivariate analysis of covariance indicated that the students using field independent as their cognitive style of learning performed better than the students using field dependent cognitive style of learning in all the subjects.

**Wang and Staver (1997)** selected a random sample of 12000 students of ninth grade belonging to the urban, suburban and rural areas from the Chinese database to see the gender differences in science achievement. By using t-tests and ANOVA, the researchers found significant gender differences across the nation. The results were interpreted in the light of the educational, political, social and cultural contexts of modern day China and the findings revealed that the male students received higher scores in comparison to the female counterparts.

**Whicker, Bol and Nunnery (1997)** investigated the effect of cooperative learning on students' achievement and attitudes in Mathematics. Using a quasi-experimental design two pre-calculus courses were compared. Students in one class studied the material in cooperative learning groups whereas students in the second class studied the material independently. Three chapter tests were used to measure students' achievement and a questionnaire was administered to the students of treatment group to assess their attitude towards the cooperative learning procedure. With the help of multivariate analysis of variance, the researchers concluded that students in the cooperative learning group had increasingly higher test scores than students in the control group. The students showed primarily favourable responses
towards the cooperative learning procedure and most students indicated that they liked working in groups.

**Campbell and Beaudry (1998)** studied high achieving 11th grade Mathematics students (330 boys, 213 girls) who participated in the Longitudinal Study of American Youth (LSAY) and reported that there was 10.8% gender gap favouring the boys in technical areas. The path model for both the sexes indicated that educated mothers have strong indirect effects on their children's Mathematics achievement. The students' self-imposed pressure and persistence had important direct effects on their achievement. Mathematics self-concept had important direct effects on Mathematics achievement only in the case of male students.

**Kiviln and Rogers (1998)** took a sample of 341 High School students from the urban (N=144) and rural (N=197) regions of Kenya (205 male and 136 female) to know the effects of gender and cultural experience (region) on the ratings of previously identified casual attribution factors - instructional strategy, ability, personal organization, effort, state of health and home environment to perceived performance in Maths. By using Hierarchical Linear Model (HLM), the investigators reported that there were significant gender and cultural experience variations in the mean ratings of the attribution factors. Instructional strategy was highly rated for perceived success, and lack of ability for perceived failure. Effort was of least importance in making attribution to either perceived success or failure.
Lin (1998) conducted a study to explore the effect of teaching Chemistry with the history of science on students' attitude towards science. A sample of 61 non-chemistry students studying in the two classes was selected for this study. Using a quasi-experimental design, the experimental group of the students was taught three historical cases of Chemistry in one school year. The analysis of covariance, using post-treatment attitude score as the dependent variable and pre-treatment attitude score as the covariate, revealed that the experimental group outperformed its counterparts in their attitude towards science.

Singh (1998) conducted a study to know the effect of part-time employment on academic achievement in High School. A sample of 3752 students of grade X was administered a standardized achievement test in four subject areas English, Mathematics, Science and Social Studies. The High School grades earned in the said subjects were also taken into account. The study revealed that a small negative effect of employment occurs on both measures of achievement when socio-economic status, gender and previous achievement were controlled.

Sreelekha and Nayar (1998) attempted to compare the achievement in Chemistry of the students taught through Concept Attainment Model (CAM) and traditional method. A sample of 40 students of class VIII was administered a self constructed Achievement Test in Chemistry after the treatment. The collected data were analyzed using t-test. The researchers reported that the CAM was effective in improving the achievement of the students in Chemistry.
Adams, Snowling and Hennessy (1999) examined the relationship between behaviour problems and academic attainment. A school population (364 children from years 3 to 6 inclusive) was assessed on a range of cognitive ability tasks. These included standardized tests of reading, arithmetic and verbal and non-verbal intelligence. To assess behaviour, teachers completed the 'Strengths and Difficulties Questionnaire' for each participating child. The study revealed a significant relationship between behaviour and academic attainment; pro-social behaviour was positively correlated with reading and arithmetic, hyper-activity and conduct problems were negatively correlated. However there was no evidence to indicate that children with behaviour problems made less academic progress over a one year period relative to their peers.

De (1999) conducted a study to know the impact of concept on the achievement in Physical Sciences of the students. A sample of 794 students selected from the schools of twenty four Districts of West Bengal was administered self developed test of Concept in Physical Sciences. By using ANOVA and coefficient of correlation, the researcher reported that the achievement in Physical Sciences was found to have high positive correlation with scores on the test of concepts in Physical Sciences.

Chang and Mao (1999) examined the comparative efficiency of inquiry-group instruction and traditional teaching methods on junior high school students' achievement and attitude towards earth science in Taiwan. They used a non-equivalent control group quasi-experimental design involving 16 intact classes. The treatment group students
(n=319) received an inquiry-group instruction and the control group students (n=293) received a traditional approach. Data collection instruments included the Earth Science Achievement Test and the Attitude Towards Earth Science Inventory. By using MANCOVA, they suggested that the students who received inquiry-group instruction had significantly higher achievement scores than did the students who received traditional instruction. The students receiving inquiry-group instruction had more favourable attitude towards earth science than did the students receiving traditional instruction.

