CHAPTER: 2

REVIEW OF RELATED LITERATURE

2.0. INTRODUCTION

This chapter is an attempt to give a brief sketch of the researches done in the field of Mathematics education in India and abroad. The studies have been taken from 1966 to 2014. The sources were second survey of research in education, third survey of research in education,fourth survey of research in education,fifth survey of educational research, sixth survey of research in education, dissertation abstract etc. A brief analysis about the variables, levels, area is also given. Indian and foreign studies are given separately.

2.1. Studies Conducted In India In Mathematics

Many studies have been conducted in the field of mathematics education, investigator has tried to review most pertinent studies related to the present study. These studies have been categorised as diagnosis and remediation programme in Mathematics, achievement and learning in Mathematics and factor affecting achievement in Mathematics. Some of the studies are as below:

2.1.1. Studies Conducted On Diagnosis and Remediation Programme in Mathematics

Das and Barua (1968) found effect of remedial teaching in arithmetic for standard IV. For the purpose of diagnosis of individual differences F.J.Schonell's Diagnostic Arithmetic Test were adopted. Pre-test post-test experimental control group design was followed. In each group there were 30 grade IV pupils. The major conclusion of the study was that remedial teaching and definitely improved significantly the achievements in arithmetic.

S.I.E.Guj. (1969) studied the basic arithmetic skills of computing addition, subtraction, multiplication and a division by a diagnostic test. The sample of the study consisted of 131 pupils of standard five, 127 of standard six and 83 of standard eight. A diagnostic test was prepared, consisting of addition, subtraction, multiplication and division of integers and fraction for pupils for standard five, six and seven and to provide remedial teaching in the light of mistakes. It was found that: (i) when

mistakes were diagnosed remedied pupils progressed well in mathematics, (ii) pupils did not know the entire process of addition, subtraction, multiplication and addition.

Ashar (1972) constructed and standardized a diagnostic 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.

Gupta (1972) studied backwardness in Mathematic skill. The purpose was to provide a standardized tool to the teachers and researchers to be able to diagnose the weak areas in Mathematics. The pre-treatment tests were administered to 294 boys and 265 girls of grade eight out of which 180 boys and 176 girls were selected for final study. Diagnostic test in basic arithmetic was constructed to measure command over basic skills. The achievement in Mathematics was measured by the Mathematics Achievement Survey test prepared by NCERT.

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 exercise has been developed and out lined. 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 preparing remedial material as well as testing its effectiveness on fractions and decimal fractions for the students of grade V of Gujarati medium school in greater Bombay. The tests and the remedial material prepared by the investigator. Ten diagnostic tests were prepared. Tests were administered to the students of 11 schools of Bombay. The major findings were that the students of class V did not have clear concept of fractions. They did not understand the place value of respective figures in decimal fractions. They did not understand addition, subtraction, multiplication and division of decimal fractions.

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 material in branching style and the post- test. The major findings were: 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 standard VI and VII the programme learning group achieved higher mean scores than the conventional group. There was no significant difference between the mean scores of achievement of two methods.

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 in 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. The tools used for data collection were a test of basic skill in mathematics, attitude scale and a diagnostic test which constructed by researcher. The final sample included 406 class VIII students of nine different schools, one from each district from ArunachalPradesh. The major findings were, one of the important causes of backwardness in mathematics was the poor command over basic arithmetic skills. Attitude was closely linked with achievement. When command over basic arithmetic skills improved attitude towards mathematics become more favourable and achievement in mathematics increased.

Bhattacharya (1986) has investigated the learning disabilities developed by secondary school students in the area of equation- sums in Algebra. Major findings of the study were, Students develop more learning disabilities in the understanding of linear equation sums in one unknown than in the knowledge of solving such sums and application of linear equation sums in one unknown than in the knowledge of solving such sums. He was found the simplified method is more effective than the method of transposition for the development of application ability of students in linear equation sums in one unknown.

