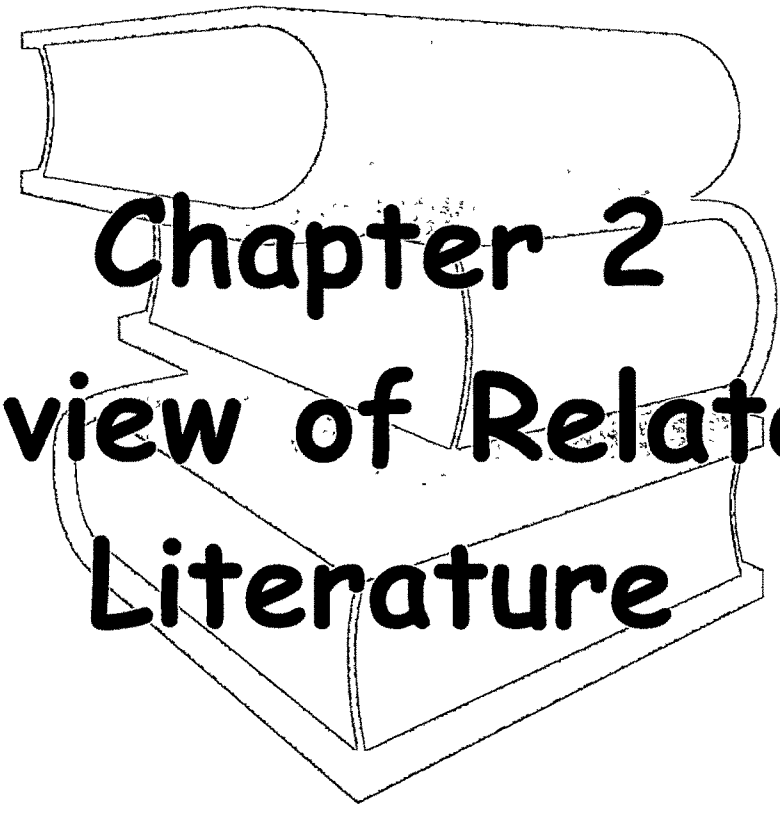


Chapter 2
Review of Related Literature

CHAPTER – II

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Review of related literature is one of the significant aspects of research. It enables the investigator to know the amount of research work carried out in the concerned area. It is necessary that the investigator is aware of the knowledge generated and on going process of knowledge generation for a better clarity of the problem and an insight into its methodological issues. For any investigator, review forms the basis for the problem under investigation and helps researcher to arrive at the proper perspective of the study.

This chapter is an attempt to give a brief sketch of the researches carried out in the field of mathematics education in India and abroad. The sources used were: Fourth Survey of Research in Education 1983-1988, Fifth Survey of Research in Education 1988-92, Dissertation, Abstract International, Indian Educational Abstracts, Thesis and Journals. The research scenario is given based on studies reported in Fourth and Fifth Survey of Research in Education. A brief analysis about the variables, levels, areas is also presented. The research gaps identified in Fourth and Fifth Survey is also mentioned. Significance of the present study has been presented. Indian and foreign studies are presented in separate sections.

2.2 INDIAN STUDIES

Major findings of studies from First Survey, Second Survey, Third Survey, Fourth Survey, Fifth Survey, Indian Educational Abstracts, Perspectives in Education, Experiments in Education, have been described in the lines to follow. They have been categorized as;

2.2.1 Achievement/ Learning in Mathematics

2.2.2 Correlates of Achievement

2.2.3 Diagnosis and Remediation

2.2.4 Attitude towards Mathematics

2.2.5 Programmes and Strategies in teaching of Mathematics

2.2.1 Achievement / Learning in Mathematics

Lalithama (1975) studied some factors affecting achievement of secondary school pupils in mathematics. The study was conducted on 732 pupils of standard nine selected on a stratified random basis. The tools used were a standardized achievement test in mathematics, a study habit inventory and Raven's standard progressive Matrices. Major findings of the study were:

i) Achievement in mathematics was positively related to intelligence, interest in mathematics, study habits, socio-economic status.

ii) Studying lessons daily, repetition in learning, influenced the achievement in mathematics positively.

Sharma (1978) studied achievement in mathematics of pupils of secondary schools with particular reference to the state of Assam. The sample included 1295 pupils from ten schools. The study was confined to the areas of arithmetic and algebra of school mathematics. A battery of sequential achievement tests were constructed for standard five to ten. The major factors found responsible for low achievement in mathematics were imparting of limited knowledge, blind use of rules, heavy syllabus, lack of natural urge, in sufficient drill at primary level and absence of methodical approach of classroom teaching.

Manika (1983) investigated the relationship between acquisition of concept in mathematics and some personal and environment variables of the pupils at primary school level in Bombay. The data was collected from 524 pupils from different schools of urban area from grade one to five. Tools used were Raven's coloured progressive matrices, mathematical concept test. The major findings were:

i) The majority of the pupils who were promoted to the next grade did not show acquisition of concepts of the lower grade.

ii) Pupils did not acquire any concept to the fullest form in one grade but the growth of concepts took place at all levels with different degrees of individual differences among the acquisition of mathematical concepts at primary school level.

iii) Concepts of higher mathematical hierarchy could not be developed unless lower concepts were acquired.

iv) For the better development and acquisition of mathematical concepts, individualized instruction was found useful.

Shah (1985) made a psychometric exploration to study relationship between achievement in arithmetic and three psychological factors viz. intelligence, problems faced by children, parent-child relationship, in few primary schools in Choryasi Block for first grade. The sample was selected through the purposive sampling technique. A total population of 897 children was included from twenty two primary schools of choryasi block. Data was collected using Arithmetic Achievement Test, Interview Schedule for the parents, student problem inventory, Individual Intelligence Test. The major findings were:

i) Inattentiveness of parents towards children.

ii) Schools had no special programmes for finding out academically backward children. None of the schools had schedule for remedial teaching.

iii) It was found some teachers were not qualified to teach arithmetic. Teachers had to teach all subjects and had not undergone any special training in teaching of mathematics.

Rajyaguru (1991) studied the achievement in mathematics, personal characteristics and environmental characteristics of over-achievers and underachievers. The sample of one thousand and ninety three was selected by stratified, proportionate sampling. The subjects were selected from six urban, six semi-urban and thirteen rural schools. The total number of overachievers was one hundred thirty three and underachievers was one hundred and fourteen. The tools used were Desai-Bhatt Group Test of Intelligence Bhavsar Numerical Aptitude Test, Mathematics Achievement Test developed by the researcher, Mathematics Anxiety Scale by Patel J. Z., Study Habit Inventory by Patel B.V., Mathematics Aptitude Scale by Desai, H. G., Interview Schedule and Rotter's Locus of Control Scale adopted by Bhogayata (in Gujarat). The findings of the study were:

There was positive and significant correlation between (a) intelligence and achievement in mathematics, (b) achievement in mathematics and numerical aptitude, (c) intelligence and numerical aptitude. Overachievers and underachievers did not differ in (a) intelligence, (b) numerical aptitude, (c) locus of control. Overachievers had (a) better study habits, (b) more positive attitude towards mathematics and (c) less mathematics anxiety. There was no association between achievement in mathematics and (a) sex, (b) birth order of the students, (c) income of father and (d) locality. Association was found between achievement in mathematics and (a) fathers' academic achievement and (b) their receiving external help or not.

Sashidharan (1992) investigated about learning intellectual skill as an educational outcome in relation to student entry characteristics and quality of instruction. The sample consisted of fifteen secondary schools of Palghat district. A total of 2432 students of standard ten were included as sample. The data was collected using the tools constructed by the researcher and also the tenth standard results of June, 1990. The major findings were.

i) The average academic achievement was less than pass mark. In the case of mathematics achievement results were still lower.

ii) Most of the students were not cognitively prepared to learn mathematics.

iii) The prevailing promotion policy gives opportunities to children to attend tenth class even through they cannot perform basic operations in mathematics. The initial deficiencies have a long-term damaging effect because the content of mathematics is organized in such a way is that learning in each class is dependent on prior learning.