**Norwich (1999)** conducted a research to explore students' reasons for learning and behaving and for not learning and behaving in English, Mathematics and other subjects. A sample of 283 students selected from two London secondary schools was administered 'Why I Learn' inventory. The study revealed that the parent interjected reasons were the highest for learning and behaving while teachers interjected and intrinsic reasons were the lowest. Intrinsic reasons were highest for not learning and behaving.

**Sutton and Soderstrom (1999)** conducted a study to see the relationship between school demographic variables (white race, low income, attendance, mobility, class size, teacher experience and teacher salary) and school achievement. Data for the study were supplied by Illinois State Board of Education (ISBE). The investigators obtained the scores of all the students of grades III and X on the reading and Mathematics from the Illinois Goal Assessment Program (ISAP). By using bivariate correlations and stepwise multiple regression analysis, the investigators claimed that all of the independent variables (except...
high-school per-student expenditure) were significantly related to the achievement scores.

**Wright (1999)** conducted a research to know the effect of students' mobility on achievement. The participants in the study were third and fourth graders studying in the 33 elementary schools in a large urban district in the Midwest, USA. Among those students, 68% were ethnic minorities. The instruments used were Metropolitan Achievement Test for third graders and Kansas Reading Assessment and Kansas Maths Assessment for the fourth graders. By applying Stepwise Multiple Regression Analysis and ANOVA, the study revealed that the low achievement scores were associated more highly with internal mobility (students moving within the school district) than with external mobility (students moving into or out of the school district). However, mobility was confounded with family income and ethnic category membership.

**Suresh (2000)** conducted a study to examine the influence of computer Assisted Learning (CAL) on the achievement in Biotechnology and attitude towards science. A sample of 200 students of XI was divided equally into experimental and control groups. By using path analysis, the researcher reported that CAL strategy had a positive influence on the achievement in Bio-technology and attitude towards science.

**Helwig, Anderson and Tindal (2001)** conducted a study in which mathematical skill level, classroom behaviour and effort of 512 students were rated by 15 third-grade teachers and 14 fifth-grade teachers in six
Review of the Related Studies

public school districts in a western state of USA. Of those students, 464 completed Mathematics and reading achievement tests. Correlation and regression analyses showed that Mathematics and reading achievement scored together with student efforts were significant predictors of teachers rating of students' Mathematics achievement. The gender was not a significant contributor in either grade. Similar results were found when students were split by general or special education. The findings suggest that the teachers did not consider students' gender when rating the Mathematics skill level of their students.

Kumaran and Kamala (2001) conducted a study to know the variables affecting academic performance of successful and unsuccessful learners in science subjects. A sample of 319 students was selected randomly from six Higher Secondary Schools in Chennai city. By using the standardized tests and treating the data with t-test, the researchers reported that the successful learners in science subjects had better study habits, study involvement, science interest and scientific attitude than the unsuccessful learners. The gender, study habits, study involvement and scientific attitude were found to be better and significant discriminating variables of successful and unsuccessful learners in the science subjects.

Okpala, Okpala and Smith (2001) examined the influence of parental involvement, socio-economic status, and instructional supplies expenditures on Mathematics achievement of fourth grade students in North Carolina. Pearson Product Moment correlation and ordinary least square regression indicated that the instructional supplies expenditures per student and parental volunteer hours were not statistically
significant in exploring Mathematics test scores. Further, the results showed that the percentage of students in free/reduced-price lunch programs was related negatively to students’ academic performance in Mathematics. This finding supports the notion that economic circumstances are correlated with academic achievement.

**Pant, Autar and Kumari (2001)** studied the performance of students in science and Mathematics at the secondary stage examination of CBSE. The researcher reported that the performance of girls in comparison to that of boys had been better with respect to pass percentage in science but in Mathematics the situation is reversed. The performance of Government school students has been very poor in both the subjects in comparison to Novodya Vidyalaya, Kendriya Vidyalaya and private public schools. Moreover, the performance of the students of Government aided schools had shown consistent improvement in the three consecutive years in both the subjects.

**Razel (2001)** meta analyzed six studies containing data over one million students in elementary, intermediate and high school to examine the relationships between the amount of television viewing and educational achievement. For small amounts of viewing, achievement increased with viewing, but as viewing increased beyond a certain point, achievement decreased.

**Kasinath (2002)** conducted a study to determine the relative efficiency of the different Piagetian conservation abilities in predicting the academic achievement in science in relation to gender and place of living. A sample of 198 students (75, boys, 123 girls and 98 urban, 100
rural) studying in class VIII, selected from the seven schools was administered self constructed Piagetian Type Tests. The marks obtained by the students in their annual examination were taken as the measure of science achievement. The study revealed that the conservation of length, number, classification and solid were found to be significant predictors of academic achievement in science. 22.5% of the total variance in science achievement among the boys was shared by conservation of solid, length and classification. 35.5% of the total variance in science achievement among girls was shared by conservation of length, number, weight and classification.