Bhardwaj (1987) carried out standardization of a comprehensive Diagnostic Test and preparation of remedial Material in Mathematics for middle standard students of Haryana. Major findings were, the error rate in all three areas, that is, arithmetic, algebra and geometry, came out to be 30.4%, 50.6% and 51.4%, respectively. There was significant improvement in achievement of the students after they had gone through the remedial exercise.

Rawool (1988) studied the conceptual maturity of students belonging to the age group 11 to 14 in non-metric geometry. The sample of the study consisted of 50 students. The data were collected using three tests. The first consisted of the task of classification, the second of the task of drawing geometrical figure as per the given description, third involved the task of describing a verbally for given geometrical figure. The major finding of the study were, The evidences showed that students were familiar with the terminology, assumptions and figural and concrete representation related to the non-metric geometrical concepts, but they failed to use these concepts at the ‘ understanding’ and ‘applications’ levels. The students failed to use geometrical terms, assumptions and figural representations rigorously and failed to deduce relationships in the geometrical context with the different concepts they added their own ideas and formulated their own assumptions, which were not accepted by the geometrical structure.

Raman (1989) identified the errors committed by students in calculus and designed remedial program. The major findings were that the errors most students committed were conceptual errors, followed by computational errors, entry behaviour errors and perceptual errors. He has developed a remedial package which reduces all type of errors significantly.

Chel (1990) attempted to diagnosis and suggest remediation of underachievement in the compulsory Mathematics of the Madhyamik examination in West Bengal. The sample comprised urban, semi-urban and rural students of classVI to X of West Bengal. The case study method was used in collecting the data. 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. The major mistakes found in the performance of students and teacher trainees in the area included mathematisation of verbal problems interpretation of Mathematics results and learning new topics in Mathematics. Underachievement was caused due to lack of

understanding of Mathematics concepts of the earlier stage and the abstract nature of Mathematics.

Dutta (1990) diagnosed learning disabilities in the reasoning power of the students in geometry. The sample consisted of 286 slow learners in geometry. The tools used were a diagnostic test in 'congruency of triangles' to identify patterns of disabilities. Structured individual interviews were conducted with 20 % students selected randomly from the original sample. The study identified thirty three major patterns of disabilities. The experimental group taught by audio-visual materials and techniques achieved significantly more than the controlled group thought by conventional method.

Gurusamy(1990) attempted to diagnose the errors committed by students of class IX in solving problems in geometry and has develop a remedial package. The case study method was used by the investigator. Tool used for data collection was a questionnaire. The major finding was, the level of performance of the students in the post-test was found to be high after the implementation of the remedial programme.

Wagh (1991) has developed a multimedia instructional system for remedial purposes for fractional numbers. The sample consisted of 120 students of standard VIII. The tools used in collecting data included a survey test, a Bettery of Eight Diagnostic tests. The major findings were, in fractional numbers and their operations, students were found to be committed common errors in the basic process, cross-multiplication, the terms used, and in mixed operations in addition, subtraction, multiplication and division. The traditional Instructional system (TIS) and the Multi-media Instructional System (MIS) remedial both helped students in improving their performance on all the six computational skills in fractional numbers.

Busamma (1995) constructed a Standerdized Diagnostic Tests in Exponents and Powers for class VII students. Using stratified random sampling technique, 1332 students of class VII from 30 different primary, upper primary and high schools of Hyderabad and Ranga Reddy Districts served as sample. Tools used included a Personal Data Blank and Diagnostic Test in Exponent and Powers (DETP). Mean, median, mode, SD, Co-efficient of variation, skewness, Kurtosis, percentile points, t-test, F-tests and Measurement and Scheffe's Tests and measurement for multiple comparison of the groups, student item chart, student error chart and polarogram were used to treat the data. The major findings of the study were: (i) Urban students proved to be better achievers than ruler students on DTEP. (2) The private school students

proved to be better achievers as compared to the Government school students. (3) Girls were sufficiently better achievers than boys of DTEP.