Dandapani (1992) identified the process variables and the characteristics of mathematics teachers which contribute to the effective teaching of mathematics. The sample consisted of six hundred and eighty nine teachers of high schools and higher secondary schools of Tanjore district in Tamilnadu. The tools used to collect data were developed by the investigator included a Teacher's Perception Scale of Effective Teaching of Mathematics and Characteristics of Effective Mathematics Teachers Description form. It was found that female teachers had a significantly higher perception than the male teachers. Teacher's perception had been found to

vary with their years of experience. The perception of teachers did not differ because of their qualification, place of work, type of management, type of school and number of periods of teaching mathematics.

Srivastava (1992) studied the learning outcomes in terms of objectives in mathematics. The sample consisted of one thousand and thirty students selected by multi-stage random sampling technique. The tools used in the study were: an Achievement Test in Mathematics, the Socio-economic Status Scale by S.P. Kulshreshta and the Culture Free Test of Intelligence (Form A) by R.B. Cattell. Intelligence and socio-economic status both were such which contributed significantly and positively to the development of learning and skill. Male and female students of urban schools showed better gains in all types of learning outcomes in mathematics than their counterparts of rural areas. Male and female students belonging to high socio-economic status group were better in all the four types of learning outcomes in comparison to low socio-economic status group.

2.2.2 Correlates of Achievement

Pal (1989) attempted to find the affective outcomes of students as predictors of their mathematical ability. The sample consisted of six hundred students from rural and urban schools. The tools used were a test on Self-concept in Mathematics, a test of Attitude towards Mathematics, a test of Anxiety towards Mathematics and a questionnaire on Academic Motivation. It was found boys showed higher self-concept than girls. There existed significant correlation between self concept in mathematics and anxiety, between self concept in mathematics and attitude, between self concept in mathematics and academic motivation.

Baskaran (1991) studied the relationship among achievement motivation, attitude towards problem-solving and achievement in mathematics. The sample was selected by stratified sampling technique. Among the total of two hundred students, hundred were boys and hundred were girls. The researcher prepared a tool with three parts in it having Achievement Motivation Inventory Test as the first part, Attitude Scale as the second part, and Achievement Test in Mathematics for standard tenth as the

final part. There was a positive relationship between the attitude towards problem solving and achievement in mathematics. Urban and rural students did not differ in their (a) achievement motivation, (b) attitude towards mathematics. Urban and rural students differ significantly in their mathematics achievement in mathematics.

Ngailiankin (1991) attempted to identify variables associated with achievement in mathematics. The sample consisted of all class ten students studying in the Central School located in the states of Nagaland, Meghalaya, Manipur. The tools used were Achievement Test in Mathematics, Attitude Scale to measure attitude towards mathematics, Educational Aspiration Scale by Sharma and Gupta, occupational Aspiration Scale by Grewal, Differential Aptitude Test, and Cattell's 14 High School Personality Questionnaire. There was a significant association between Attitude toward mathematics, Educational aspiration, Numerical ability, Abstract reasoning and achievement in mathematics.

Setia (1992) addressed to the theoretical understanding of the achievement of learners at the senior secondary stage in modern mathematics in relation to socio-psychological and educational factors. The sample consisted of five hundred and ten senior secondary students and forty two teachers. The tools used were the Group Test of General Mental Ability by Tondon, the Socio-economic Status Scale by Trivedi and Udai Pareek, the Modern Mathematical Concept Test and Classroom Behaviour Questionnaire. The study found the intellectual level of rapid and average learners, SES of slow learners, personality traits of rapid average and slow learners and adjustment of rapid learners correlated significantly with their achievement in modern mathematics.

Rangappa (1992) investigated into the relationship between self-concept, reading ability and achievement in mathematics. The sample of thousand students of standard seven was selected by using stratified random sampling technique. The tools used were self-concept inventory developed by the researcher, a standardized reading test by Deve Gawda and Shivananda and Achievement Test in Mathematics. The major findings were:

i) There was no significant difference in the achievement of students having different levels of self-concept.

ii) There was a significant difference in the performance of the students of rural and urban schools.

iii) There was a significant difference in the achievement of students having different levels of reading ability.

Gupta, Mukerjee, & Chatterji, (1993) attempted to identify the factors affecting the academic achievement of adolescents studying in Class X in the State of West Bengal. The sample of the study comprised 1,453 subjects who were selected by stratified sampling procedure from sixty four schools registered under West Bengal Board of Secondary Education from Class X. Raven's Standard Progressive Matrices (SPM), Achievement Motivation Test (AMT) of Prayag Mehta and Prolonged Deprivation Scale (PDS) of Tripathi and Misra were used as tools to collect data for the study. Out of the four groups, urban girls had the least deprived average followed by that urban boys. The most deprived group was the group of rural boys. The rural girls were more motivated for achievement than other three groups. Intelligence was found to be most closely positively related to academic achievement but not to achievement motivation. The prolonged deprivation had negative relation with academic achievement. It was observed that girls, both of rural and urban origin were more motivated than boys. Girls in general were found more serious than the boys, possessed self respect which generated achievement motivation.

Jain (1979) conducted a study of the significant correlates of high school failures in mathematics and English. The data was collected by the use of measuring devices English ability test, mathematics abillty test. Two group of students, successful and failures in both the subjects were isolated and selected. The major finding was that factors affecting learning mathematics were intelligence, abstract reasoning, numerical ability, mathematical background, knowledge of mathematical concepts, rules, and principles.

Thampuratty (1994) examined the interaction effects of creativity, attitude towards problem solving and social position on the achievement on mathematics of secondary school pupils. The study was conducted on a sample of seven hundred seventy school pupils. The tools used were the Test of Achievement in Mathematics by Sumangala and Thampuratty, a Comprehensive Test of Creativity for Secondary school pupils by Sumangala, Scale of Attitude. Towards problem solving by Pillai and Scale for Social Position by Sumangala and Thampuratty. The Major findings were:

i) Significant differences existed in the mean scores of achievement in mathematics between the three group pairs of creativity.

ii) Significant differences existed in the mean scored of achievement in mathematics between three group pairs of attitude towards problem solving.

iii) Positive, high and significant relation existed between attitude towards problem solving and achievement in mathematics.

Sumangala (1995) studied some psychological variables discriminating between high and low achievers in mathematics. The study was conducted on a stratified sample of 750 (362 boys and 388 girls) students of Standard IX drawn from twenty schools of five revenue districts of Kerala. Tools used included Test of Mathematics Aptitude by Sumangala and Malini, Scale of Attitude towards Mathematics by Sumangala and Sunny, Scale of Self-concept in Mathematics by Sumangala and Malini and Generalized Test of Achievement in Mathematics by Sumangala and Jayasree. Mathematics Aptitude and its components viz., Numerical Ability, Numerical Reasoning, Ability to use Symbols, Spatial Ability and Abstract Reasoning, Attitude towards Mathematics and Self-Concept in Mathematics discriminated significantly between high and low achievers in Mathematics. The relation among the independent variables, Mathematics, Aptitude and its components viz., Numerical Ability, Numerical Reasoning, Ability to use Symbols, Spatial Ability and Abstract Reasoning, Attitude towards Mathematics and Self-Concept in Mathematics with Achievement in mathematics were significant and positive.

Naga Lakshmi (1996) examined the construction of a problem-solving ability test in mathematics and also examined the problem-solving abilities of students of Class X in twin cities of Hyderabad. This study was conducted on one thousand students of Class X selected from Schools of twin cities in and around Hyderabad using normative survery method. Tools used to collect the data included problem-solving ability test in mathematics and a personal data blank. The major findings were:

i) There was a significant difference in the problem solving ability in mathematics of students of rural and urban areas in favour of the latter group.

ii) There was no difference between the performance of boys and girls regarding problem-solving ability in mathematics.

iii) The higher qualifications of the parents, the better was the performance of the students with reference to problem-solving ability in mathematics.

iv) The school climate influenced the performance of the students.