Khan (2002) conducted a study on a sample of 200 girls to know the characteristics of high and low achieving girls in science subject at the higher secondary stage. By using the standardized tests, the researcher reported that the low achieving girls were found to have the characteristics as confident and suspicions, conservative, obstructive, poor achievement, lack of non-verbal intelligence, liveliness and creativity. The high achieving girls were characterized by nervousness, experimenting, venturesome, introversion, cooperative and seriousness.

Sharma and Sansanwal (2002) conducted a study to see the effectiveness of video based instructional strategies for teaching science on achievement in science of the students. A sample of 115 students of class XI was selected randomly from Kendriya Vidyalya and administered a self constructed science achievement test. By using ANOVA, the researcher concluded that the video viewing followed by lecture or discussion was found to be more effective instructional
strategy in terms of science achievement as compared to the video viewing only.

**Singh, Granville and Dika (2002)** studied the effects of motivation, attitude and academic engagement on achievement in Mathematics and science of 8th grade students. A sample of 3227 students selected from the National Education Longitudinal Study was administered a questionnaire. Using the LISREL 8 computer program, the study revealed that there was a positive effect of motivation, attitude and academic engagement (time) on Mathematics and science achievement. The strongest effects were those of academic time spent on homework.

**Vaughan (2002)** examined the effects of cooperative learning on the achievement in and attitude towards Mathematics of fifth grade students. The students participated in 12 weeks cooperative learning in Mathematics during the fall semester and completed California Achievement Test and Peterson’s Attitude Towards Mathematics Scale at four different intervals. The data were analyzed with one factor repeated measures ANOVA design. The findings suggested that there were positive gains in attitudes and achievement due to the treatment.

**Ahmad, Raheem and Hasan (2003)** conducted a study to see the independent and interactive effects of sex, socio-economic status and intelligence on attitude towards science of secondary school students. A sample of 286 students was administered Science Attitude Scale by Grewal, Socio-Economic Status Scale by Srivastava and General Intelligence Scale by Mohsin. By applying AxB and AxBxC Factorial
ANOVA followed by Scheffe technique, the study revealed that the males and females enjoy the same degree of attitude towards science. The students of higher SES show more positive attitude towards science than the middle and lower counterparts. The students who are from high and middle levels of intelligence enjoy significantly more favourable attitude towards science than the lower one. Moreover, the students of middle level of intelligence show significantly better attitude towards science than the lower one.

Gupta and Rawat (2003) conducted a research to examine the comparative effectiveness of Techno lab based science learning cycle for conceptual understanding and transfer and the traditional approach. A sample of 144 students from eight schools of Delhi was selected and equally divided into control and experimental groups. The tools used were self-made achievement test in science, students' construction sheets and interviews. By using t-test, the researchers reported that the proposed learning cycle enhances understanding and transfer. Moreover, the study shows that the greater percentage of students performs better through this approach in comparison to the traditional approach.

Riding, Grimley, Dahraei and Banner (2003) conducted a research to study the relationship between working memory, cognitive style and gender on learning behaviour and performance on a range of school subjects. The sample comprised 206 secondary school students and completed Information Processing Index and Cognitive Styles Analysis. Also, the attainment in the subjects was rated by their subject teachers. The researchers concluded that there was a significant
interaction between working memory capacity and cognitive style for learning behaviour. The study further revealed that females scored more in Music, Language, Art, History, English and Technology but less in Mathematics and Science than the males.

Vidyapati and Rao (2003) conducted a study to know the gender and socio-cultural differences in scientific attitude, scientific creativity and science achievement. The study was conducted on a sample of 55 students (34 boys, 21 girls) of class IX of Jawahar Novodya Vidyalya in Cuttack. The tools used were self-made Scientific Attitude Study (SAS), Scientific Creativity Test and Biographical Information Blank (BIB). The science achievement was measured from the scores obtained by the students in science at the terminal examination. The results of the study revealed that the students with higher creative abilities have good achievement in science. The girls were found to have significantly higher achievement in science. Moreover, there was no significant difference in science achievement with respect to socio-cultural context.

Guddadanaveri (2004) conducted a study to compare the achievement of students taught by direct instruction and conventional method of teaching. A sample of 131 students of IX standard was selected from a school in Dharwad. Sixty students were assigned in experimental group and 71 in control group. The researcher used a self made Summative Achievement Test in Science. By using ANCOVA, the researcher reported that the gain in achievement of experimental group is higher than the control group. The below average students of the experimental group benefited the most by the direct instruction.
Von (2005) conducted a study on science achievement in the social context. He found substantial gaps in the achievement of the respondents from different social groups.

The review of the related studies clearly indicates that there is still a gap of knowledge concerning the magnitude of relationship between certain cognitive and non-cognitive variables (as predictors of) and attitude towards science and science achievement. As such the present investigator has made a humble effort to identify these relationships in his research programme, “a study of certain cognitive and non-cognitive predictors of attitude towards science and science achievement among Muslim and Non-Muslim adolescents.”

The method and procedure in this regard is given in the next chapter.