Subramaniam& Singh (1996) studied the mistake committed by students in the application of different mathematical skills and developing preventive and remedial teaching strategies using metacognitive approach for qualitative improvement in teaching of Mathematics. The data were collected from eight government primary schools in the districts (Sehore and Bilaspur districts of MP). Each school was visited on three consecutive days. On the first day, test in Mathematics was administered to children. These children were interviewed on the second day. On the last day, mistakes committed by children were identified, analysed and classified through a workshop and the recorded diagrams were scanned. Finally a compendium of mistakes was prepared. The major findings were: (i) The students committed six types of mistake in addition, eight types of mistakes in subtraction, ten types of mistakes in multiplication and six types of mistakes in division. (ii) Some students felt that due to confusion between multiplication and addition signs, forgetfulness of the procedures, lack of opportunity to write on the note book etc, they committed mistakes in the test. (iii) Poor concept of carrying over, zero & multiplication, introvert behaviour, lack of writing skills, etc were observed as possible causes of mistakes committed by students. (iv) The teachers of the schools cited home environment, SES, physical facilities in the school, extra workload on teachers, lack of interest, motivation and discipline, large size of class, general promotion policy, etc responsible for the poor performance of children in the test.

Viswanathan (1997) studied the effect of diagnostic error learning strategy on the achievement of slow learners of standard IX in Mathematics. Experimental method with equated group design was adopted for the study. Both the groups, the experimental and the controlled group, consisted 150 subjects each. The tools used were a diagnostic test in Mathematics for standard IX pupils, Achievement test in Mathematics for standard IX by C.P.Sreekantan Nair and Viswanathan K. S., Raven's progressive Matrices for measuring intelligence of slow learners of IX standard, and attitude scale towards problem solving. The data were analysed with the help of t-test. The learners treated with diagnostic error learning strategy when compared with those taught using conventional method. Slow learners of experimental group performed better in retention than those in the control group.

Warute (1998) developed remedial materials in Mathematics for standard I and II. The focus of the study was to find out the gap between expected performance and the actual performance in Mathematics of the students of standard I and II and to trace the trends of deficiencies (hard spots) in mathematics among these children followed by implementation of remedial materials. The two groups pre test-post test design was used for experimental study. Groups were equated on IQ and SES factors. The remedial programmes developed for the study, included instructions, games and practice sheets in Mathematics. The findings of the study were: (i) A large number of students in the conventional classroom situation do not achieve the expected level of performance in Mathematics even at the end of the academic year in standard I and II. (ii) All the students learn concepts differently. (iii) Concrete materials help standard I and II students in understanding and acquiring mastery over the mathematical skills. (iv)Remedial materials help in improving the performance of students in Mathematics. In standard I scores from 20% to 35% similarly, in standard II scores improved from 37.5% to 81.25% after using the remedial program.

Ramanuj& Shah (1999) diagnosed student's deficiencies in learning area –'fraction' of class IV Mathematics (Gujarat: GCERT). The study was on construction os a diagnostic test to diagnose deficiencies of the students in learning area: fraction. The sample of the study comprised of all the 1,704 students from the 17 schools run by NagarPrathmikShikshanSamiti and government-recognised private schools. A rating scale was constructed containing items pertaining to 60 competencies in the five (total) learning areas. Hardspots relating to fraction were identified on the basis of experience of 20 teachers. After analyzing the hardspots, the test was constructed relating to six competencies. Major findings: (i) About 70% of the students were found to be weak in competency number 4.4.1 as viewed in the context of MLL norm (70 X 80). (ii) By and large, students were found weak (50 X 50) in the competency number 4.4.3. (iii) Nearly 81% of the students attained 50% achievement level in competency number 4.4.4. (iv) About 68% of the students were found to be weak in competency number 4.4.5. (v) Most 90 % of the students were found to be weak in the competency number 4.4.6. (vi) Almost all (98%) the students were found to be weak in the competency number 4.4.1.