Verma (1996) explored the main and interaction effects of intellectual ability and test of anxiety on achievement in four school courses viz., English, mathematics, general science and social studies. The sample of the study comprised 500 students of Class X in ten government secondary schools of Delhi. Subjects were selected by cluster sampling technique. The tools used were the Group General Mental Ability (Hindi) by Jalota and Test Anxiety Inventory (Hindi) by Sharma, Sub and Spielberger. Achievement marks were noted from official', records of the concerned schools. It was found that there were significant main effects of both intellectual ability and test anxiety on achievement of students in all the four school courses. However, interaction between the two variable was obtained in case of mathematics and general science only. In case of interaction, it was observed that in mathematics and general science, high intellectual ability students on the average performed worse under high test anxiety condition but there was no significant difference in academic performance of low intellectual ability students under high and low test anxiety conditions in each of the two above mentioned courses.

2.2.3 Diagnosis and Remediation

Lulla (1966) investigated the academic causes of backwardness in mathematics at the primary stage. A questionnaire was prepared and administered. The major findings were:

i) The syllabus was out-dated, lopsided, impractical, and for away from the realities.

ii) Some content in the syllabus was difficult to teach.

iii) Overcrowded classes, frequent transfer of teachers, irregularities of attendance contributed a lot to the low achievement of the pupils.

Das and Barua (1968) studied the effect of remedial teaching in arithmetic for grade four pupils of Assam. For the purpose of diagnosis of individual differences, F. J. Schnoll's Diagnostic Arithmetic Tests were adopted. Pretest-post test experimental control group design was followed. In each group there were thirty grade four pupils. The major finding of the study was that remedial teaching has definitely improved the achievements in arithmetic.

S.I.E. Guj. (1969) studied the basic arithmetic skills of computing addition, subtraction, multiplication and division by a diagnostic test. The sample for the study consisted of 131 pupils of standard five, 127 of standard six and eighty three of standard eight. A diagnostic test was prepared, consisting of addition, subtraction, multiplication and division of integers and fractions for pupils of standard five, six and seven and to provide remedial teaching in the light of mistakes. The major findings were:

i) When mistakes were diagnosed and remedied pupils progressed well in mathematics.

ii) Pupils did not know the entire process of addition, subtraction, multiplication and division

Ashar (1972) constructed and standardized a diagnostics test in basic algebraic skills for Gujarati medium pupils of secondary schools. The sample consisted of 268 students in all of eight, nine, ten grade, from five different schools. Norms in terms of standard scores, percentiles, stanines were established. Some of the findings were:

i) Pupils committed errors due to lack of systematic approach.

ii) The errors of conceptual type predominated the computational type.

iii) Trends of errors continued to a greater extent in the higher grades.

Bhirud (1975) constructed and standardized a diagnostic test in algebra. The main purpose of the study was to construct and standardize a diagnostic test related to some selected units of factorization of grade nine. The try out test was administered to 370 pupils. Final test consisted of fifty-four items. It was administered to 1,044 pupils. Remedial exercises has been developed and outlined. The study revealed that weakness about signs, coefficients and indices were some of the basic hindrances to understand and perform algebraic factorization.

Thakore (1980) constructed diagnostic tests and prepared remedial material as well as testing its effectiveness on fractions and decimals for the students of grade five of Gujarati Medium schools in greater Bombay. The major aim was construction of diagnostic tests followed by preparation of remedial material and testing its effectiveness. The major findings were:

i) The students of grade five did not have clear concept of fractions. Simplification was found to be a difficult process for them.

ii) Students did not understand the place values of respective figures in decimal fractions.

iii) Student did not understand addition, subtraction, multiplication and division of decimal fractions.

Bhattacharya (1982) conducted a study pertaining to diagnosis and prevention of learning disabilities of primary school students in arithmetic. A diagnostic tool in common fraction was administered to 450 students of grade five and 500 students of grade six in case of decimal fractions. The major findings were:

i) The experimental group had achieved significantly more than the control group, wherein the experimental group was taught by audio-visual materials.

ii) The experimental group showed better results and prolonged memory of the learned materials than the control group.

Rastogi (1983) attempted to diagnose weakness in arithmetic, related to basic arithmetic skills and their remedial measures of standard eight

students. The design of the study was experimental in nature. A diagnostic test in basic arithmetic skills was constructed and standardized. The final sample consisted of 406 students of grade eight from nine different schools of Arunachal Pradesh. The Major findings were:

i) One of the important causes of backwardness in mathematics was the poor command over basic arithmetic skills.

ii) When command over basic arithmetic skills improved, attitudes towards mathematics became favourable and achievement in mathematics increased.

iii) Basic arithmetic skills could very quickly and conveniently be mastered by course of self-help in basic arithmetic skills as developed during the study.

Bhardwaj (1987) standardized a comprehensive diagnostic test and prepared remedial material for middle school students of Haryana. Test was standardized on a sample of 1146 students. ***It was found that there was significant improvement in achievement of the students after they had gone through the remedial exercises.***

Jain & Burad (1988) studied the problem of low results in compulsory mathematics at the secondary level examination in the state of Rajasthan. The sample of the study comprised of rural and urban boys and girls of 100 government and private schools with lower results than those of the private students of Rajasthan. The tools used to collect data included questionnaires for subjects experts, for heads of the institutions, for subject teachers and for students. Non-availability of mathematics teachers due to late appointment and frequent transfers, lack of appropriate classrooms, blackboards and other physical facilities, irregular attendance of students, teachers habit of leaving the headquarters daily and lack of residential facilities in some difficult areas were the administrative causes. A low standard in the lower classes non-availability of text books, lack of timely correction of homework, an overburdened and uninteresting curriculum, lack of child-centred training, overcrowded classrooms, lack of sufficient periods for the subject, use of guidebooks by students, lack of proper supervision were the academic causes.

Chel (1990) attempted to diagnose and suggest remediation of underachievement in the compulsory mathematics of the madhymik examination in W. Bengal. The sample comprised from urban, semi-urban and rural students of Class VI to X of W. Bengal. The case study method was used in collecting the data. The major findings were:

1) The main difficulties faced by students included content gaps, confusion in understanding mathematics language, stereotype way of presenting contents and lack of openness in training.
2) The major mistakes found in the performances of students and teacher trainees in the area include interpretation of mathematics results and learning new topics in mathematics.
3) Underachievement was caused due to lack of understanding of mathematics concepts of the earlier stage and the abstract nature of the mathematics.

Sarala (1990) surveyed the conceptual errors of secondary school pupils in learning selected areas of mathematics. The sample comprised of eight hundred pupils from secondary schools in Trivandrum revenue district. The tools used were diagnostic tests in sets, trigonometry and in statistics, The Non-verbal test of Intelligence by Nafde, personal data sheet. The major findings were that the number of conceptual errors committed by secondary school pupils in the areas selected for the study was very high. Conceptual errors in mathematics were seen to be influenced by sex, locality of school, management of school, intelligence, study habits, socio-economic status and caste.

Kasat (1991) attempted to identify the causes of the large failures in mathematics at SSC examination marathi medium high school students in Palghar Taluka. The sample of the study comprised of 200 students of twenty five marathi medium high schools of Palghar Taluka between October 1988 and October 1989, who had failed in mathematics. Standardised tests of numerical ability and a self-made questionnaires for teachers were used to collect data. The major findings were:

i) Low intelligence, poor numerical ability, poor comprehensive and recall ability, no interest in mathematics and poor study habits were the causes of the large failures of boys and girls.

ii) Percentage, rational, algebraic expression, variation, probability and statistics were difficult topics in mathematics.

iii) The parents being illiterate could not help the children at home. There were no finances for audio – visual aids in the schools.

iv) The teacher found that the mathematical curriculum was not child centered. Topics such as percentage and shares were difficult in arithmetic circle, arc and area, were difficult to teach in geometry.