Venkateshwarlu (2001) worked on Diagnosis and Remediation of Mathematical Difficulties at primary level studying in III and IV standard. Sample for the present study was obtained from different schools of Bereilly city of Uttar Pradesh Studyingin

III and IV standards. All the 1480 children were administered tests for diagnosis of mathematical learning disabilities. Out of 1480, only 113 were selected on the basis of specific criteria adopted for diagnosis of mathematical learning disabilities. The various tools employed in the study were identifying questionnaire prepared by investigator, grade level assessment device for children with learning problems in schools by Janti Narayan and arithmetic diagnosis test for primary children by Rama. The data were analysed with the help of t-test. The findings of the study was Remedial methods are superior to conventional methods. Remedial treatment had equal effect on the achievement of mathematical learning disabled boys and girls. Remedial treatment had equal effect on the achievement of urban and rural mathematical learning disabilities.

George (2003) investigated into the Mathematical Backwardness and its Remediation in Goa. The focus of the study was on construction of a diagnostic test in Mathematics for standard VII, identification of the causes of backwardness in Mathematics and to formulate remedial programs for the selected case studies. The sample was selected from a population of forty-one schools of PondaTaluka. Of these schools, ten were government schools; one missionary school and remaining were privately run management schools. The study involved samples for various purposes at various stages mainly for Standardization of test, Diagnosis and case study. Tools used in the study were Standardized Mathematics Achievement EST, Diagnostic Test, Cattle's Cultural Fair Intelligence Test Scale three Form-A, Raven's standard Progressive Matrices, Interview Schedules, Home Background and other details Questionnaire for Backwardness. Study includes both qualitative and quantitative data. The findings of the study were: (i) Mean for entire sample as well as Highest score of entire sample was much lower than the norms itself. (ii) Percentages of correct response on diagnostic test revealed areas of backwardness. (iii) Case study findings were such that the expectations of students from Mathematics teacher and kind of teacher behaviors appreciated by the students were posing questions about prevalent teacher practices. (iv) Remedial programme showed improvement in terms of attitude and performance.

Patel (2007) developed a programme for enhancing achievement of the students of class X in mathematics. The tools used were data collection were information schedule for students, questionnaire for students, teachers and parents, unit tests and achievement test. It was a single group pre-test post-test design. Multi-stage cluster

sampling was used and the size of the sample was seventy students. The programme for locating the weaknesses related to the perquisite for teaching each unit and remediating it prior to teaching was developed and implemented. It was found using t-test that the programme was effective and students were able to score high in the achievement test.

2.1.2. Studies Conducted On Achievement and Leaning in Mathematics

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 if four schools of Chandigarh. The students were divided into three groups of 100 each. One group was taught Mathematics through lecture discussion and the second group was taught Mathematics through inductive – drill and third group was taught Mathematics through auto-instruction group discussion. The data collected through pre testpost test were analysed through four ways (3 X 2 X 2 X 3) 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 intelligence than average and below-average intelligence.

Kothari (1985) investigated the efficacy of different instructional media into 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. 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. 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. Visual projection is comparatively more effective than any other Instructional media like Activities and experiment or even programmed learning material for teaching of Mathematics. The low achieving pupils are comparatively more benefited by programmed learning material than the high achievers and the average achieving pupils.

Mohpatra(1990) looked into the critical appraisal of the secondary school mathematics curriculum of Orissa. The sample consisted of two hundred and twenty secondary school teaches and five hundred and fifty six students. The tools used were questionnaires for students studying mathematics and for teachers teaching mathematics. The mathematics teachers were conservative in their outlook as far as the objectives of teaching mathematics were concerned. They emphasised the Fundamental mathematical operations, familiarity with mathematical concepts and terms, development of mathematical skills, objectives like development of discipline, determination and a sense of proportion were given the least importance. The students were, by and large, pragmatic in their approach and considered mathematics to be a utilitarian subject. The teacher provided high ranking to the traditional topics and resisted the intrusion of new topics.

Sarangapani (1990) used the piagetian view for analysing curriculum design and materials for critical evaluation of the NCERT primary mathematics series. Document analysis was used in the study. The concept of specific learning objectives and minimum levels of learning put forward by the National curriculum Framework were found to militate against child-centredness. There was overall mismatch between the various tasks and objectives prescribed the operational level of the age-group for which they were meant. Problems were either numerical computation or involve situations removed from the child's reality and did not encourage operativity. All the concepts were sequenced logically rather than psychologically. There was also a high level of algorithmisaton which may help children in coping with what has to be learnt, but which will also impede conceptualisation, as it rules out the scope of children inventing conceptual inks.

Nalayini (1991) attempted study to find out the effectiveness of Using Number games to teach Arithmetic at Primary level. The sample comprised students of classes I to IV of kendriyaVidyalaya Coimbatore. In each class, the experimental group consisted of

50 students and the control group of 25 students. It was found that neither the educational level nor the economic status of parents influenced the arithmetic growth score of the pupils. It was also conclude that number games motivated children to develop the computational skills.

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 developed by the investigator include a Teacher's Perception Scale of Effective Teaching of Mathematics and Characteristics of Effective Mathematics teacher 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 teacher did not differ because of their qualification, place of work, type of management, type of school and number of periods of teaching mathematics.

Kapur&Rasario (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. (ii) Students with problems in learning can be helped through remedial education which has varied instructional objectives.

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 technique used included mean, and't' test for data

analysis: The major findings were: The group taught through CAT in all the schools showed a substantial progress. The CAI method of teaching Mathematics had proved to be more effective. Both boys and girls gained from the computer treatment. A significant favourable change in the attitude of the pupils of the experimental groups over the control groups was observed.

Sharma (1999) studied the effect of mathematical instructions on students' performance interactions in mathematics. The researcher followed the following stages while developing mathematical exercise on the proposed topics. Stage I: Preparing of the program, Step:II Writing the exercise, Stage: III Try-out for Modification, and Stage IV: Evaluation of the programme. The program developed by the researcher was evaluated on the basis of the try-out in terms of: (i) Error rate; (ii) Sequence progression; (iii) Criterion test findings and (iv) Exercises Analysis. Unit wise error rate, sequence programme chart, criterion test findings and exercises analysis were prepared. Experimental findings in terms of error rate, criterion test and significance of difference between mean show that: (1) 85% of the learners were able to perform sums correctly, (2) 85% of the learners were able to perform 85% of the items of criterion test correctly, (3) Researcher also found that there was a significant difference in mathematics attainment of the learners studying through mathematical instructions as compared to conventional instructions.

Mukherjee (2001) developed a Mastery Learning programme based on competencies in Mathematics for standard III. The study focused on the improvement of the programme for pupils having less than 50% achievement. The treatment continued for 60 days. Post tests were conducted to check the retention of teaching, one month later the implementation of the mastery learning programme. Data were analysed by using criteria based percentage and ANCOVA. The findings of the study were: (i) Mastery is attained by the students of experimental group in all three areas, viz., Measurement, Fraction, Geometry. As per the result of total score of post tests I and II, none of the students from control group achieved mastery, whereas in expremental group six students achieved good mastery in post test I. Thirty-three students in post test I and forty students in post test II achieved excellently. One student in post test I achieved complete mastery.

Patel (2002) worked on Construction and Standardization of an Achievement Test in Mathematics for the student of Grade IX. A sample of 3012 students of grade IX was selected by stratified random sampling method from among the secondary schools of

25 districts of the state of the Gujarat. Initially 399 objectives type items were constructed on the basis of syllabus of grade IX and were tried out on 178 students. Item analysis was done and 50 items for which point biserial was significant at 0.005 levels were selected for the final test. The reliability of the test was established by Test-Retest Method and Rational Equivalence method. It was found to be 0.73 to 0.89. Face validity of the test was established using opinion of the teachers and the concurrent validity was established using school examination results and intelligence test. It was found to be between 0.7 to 0.89. The Norms were established using percentile rank and T-scores. The major findings of the study were: (1) there was no significant difference in the achievements of mathematics between boys and girls of state of Gujarat. (2)Students of Kutch had higher achievements in mathematics as compared to the students of Northern Gujarat, Central Gujarat, Southern Gujarat and Saurastra. (3) Difference in the achievement in mathematics of boys and girls of Central Gujarat, Southern Gujarat and Saurastra was found significant and hence separate norms for boys and girls were developed for those areas.