Kapur & Rosario (1992) conducted intervention strategies for students with problems in learning arithmetic. The sample consisted of twenty five students in the age group of eight to eleven years of class four, having significant problems in learning arithmetic. Tools used in the study were the Wesheler Intelligence Scale for children and a short form of arithmetic test based on Schonell Diagnostic Arithmetic Test. It was found that:

(i) Despite having average intellectual abilities and having regular classroom coaching, many students fail to perform well in arithmetic.

2.2.4 Attitude towards Mathematics

Rosaly (1992) attempted to find out whether high school students have a favourable attitude towards learning mathematics and whether their attitude affect their achievement in mathematics. The sample comprised of 200 students of standard tenth in eight high schools in Dindigul, Tamil Nadu. A Mathematics Attitude Scale and an Achievement Test in Mathematics were constructed and used. It was found that the attitude of high school students towards learning mathematics and their achievement in mathematics were related. Urban boys and girls had a more positive attitude towards mathematics than rural boys and girls.

Singh, Ahluwalia, Sudarshan & Verma (1994) attempted to study the attitude towards mathematics as a function of some individual characteristics like sex, age and intelligence. The sample comprised 220 students of Grade IX studying mathematics in different schools of Education Department of

Bhilai Steel Plant, Bhilai (Madhya Pradesh). Students were divided into, High Intelligence Group (HIG), Average Intelligence Group (AIG), Low Intelligence Group (LIG), male and female groups 13+, 14+ and 15+ year groups. The tools used were the General Intelligence Test developed and standardised by S.M. Mohsin and the Attitude towards Mathematics Scale standardised by Suydam, M.N. The students of high intelligence group had more favourable attitude towards mathematics compared to the students of both average and low intelligence groups. The students of average intelligence had a more favourable attitude towards mathematics than the students of low intelligence. The males did not have a more favourable attitude towards mathematics than females.

Wangu & Thomas (1995) assessed the attitude towards the achievement in mathematics among high school students of tribal town of Aizawl. The sample of the study comprised 300 students, covering both boys and girls, studying in Class IX of high schools of Aizwal. Students were selected on the basis of stratified random sampling technique. The tools used to collect the data included the Achievement Test in Mathematics for Class IX and the Attitude towards Mathematics Scale. It was found that there was a significant positive correlation between the scores of attitude towards and achievement in mathematics for the total sample as well as the sub-groups.

2.2.5 Programmes and Strategies in Teaching of Mathematics

Trivedi (1980) studied the use of branching variety of programmed learning materials in mathematics as a diagnostic and remedial tool. The sample of 80 students of class V, VI, VII, 40 male students and 40 female were divided into two groups randomly. One was control group and the other taught by the programmed learning technique. The tools used were the pre-test, the intelligence test, the programmed learning material in branching style and the post test. The major findings were:

i) The mean scores obtained by the conventional group students is higher than the mean scores obtained by the programmed learning group of standards V while for standards VI and VII the programme learning group achieved higher mean scores than the conventional group

ii) There was no significant difference between the mean scores of achievement of two methods

Chitkara (1985) studied the effectiveness of different strategies of Teaching on Achievement in mathematics. In the study a pre test / post test experimental design was followed. The strategies of teaching varied in three ways (a) lecture – discussion (b) inductive – drill and (c) auto – instruction group discussion. The variable of intelligence had three levels – low average, and above average. A sample of 300 students was randomly selected from grade IX students of four schools of Chandigarh. The students were divided into three groups of 100 each. One group was taught mathematics through lecture discussion the second group was taught mathematics through inductive – drill and the third group was taught mathematics through auto-instruction group discussion. The data collected through pre test/ post test were analysed through four ways (3x2 x 2x3) analysis of variance. The major findings were:

i) All the three strategies were found to be equally effective in terms of achievement in mathematics disregarding levels of intelligence sex and personality type.

ii) Lecture discussion strategy was found in favour of average ability students as they scored significantly higher than above – average and below average groups.

iii) Inductive – drill and auto instruction group discussion was more suited to the students having above average intelligence than average and below-average intelligence.

Kothari (1985) investigated the efficacy of different instructional media in to the teaching of mathematics to the pupils of class IX in relation to certain variables. The sample of 120 students was selected from two schools of Anand. The tools used were Junior Index of Motivation, Reasoning Ability and Criterion Tests.

i) The study disclosed under observation that pupils were very eager to know about the different instructional media. It was their demand that all the units of mathematics should be taught through visual projection.

ii) In case of instructional media namely Activities and experiment, pupils were very busy in drawing figures. They enjoyed studying through this media as it was activity oriented.

iii) Visual Projection is comparatively more effective than any other Instructional media like Activities and experiment or even programmed learning material for teaching of mathematics.

iv) The low achieving pupils are comparatively more benefited by programmed learning material than the high achievers and the average achieving pupils.

Shashikala Devi (1987) studied an analytical study of effective mathematics teaching. The study was conducted under two phases the first on the identification of effective mathematics teachers and the second analysing their teaching. The sample was 14 teachers, each teacher's 14 lessons were observed. Tools used were questionnaire for head masters, Questionnaire for teachers, bio–data sheet for teachers, Teacher's dairy, observation schedule, pro forma for the study of student's books, interview schedule for teachers. The major findings were:

i) It was found that explaining, eliciting through questioning, teacher's working out model problems, black board work, independent work by students, giving individual guidance, providing feedback and giving assignments were the important and most often used ingredients of effective teaching

ii) Findings of the study suggested for Teacher's training programme regarding the specific skills which are found to characterize effective mathematics Teaching, the black board work, giving graded drill problems. Making the students do independent work giving individual guidance and providing feed back.

Srivastava (1990) studied effectiveness of programmed learning as a function of anxiety under different motivational conditions. The sample comprised 257 students of urban schools and 286 students of rural school students in classes IX and X stratified random basis. The tools used DAT, Different Aptitude Test, Achievement test, Achievement Anxiety test. The major findings were:

i) The use of programmed learning as a teaching device was particularly helpful for low and average achievers.

ii) Knowledge of the result and praise by the teacher were good motivators. The third motivational condition – reward under competition.

Gangopadhyay (1991) attempted to investigate the relative effectiveness of teacher's class-room teaching techniques in relation to students' achievement. The sample of 100 students of class IX divided in to four groups. The 15 teaching units were planned in lessons of four types. The tools used included Test of intelligence, pre-test and post test for Achievement. Major finding were:

i) Technique T2 (lecturing and explanation) showed more effectiveness than T, (lecturing)

ii) Technique T3 (lecturing and explanation with questioning answering) showed move effectiveness than T2 (lecturing and explanation) and T1 (lecturing (at the post-test level.

iii) Technique T4 (lecturing and explanation with questioning answering by using feedback sequence) showed move effectiveness then T3, T2, and T1 at the post test level.

Singh (1992) compared the results of computer assisted instruction (CAI) with conventional method of instruction in teaching mathematics for certain selected units of the mathematical curriculum. The study was conducted in four higher secondary schools having facilities of three to five BBC micro computers. The students belonged to different socio-economic groups. Three units of the mathematics syllabus for class IX namely, simultaneous equations in algebra, statistical data and their graphical representation in statistics and triangles and their congruence in geometry were chosen for the study. The tools used in the study included rating scale by the researcher, Genus Intelligence Test the Attitude scale towards Mathematics and educational software. The statistical techniques used included mean, and 't' test for data analysis. The Major finding were:

i) The group taught through CAT in all the schools showed a substantial progress.

ii) The CAI method of teaching mathematics had proved to be move effective.

iii) Both boys and girls gained from the computer treatment.

iv) A significant favourable change in the attitude of the pupils of the experimental groups over the control groups was observed.

2.2.6. Summary for Indian Studies

From the studies in achievement in mathematics, it can be interpreted that achievement in mathematics is related to various factors like intelligence, study habits, attitude towards mathematics. Sharma (1978) found insufficient drill at primary and absence of methodical approach of classroom teaching while Manika (1983) concluded that unless lower concepts are developed higher mathematical concepts cannot be developed, as factors for low achievement in mathematics. Lack of acquisition of concepts of the lower grade was yet another factor found by Manika (1983). These conclusions lead to a fact that acquisition of concepts at the lower grade needs to be focussed. Shah (1985) found some psychological factors like inattentiveness of parents, lack of remedial teaching and teachers not qualified to teach arithmetic and lack of special training in teaching of mathematics.