Pooja (2004) studies the Arithmetic error profile of learning Disabled children: Improving Arithmetic skills. The study focused on identification the types of errors committed by learning disabled children in Arithmetic and developing an intervention programme for improving the Arithmetic performance of learning disabled children. The experimental method was used for the present research study./ It employed pre-test, treatment, post-test design. A sample of 30 students of grade II were drawn from English medium schools of Karnal city and was divided into equal groups as control group and expremental group. The main findings were: (i) The prevalence rate of learning disability in Arithmetic among grade II students came out to be 7.31 percent. (ii) The identification of types of errors committed by learning disabled children revealed that the highest error rate was in the dimension of ‘multiplication’ followed by ‘subtraction’ and ‘addition’. It reflected that the average 55-60% of errors was committed by learning disabled children in Arithmetic. (iii) Teaching through a set of intervention strategies i.e. Concrete Material Strategies, Touch Math Program, and Multi-sensory Basic Operation program was found to have a significant positive effect in Arithmetic skills on the basis of comparison between scores of experimental and control groups on pre-tests and post-tests.

Kumar (2008) investigates on the formation of concepts in Mathematics among the pupils of std. VI, VII, VIII & its relation to correlated approach in teaching learning

process. The sample consisted of 948 students from the three randomly selected schoolsin greater Mumbai affiliated to the Maharashtra state Board of Secondary & Higher Secondary Education, Pune. The design of the study was experimental post test only Control group design. Tools used were Achievement Test and data were analysed using Mean, SD, T-test. It was found that the students who were taught using correlated approach were highly benefited. Knowledge when perceived as whole enables the pupils to link the previous knowledge with the present knowledge and form a better configuration of knowledge.

2.1.3 Studies Conducted On Factor Affecting Mathematics Achievement

Lulla, Shah and Darji (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.

Lalithama (1975) has found some factor affecting achievement of secondary school pupils in mathematics. The study was conducted on 732 pupils of standard IX selected on stratified random basis. The tools used were a Standardised Achievement Test in Mathematics, a Study Habit Inventory, an Interest Inventory, a Socio Economic Status Scale and the Raven's Standard Progressive Matrices. The study revealed that the achievement in mathematics positively related to intelligence, interest in mathematics, study habits and SES. Studying lesson daily, studying mathematics by writing, repetition in learning, over learning, private tution etc. influence the achievement of mathematics.

Sharma (1978) studied the achievement in mathematics by pupils of secondary school with particular reference to the state of Assam. The study was confined to the area of arithmetic and algebra. The sample included 1295 pupils from ten schools. A Battery of Sequential Achievement Tests was constructed for standard five to ten. An analysis of syllabus, textbooks, school records and board's records was also done. The major defects were the lack of drilling and knowledge of fundamentals and the inability to transform verbal statements into mathematical statements. All the pupils acquired knowledge and skill better than understanding and application of different topics, there was undue emphasis on the mechanical learning of mathematics. Some

major factor responsible for low achievement in mathematics were the imparting of limited knowledge, blind use of rules, heavy syllabus, defective textbooks, lack of the natural urge among pupils to learn mathematics, insufficient drill work at the primary stage and absence of the methodical approach of the classroom teaching.

Jain (1979) studied significant correlates of high school failures in mathematics and English with special reference to Jammu division. For the data collection the measuring devices used were Humanities Group Test of General Mental Ability (Joshi), Numerical Ability Test, Abstract Reasoning Test, Mathematical Ability Test, a Scale to Assess Attitude towards Mathematics and a Questionnaire on various factor associated with mathematics learning. The major finding was that the factors played a vital role in learning mathematics were intelligence, abstract reasoning, numerical ability, and knowledge of mathematical concepts, rules and principles, attitude towards mathematics.