Sasidharan (1992) found lack of prerequisites even in tenth standard students with regard to the basics in mathematics. Kapoor and Rosario (1992) found that despite having average intellectual abilities and having regular classroom teaching, many students fail to perform well in arithmetic. The study also reported that remedial education with varied instructional objectives can help pupils with problems in learning. Dandapani (1992) found that the female teachers had a significantly higher perception then the male teachers and the teacher's perception about effective teaching varied with experience. However, these findings showed the factors that are not usually considered with respect to achievement or learning in mathematics. Rajyaguru (1991) found that while overachievers and underachiever differed with respect to study habits, attitude towards mathematics are anxiety, did not differ due to sex, locality. Intelligence did play a role in achievement in mathematics. Hence, emphasis could be made on improving study habits,

attitude and lowering of anxiety rather than only changing text books and teaching methods. It was also found that concepts were sequenced logically rather than psychologically. These kind of studies at all levels would also help improving achievement in mathematics. It showed the haphazard manner in which curriculum is being developed. The studies on correlates of achievement brought out factors influencing achievement in mathematics. The achievement in mathematics was found to be related to attitude towards problem solving, Baskaran (1991), reading ability, location Rangappa (1992), prolonged deprivation Gupta et al (1993), self-concepts, mathematical aptitude Sumangala (1995). Hence, any effort to enhance mathematical achievement must also consider these factors. These differences cannot be ironed out nor neglected. Verma (1996) found high intellectual ability students did performed worse. Gupta et. al. (1993) found girls in general (rural and urban) were more serious and more motivated than boys. However, there was no difference in the problem solving ability between boys and girls. Nagalakshmi (1996) also found problem solving ability infavour of urban boys and girls. These findings revealed vital factors influencing achievement in mathematics. Rastogi (1983) found attitude towards mathematics related to achievement in mathematics. Wangu and Thomas (1995), Singh Ahluvalia, Sudarshan, Verma (1996) also found such relations. Singh Ahluwalia, Sudarshan and Verma (1996) found high intelligence group have more favourable attitude towards mathematics compared to average and low intelligence groups. Rosaly (1992) found urban boys and girls had more positive attitude towards mathematics.

Setia (1992) found separate factors correlated significantly to mathematics achievement i.e. intellectual level of rapid and average learners, personality traits of rapid, average and slow learners. Pal (1989) found relationship between self concept and mathematics. Rajyagura (1991), Sumangala (1995) and Thampuratty (1994) also found positive relation between attitude towards mathematics and mathematics achievement. Attitude towards mathematics found to be a deciding factor of mathematics achievement. Rastogi (1983) found when command over basic arithmetic skills improved attitudes towards mathematics became favourable and

achievement increased. About eighteen studies have been reported regarding diagnosis of mathematical backwardness. The various studies in this area have shown low achievement in mathematics due to poor command over basic Mathematical skills.

Rastogi (1983), Ashar (1972) found that pupils committed errors due to lack of systematic approach while Bhirud (1975) observed weakness in performing algebraic factorization due to weakness in understanding basics. It was found that when mistakes were diagnosed and remedied pupils progressed well in mathematics, S.I.E. Guj (1969), Rastogi (1983), Bhardwaj (1987) and Das and Barua (1968), Kapur and Rosario (1992) support this. Similarly Sarala (1990), Chel (1990), Jain and Bhurad, (1988) and Kasat (1991) also attempted to diagnose mathematical errors and high number of conceptual errors committed by secondary school students while Wagh (1991) found students of standard eight committed errors in fractional numbers and their operations. This could be compared to the study by Bhirud (1975). In the cross sectional study by Chel (1990) it was found that difficulties faced by students included content gaps, confusion in understanding mathematics language, stereo type way of presenting contents. Similar findings were of Manika (1983), S.I.E. Guj (1969), Sharma (1978). Jain and Burad (1988) found lack of infrastructure, non- availability of teachers, lack of child centred training, uninteresting curriculum as some of the factors responsible for low results in mathematics. A very similar finding was that of Lulla (1966).

2.3 FOREIGN STUDIES

The studies cited here are taken from Dissertation Abstracts International. The studies being of uniquely different categorization was difficult.

Tzeng Shwu-Rong (1987) studied the relationships among gender, attitudes towards mathematics, and mathematics attributions of sixth grade high, average, and low achievers in Taiwan, Republic of China. The intent of this study was to examine the role of certain affective and attributional factors on the mathematics performance of Chinese (Taiwanese) students. The

sample consisted of four hundred and thirty-two sixth grade students classified to three levels – high average and low. The Fennema-Sherman Mathematics Attitudes Scales and the Mathematics Attribution Scale were used to measure student's attitudes toward mathematics and attributions of success / failure in mathematics. The major findings were:

i) The higher the achievement, the more positive were attitudes towards mathematics;

ii) There were no significant differences between male and female students in attitudes toward mathematics, except for the females' less stereotyped perceptions of mathematics as a Male Domain;

iii) The higher the achievement, the more attributions of success were due to having ability, to effort, to easy interesting tasks, and to a too effective teachers or facilitative peer groups. The lower the achievement, the more were attributions of failure to not having ability, to task difficulty, and to lack of effective teachers or facilitative peer groups;

iv) In general, there were significant positive relationship among the variables under "attitude toward mathematics", among variables of attitude toward mathematics and variables of mathematics success attribution, and among the variables under "mathematics failure attribution." However, the relationships among variables of attitudes toward mathematics and variables of mathematics failure attribution were significant and negative.

Avile's A.P. (1989) studied the environmental and educational characterization of low-achievers' experiences and attitude towards mathematics performances using case studies. This study investigated the relationship of attitude towards mathematics performance to the familial and academic environment of eight students identified as mathematics low achievers admitted to Puerto Rico Junior College. In the development of the study, eight questions were addressed in relation to performance, kind of family life, quality of schooling received, and self-concept related to family and academic events. The study followed a naturalistic approach. The findings of the investigation revealed that many students are misclassified. Familial and academic environments are closely related to the development of attitudes

toward academic performance. When even one of these environments is improved, the level of achievement is improved.

Rose (1991) studied strategies and skills used by middle school students during the solving of non-routine mathematics problems. This study has identified the role of the teacher in mathematics learning and the need for non-routine mathematics problems as a regular part of school mathematics. Qualitative research methods were used to identify the cognitive and meta-cognitive skills and processes used in problem solving and to determine the affective influences on the problem solving processes. Six middle grade students were selected to participate in the study. Each student was interviewed four times. The transcriptions were analyzed using a constant comparative method. The major findings were:

i) Students are not aware of the various alternatives available to help them understand a non-routine mathematics problem when they first read it.

ii) The only skills which students perceive as mathematics skills are the basic computations of addition, subtraction, multiplication, and division.

iii) Students model the problem solving strategies and behaviours of their teacher.

Kalamaros (1991) tried to study instructional method and decreased student errors on mathematics worksheets. Teachers often express concern about student's poor performance on classroom mathematics worksheets. Performance deficits may be attributed in part to personal internal variables and/ or to external factors such as materials or instructional methods. The purpose of this study was to explore the effect that instructional methods have on student performance on mathematics worksheets. A multiple baseline single organism study was completed with eleven third grade subjects. The subjects were referred for participation by their classroom teacher based on the teacher's belief that the student had "difficulty following written directions." Teachers need to be aware of the potential relationship between reading ability and mathematics performance. When teachers are interested in determining students' skills in mathematics, the effects of reading must be taken into account. Teachers must evaluate the types of errors students made and take the time to show students explicitly how to correct those

errors. Without this effort, errors are likely to be repeated. Teachers should always consider the impact that attitudes and beliefs about mathematics ability have on student performance. Controlling for these influences increases the likelihood that students will demonstrate their true mathematics skills.

Karen (1998) studied student attitude toward mathematics projects. The purpose of this study was to examine if mathematics anxiety, learning preference, exposure to projects, the teacher, gender, and ethnicity are related to student attitude toward projects. This study tested seventeen hypotheses and both qualitative and quantitative methods were employed. The 304 students in the study completed an attitude survey, a mathematics anxiety survey, and a learning style inventory. Students had a positive attitude toward projects and were willing to take another project class and enjoyed working groups. Students also disliked many things, including: negative group experiences, the extent of writing, the amount of work involved, and a desire for more time when working on a project. Students also stated that their attitudes toward projects were also affected by the teacher, the group, and the content of the project.

Greg (1998) studied attitudes toward mathematics and knowledge of mathematical concepts of preservice elementary, early childhood, and special education teachers. The advent of the National Council of Teachers of Mathematics (NCTM) Professional Teaching Standard requires that teachers of mathematics be competent, value mathematics, and stress the importance of solving real-world problems in teaching mathematics to successfully prepare students for the technological world of the twenty-first century. Studies have shown that teachers of elementary mathematics tend to suffer math anxiety and are weak in mathematics content skills. Because of the tendency, the preparation of preserve elementary teachers needs to address the level of mathematics anxiety and the achievement of appropriate content knowledge and work toward developing a more positive attitude in mathematics and increase the achievement in mathematics content. This paper addresses the attitudes toward mathematics and achievement in math content knowledge of pre–service elementary, early childhood, and special

education teachers and the changes through standards espoused methods in pre–service mathematics content courses are used. Students enrolled in required mathematics courses for elementary education were given an attitude instrument in fall 1997 at the beginning and end of the semester to determine their self-efficacy in mathematics, their feelings about problem solving, and how they value mathematics. Fifteen students were interviewed to determine their attitudes toward mathematics and when these attitudes were developed a achievement test based on the Third International Mathematics and Science Study (TIMMS) Population Two items was administered in spring 1998. Results of the attitude test showed that students tend to improve their attitudes toward mathematics when taught by instructors who model appropriate strategies. Results of the achievement test indicate that students are weak in mathematical content.

Timmel (1999) studied the factors impacting the achievement and participation of high school girls in mathematics. The purpose of this study was to compare the factors of teacher, impact, student self-esteem, school culture/ organization, and parental support on the participation and achievement of high school girls in higher mathematics courses in two suburban Westchester, New York, high schools. Factor analysis of the data did not lend support to the possibility that males and females differ in the cognitive level of their mathematics achievement. Data analysis confirmed the importance of parental encouragement, self-esteem, and mentoring and encouragement of a teacher as significant factors in girls, mathematical success and continuance to study mathematics. Neither all factors nor all dimensions studied were significant predictors of achievement and participation of girls in mathematics. Recommendations included further use of classroom processes that promote gender equity, increase student self-esteem, and in turn mathematics achievement. Also recommended was further research in a low socio economic environment, in a single-sex classroom, in a male-dominated school culture/organization, in elementary and middle school, and finally, in other subject areas.

Smith (1999) analysed the role of language and representations in children's mathematical reasoning. The central goal of the study was to

understand the processes and tools of children's mathematical reasoning. The role of various factors while doing mathematics was considered (i) child's view of self, (ii) the use (formal and informal) of language, (iii) the context in which the mathematics was situated, and (iv) different forms of self-monitoring.

This study found that the students' attitudes toward themselves and their beliefs about the nature of the discipline largely shape their use of the contexts of the problems, affecting their engagement with the mathematical issues entailed. By probing their understanding and then designing tasks that draw children near the boundaries of their understanding, the protocols made their decision-making and tools, as well as their language and representations, visible.

Ridlon (1999) studied the effect of problem centred learning on the mathematics of sixth graders. This study described the effects of a problem centred approach to mathematics on the attitudes, actions, and achievement of sixth grade students at a middle school in the south-east. Two groups of sixth graders were randomly selected to participate in a nine-week study. Data sources included a pre-test and post-test, student and parent surveys, student writings, and observations by the researcher and regular teacher who were both present at all times. Additional data were collected from the experimental group through interviews of students and their parents, student journals, and student work. A quantitative and qualitative analysis of all the results showed that Problem Centred Learning was indeed effective in the opinion of the involved stakeholders. Students came to view mathematics in a more positive light, enjoyed the class, and felt they had learned more than usual. Students believed attitude and achievement were measurably increased. The test scores gave strong evidence to support these convictions because the problem centerd had a highly significant increase in achievement compared to the traditional curriculum. Thus, Problem Centred Learning appeared promising and worth further investigation.

Dupree (1999) studied mathematical empowerment: A case study of relational classroom learning. This is a study of the relationships that developed among the students in a small class of Mathematics for Critical

Thinking. Students worked together to establish the socio–mathematical norms that would enhance the development of mathematical power within the students and promote the evolution of problem-solving skills. The findings indicated that the relationships within the classroom enhanced the development of viable relationships with mathematics. There were also indications that the fact that the students were all females may have contributed to the workable relationships with mathematics. There are strong implications that mathematics can be made more accessible to more students by restructuring the mathematics curricula to accommodate the different ways that students approach the construction of their mathematical knowledge. Findings call for college and university mathematics departments to re-examine the traditional lecture method for disseminating mathematics to large numbers of students in a lecture hall and consider more opportunities for students to engage in mathematics at a personal level. This could revolutionize mathematics education in ways that would empower all students.

Sjostrom (2000) studied the beliefs and practices of teachers regarding the high failure rate in Algebra I. The sample consisted of four algebra teachers in a high school with a diverse student population. The study was a qualitative case study and tools used were seen structure interviews and classroom observation. It was found that there were strong connection between the beliefs of the teachers regarding the nature of mathematics, their attributions for student failure in algebra, their self-efficacy, and the modifications they made in instructional practices.

Warrick (2000) conducted an intervention program for parental assistance with mathematical homework and the relationship with increased student achievement. The sample consisted of children of thirty parents in the experimental group and thirty five children of parents in the control group. The experimental group scored significantly higher than the control group in all section of the ITBS (Iowa Test of Basic Skills) and in addition completed more homework than the control group. These findings suggest that training parents to help their children with mathematics homework leads to ignored student achievement.

Duncan (2000) studied the relationship between math preparation in high school and mathematics skills of college entering students. The sample consisted of college extras. The study found that most students in remedial mathematics were exposed to the mathematics content in high school but they never learn the material sufficiently enough to acquire math skills for college. The researcher concluded that increasing the mathematics requirements in high school does not ensure students that they will have sufficient mathematics skills necessary to readily enter college.

Siebert (2000) studied the coherent, dynamic accounts of prospective secondary mathematics teachers' knowledge of and beliefs about mathematics. This thesis presented accounts of the mathematical knowledge and beliefs of eight prospective secondary mathematics teachers (PSTs) as they progressed through a six-week unit on division of fractions that was designed to bring about change in their knowledge and beliefs about mathematics. This study used qualitative methods, including grounded theory, teaching experiment methodology, and case studies to investigate PSTs' knowledge of and beliefs about mathematics as they participated in the division of fractions unit. Through a series of mathematical explorations, the PSTs were also developed new understanding for division of fractions. Students began to view mathematics as a collection of rules and procedures that were supported by underlying concepts. Nevertheless, they continued to see rules and procedures as the major landmarks in the mathematical landscape, which in turn limited the mathematical understandings they were able to develop during the unit.

Dominguez (2001) studied about the college algebra students' understanding of the concept of variable. The sample was made up of thirteen students enrolled in a college algebra course. Think aloud procedure in class observation and analysis of the text book were used. The study found students' level of confidence in approaching standard algebra problems was higher for familiar type of problem than for non-familiar type of.

2.3.1 Summary for Foreign Studies

The foreign studies have used qualitative methods focussing on attitude towards mathematics, hurdles in learning of mathematics, students beliefs, and similar such areas.

Studies on achievement by **Smith (1999), Ridlon (1999), Dupree (1999), Rose (1991)** found certain elements in the teaching learning of mathematics. They were: student's attitude towards themselves, student's decisions, their language and representations, student's beliefs, student's construction of mathematical knowledge. From the focus of these studies, it was possible to gauge the importance given to student and mathematical relationship. **Rose (1991)** demonstrated the need for teacher to concentrate on fostering student's self-esteem and positive attitudes towards problem solving. Non-routine problems should become a regular part to school mathematics. **Kalamaros (1991)** insisted on teacher to be aware of the potential relationship between reading ability and mathematics performance, also the impact of beliefs about mathematics ability on student performance. **Smith (1999)** elicited the reasoning of children as they do mathematics, and designed tasks to know their language, decision-making tools. These studies bring one nearer to the understanding of student's thinking and learning. **Ridlon (1999)** addressed to the decisions made by children during middle school affecting their attitude and ability to do mathematics for the rest of their lives. Problem centered learning changed their view about mathematics in a more positive light, enjoyed the class and felt they had learned more than usual. It was found that the notations students invented helped them keep track of their ideas and organize their data. This study indicated need for liberating the students from traditional, stereo-type teaching learning situations. **Kalamaros (1991)** emphasized need for teachers to evaluate types of errors and show how to correct them or else errors were likely to be repeated. **Tzeng, Shwu-Rong (1987)** found higher the achievement, the more attributions of success were due to having ability to effort, to interesting tasks and to effective teachers. Hence, there was a felt need for continuous monitoring of student errors to enhance mathematics performance and ensure higher performance leadings to positive attitude. **Karen (1988)** found

students had positive attitude towards mathematics projects. **Avile's (1989)** found that familial and academic environment were closely related to development of attitudes towards academic performance. Hence curriculum planning and school environment, contributed towards attitude formation. **Greg (1998)** found that students tend to improve their attitudes towards mathematics when taught by instructors who model appropriate strategies. **Siebert (2000)** found that prospective secondary teacher had only limited conceptual understanding. Teacher's attitude, beliefs, conceptual understanding, influenced student's attitude towards mathematics. **Sjostrom (2000)** addresses the high failure rate in Algebra I in relation to teachers' beliefs. The study recommended teachers must go beyond their student related alternation to design an effective instructional program, teacher educators need to teach content in connection with reformed pedagogy and challenging teachers' beliefs about mathematics, educational administrators must clearly define what students are expected to do and provide teachers with the necessary training provide a supportive environment which include manageable class sizes. Another unique study was of Warrick (2000) also examined the difference in academic achievement between one group from parents enrolled training program and a groups who received, no such assistance. The findings suggested that training parents to help their children with mathematics homework leads to improved student achievement. This study focused on an area hardly considered in relation to student achievement in mathematics. Homework being an essential ingredient in school program, this study suggested that other than changing teaching methods, providing remedial teaching and such similar efforts, now efforts could be made to train parents, to enhance student achievement in mathematics. Studies by Warrick (2000), Sjostorm (2000), Dominguez (2001) and Duncan (2000) have brought new dimensions, new areas in mathematics education research. Such studies would contribute constructively towards finding solutions to the epidemic of mathematical backwardness.

2.4 RESEARCH SCENARIO

The Fourth Survey of Research in Education gives a comprehensive report about research in mathematics education. Though mathematics occupies an important place, the researches in the area have been scanty. The momentum in mathematics education picked up only in 1970 – 1980. Fourth Survey has included studies of third Survey also. Research in mathematics education has been given as a separate area of research in the Fourth Survey. There are about sixty eight studies cited under mathematics education in Fourth survey. Below is given a brief analysis of the research studies cited in Fourth and Fifth Survey

2.4.1 Brief Analysis of Fourth Survey of Research in Education

The Fourth Survey reported about the studies from 1970 to 1988 in the field of Mathematics Education. It reported about sixty – eight studies, in four different categories: [a] Teaching and teacher behaviour – twenty – two studies. [b] Curriculùm and text – books – thirteen studies, [c] Factors affecting mathematics achievement – twenty studies, [d] Diagnostic and other tests in mathematics – nine. Table 3 shows the decade wise growth of Research in Mathematics Education.

Table – 3:

Decade Wise Growth of Research in Mathematics Education

Decade	Ph. D. Thesis in		Research Projects	Total
	Education	Other Subjects		
1941-50	1	0	0	1
1951-60	0	0	0	0
1961-70	2	0	5	7
1971-80	21	0	10	31
1981-88	28	0	1	29
Total	**52**	**0**	**16**	**68**

The survey has pointed out the large number of students failing in mathematics, according to NCERT analysis. The research gaps identified are (i) research based development curriculum, (ii) studies in the area of diagnostic testing, (iii) developing a major intervention programme to streamline mathematics education, (iv) designing more effective programmes

for preparing teachers of mathematics, (v) experimenting on models of teaching, (vi) text–book analysis to find out their relevance to objectives, content, methodology, feedback, (vii) standardizing tests, and (viii) investigate into how the attitude towards mathematics is formed.

Majority of the studies have been devoted to teaching and teacher behaviour and factors affecting mathematics achievement. The research scenario of mathematics education is not very different from other subjects in terms of the boom of research activity period i.e. 1970 onwards. However, mathematics, having higher utilitarian value, more research is expected in this area. The number of research projects also showed a slump in the 1980s. State Boards, NCERT, SCERTs have taken up projects to identify causes of low achievement and high rate of failure in mathematics, also poor knowledge of basics of mathematics at various levels.

The research studies spread over a wide range of teaching methods, it was found that all teaching methods did not suit all learning styles. Programmed instruction was found to be effective than traditional teaching. However, it was also dependent on urban and rural setting. Studies on Ausubel's advanced organizer and Bruner's concept attainment model found models to be superior to traditional methods. Mastery learning strategy was also found superior to traditional method as it enhanced mathematics achievement, attitude towards mathematics, and improved self-concept.

All these studies on teaching have shown the superiority and effectiveness of various methods. Teachers need to choose the methods rather than use same methods for all topics.

The survey has noted the dearth of studies on teacher preparation. Studies on developing instructional competence in mathematics teachers through micro-teaching technique would be beneficial. Studies also cite reluctance on the part of the teachers to take up non-conventional methods.

Factors affecting mathematics achievement were found to be both cognitive and affective. Variables like SES, intelligence, language mastery, attitude towards mathematics, numerical reasoning, numerical ability, were found to have significant effect on mathematics achievement. Causes of under and low achievement in mathematics vary from defective text-books,

blind use of rules, insufficient drill work, absence of methodical approach, lack of motivation. Studies conducted on the mathematically gifted found having high intelligence numerical ability, abstract reasoning. The factors have been abundantly identified. Studies on how these factors can be taken care of to enhance achievement in mathematics are urgently needed.

The studies on curriculum were very few. There were studies comparing mathematics curriculum of India and other countries, utility of mathematics content in professional courses, objectives of mathematics, teaching and relevance of modern mathematics in developing students' abilities. Only five Indian States had conducted research in the area of text-book and syllabus. One of the studies developed criteria for writing and evaluating text-books in mathematics. Other studies found teachers not using new teaching methods given in the text-book while still other studies found lack of relationship between course-content in the syllabus and the text-book. There seems to be an urgent need to look into the content, presentation and use of methods in teaching of mathematics. Research to examine relevance of mathematics course-content is also of utmost need. The various state boards could take up text-book analysis and finding the relevance of mathematics course-content vis-à-vis various professional courses.

Out of the nine studies in the area of diagnostic and other tests, only four studies were on construction of diagnostic tests and remediation. All of them found remedial measures were effective. Few studies were on developing attitude scale to measure attitude towards mathematics, constructing tests in mathematical creativity were.

The survey observed that there is a dearth of researches in developing and standardizing tests. Also, studies on how attitude is formed towards mathematics was essential. The survey had identified major issues before teacher educators in mathematics such as in-depth study of the mathematics curriculum, curricular renewal, refining teaching methods in mathematics with regard to advances in pedagogy and educational technology.

2.4.2 Brief Analysis of Fifth Survey of Research in Education

The fifth Survey reported about the studies from 1988 to 1992. A total of forty – seven studies have been reported. The categories were: [a] High failure in mathematics – three studies, [b] Improvement of learning and teaching of mathematics – twenty six studies, [c] Improvement of teaching and learning of geometry – seven studies, [d] Evaluation of curriculum – three studies.

The survey has cited seven studies dealing with the areas of high rate of failure in mathematics, errors committed, diagnosis and remediation in geometry. The number of studies in mathematics education is not very impressive and more so in diagnosis and remediation, underachievement, attitude towards mathematics. Fifth Survey also identified twenty three research gaps. The research gaps identified in the Forth Survey have not been satisfactorily addressed in studies cited in Fifth Survey. Looking at the gravity of the problems of failures in mathematics, under achievement in mathematics, at different levels and particularly at secondary level, the number of studies is less. Out of the twenty six studies in improvement of learning and teaching of mathematics, two studies were on attitude towards mathematics and two on errors committed by students in mathematics.

It was surprising to find an area on improvement in learning and teaching of geometry. The survey itself has commented about the difficulty found in algebra than in geometry. The inclusion of new area of high failure rate in mathematics, itself showed the alarming situation. The survey has given another new area of research, as identified by the Fourth Survey as research gap i.e., Evaluation of Curriculum, even though number of studies are few. Another area identified is attitude towards mathematics. This has been found to be a determining factor in mathematics achievement. Total number of researches amounting to fourty seven included – twenty nine Thesis, nine M. Phil Dissertations, five Research Reports and four Research Articles. This is an encouraging indicator when compared to the research situation till 1988. In order to combat problems like high failure rate, wide spread low achievement in mathematics, there needs to be more of research projects than individual researches.

The survey has cited studies pertaining to correlates of achievement in Mathematics. A few of them have been cited in the present study. It is essential though, to have studies pertaining to relevance of mathematics curriculum vis–a–vis professional, academic courses. The very existence of high rate of failures, large number of errors should pose the urgency to investigate the evaluation methods and teaching methods.

The analysis clearly revealed the kind of researches reported in the Fifth Survey. It showed that researches were carried out in some parts of the country and in certain areas of mathematics only. It has not seen that the research gaps identified by the Fourth Survey had been taken care of. Very few studies had been carried out in the area of teacher education, diagnosis and remediation. No studies were on text – book analysis. Study of Srivastava [1992] about learning outcome in terms of objectives of mathematics, has given basis for curriculum framers. Study of Sarangpani [1990] had posed questions about the suitability of the level of the learner and the tasks and objectives, while the number of researches cited under correlates of achievement have increased, the number for diagnosis and remediation was low.

Fifth Survey pointed out that even though the number of research studies have increased, considering the large number of problems, the number is not impressive.

2.4.3 Research Gaps

Research is being conducted in mathematics education since 1943. Much has been achieved. Looking at the researches being conducted and still many areas remaining untouched, there is a need to point out research gaps.

The following areas were identified by the investigator as research gaps in Mathematics education.

i) **Curriculum Framing:** More of research should be conducted to find out inclusion of practicum in the theory and to know its relevance with respect of school education.

ii) **Technology and Pedagogy:** To find out role of technology and pedagogy in enhancing achievement in mathematics, research should be conducted.

iii) **Evaluation:** Through research, role of continuous assessment to encourage thinking and reasoning ability of the students can be found out.

iv) **Text Books:** Text–book research should be conducted to develop catering the needs of common citizen so that irrelevant and out dated topics, can be exempted where as appropriate logical and psychological sequence should be followed in the textbooks. Self–explanatory and user friendly approach should be the criteria for writing a text–book.

v) **Diagnosis and Remediation:** Research for construction of diagnostic tests for various topics and various levels are to be conducted.

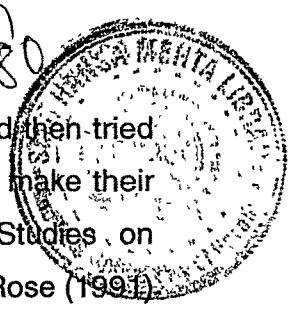
vi) **Attitude towards Mathematics:** Through research attitude of teachers towards mathematics, attitude of students towards mathematics and causes, effect of teacher's attitude towards mathematics as student's achievement should be found out.

vii) **Application of Mathematics:** Research for various topics for application of mathematics such as projects to find mathematics in daily life and use of school mathematics in daily life, industry, other sectors, role of mathematics in advancement of mankind, mathematics in different cultures should be further conducted.

viii) **Teaching of Mathematics:** Different research can be conducted to find out innovative methods of teaching by using technology, students constructing their own knowledge, using inputs from culture and context.

2.5 SIGNIFICANCE OF THE PRESENT STUDY

Having reviewed studies in mathematical Education, new areas of research emerged. Sharma (1978) pointed out blind use of rules. Bhirud (1975) found weaknesses in signs, coefficients indices in grade nine. Studies by Rajyaguru (1991), Rosaly (1992), Thampuratty (1994), Sumangala (1995), Wangu and Thomas (1995) found attitude towards mathematics as a deciding factor of mathematics achievement. Hence in the present study the



investigator first tested prerequisite knowledge of the students and then tried to remove weaknesses through remedial programme and tried to make their attitude positive towards mathematics through counselling. Studies on achievement by Smith (1999), Ridlon (1999), Dupree (1999) and Rose (1991) found certain elements in the teaching-learning of mathematics such as students' attitude towards themselves, students' decisions, their language and representations, students' beliefs, students' construction of mathematical knowledge.

The findings of the these studies, provided sufficient ground for the investigator for development of a Programme for enhancing Achievement of the students of class X in Mathematics. The investigator has especially planned out the teaching learning process in which first prerequisite test for each chapter was conducted, remedial measures were provided to improve their prerequisite knowledge, then unit of class X was taught, unit test was held, remedial teaching was provided as and when needed, correlates to achievement were provided through group and individual counselling and attempts were made to enhance achievement.

Teacher evaluated answer-books of different prerequisite as well as unit tests and error analysis was carried out, then causes of errors were located and proper instructions were given to overcome these types of errors. The teacher encouraged their confidence by giving sufficient homework and class practice. As Kalamaros (1991) emphasized need for teachers to evaluate types of errors and show how to correct them or else errors were likely to be repeated. Tzeng, Shwu-Rong (1987) found the higher the achievement, the more attributions of success were due to – having ability to effort rather than to interesting tasks and to effective teachers. Attitude of the students towards the subject Mathematics is very important if the students have positive attitude then one can learn the subject with interest and achieve good result. Tzeng, Shwu-Rong (1987) found Higher Achievement Related to Positive Attitude towards Mathematics. So the investigator provided counselling to make their negative attitude positive towards Mathematics. For that technique of self–talk and auto–suggestions were provided.

In this study the investigator explained to the students about time management, stress management, importance of handwriting and how to improve it, concentration technique, skill of paper writing, etc to enhance their achievement in mathematics. In short, in this study the investigator tried out to enhance the achievement of the student of class X in Mathematics through well planned teaching learning process as well as by providing correlates to achievement through individual and group counselling.

This enhancing achievement programme will provide a path to teachers, students as well as parents to lead one's child to enhance their achievement in mathematics for e.g. this study will provide understanding for causes of low achievement to the teacher so that the teacher will try to minimize such causes and will be able to give the proper guidance and counselling and can also provide better teaching learning methods so that the students can enhance their achievement. This study will be helpful to the parents to understand one's child and provide them proper guideline and counselling to work hard in the subject mathematics. The parents will also come to know the reason of low achievement and will be able to give proper learning help to enhance the achievement. This programme will be helpful to the students because the students will understand the causes of low achievement and will adjust the teaching learning procedure accordingly. Students will also understand correlates of achievement to enhance one's interest and confidence in mathematics.

This study will provide how to teach any chapter in any class through seven steps teaching programme for better understanding. If any teacher or parent teaches using seven steps teaching programme, the achievement of the student will enhance.