Manika (1983) found acquisition of concept in mathematics of pupils at primary school level and its relation to some personal and environmental variables of the pupils. The data were collected from 524 pupils from municipal school, grant-in-aid schools and private schools of urban areas from grade I through grade V. Tools employed in the study were Raven's coloured progressive matrices test, abstraction and generalization test/ black test and mathematical concept test. The study found that the majority of pupils who were promoted to the next grade did not show acquisition of concepts of the lower grade. Mathematical concepts developed better with pupils good in language. For the better development and the acquisition of concepts, individualised instruction was found useful.

Patel (1984) found mathematical ability of pupils of classes IX and X in the context of some cognitive and affective variables. The tools used for data collection were mathematical ability test, space visualised test (SVT), Mathematical attitude scale, mathematical anxiety test. The study revealed that the pupils having high reasoning ability, space visualisation and favourable attitude towards mathematics were found better in mathematical ability.

Shah (1985) made a psychometric exploration to study relationship between achievement in arithmetic and three psychological factors viz. intelligence, problem faced by children, parent-child relationship, in few primary schools in choryashi Block for the 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 choryashi Block. Data was collected using Arithmetic Achievement Test, Interview Schedule for the parents, student problem inventory, And Individual Intelligence Test. The major findings were inattentiveness of parents; School had no special peogrammes for finding out backward children. It was found that some teachers were not qualified to teach arithmetic. Teachers had to teach all subjects and had not under gone any special training to teaching of mathematics.

Deshmukh (1988) identified some temperamental correlates of mathematics learning. The sample of the study comprised 1,008 subjects selected by using the stratified random sampling procedure. The tools used to collect data included the Thorndike Dimensions of Temperament Inventory, the SRA tests of educational ability, an achievement test in mathematics and a socio economic status scale. The study found that, as far as cognitive abilities, basal to mathematics learning is concerned. The high achievers were found to be more critical, more responsible, more solitary and more ascendant than the average achievers who are tender minded.

Jain and Burad (1988) attempted study to find out the causes as responsible for low results in secondary mathematics in Rajasthan. The sample of the study comprised rural and urban boys and girls of 100 government and private school. The findings were non-availability of mathematics teacher due to late appointments and frequent teacher transfers; lack of appropriate classrooms and other physical facilities; irregular attendance of students; low standard in the lower classes; non-availability of textbooks; lack of timely correction of homework; overburdened and uninteresting curriculum; lack of child centered teaching; insufficient periods for teaching mathematics; and lack of suitable teaching aids.

Pal (1989) attempted to find the affective outcomes of students as predictors of their mathematical ability. The sample consisted of 600 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. 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.

Sarala (1990) has analysed the conceptual errors of secondary schools students in learning selected areas in modern mathematics. The sample consisted of 800 pupils selected by the stratified sampling procedure from the secondary schools in the Trivendram 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 the numbers of errors are quite large, and these errors are influenced by sex, locality of the school, management of the school, intelligence, study habits and socio- economic-status. The errors decrease with intelligence.

Baskaran (1991) studied the relationship among achievement motivation, attitude towards problem-solving and achievement in mathematics. The sample was selected by stratified sampling technique. 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 relation between the attitude towards problem solving and achievement in mathematics. Urban and rural students did not differ in their achievement motivation and attitude towards mathematics. Urban and rural students differ significantly in their mathematics achievement.

Rajyaguru (1991) studied the achievement in mathematics, personal characteristics and- environmental characteristics of over- achievers and underachievers. The sample of the study consists of 1093 students which were selected through stratified proportionate sampling. The subjects were selected from six urban, six semi- urban and thirteen rural schools. The tools used were Desai-Bhatt Group Test for intelligence, Bhavsar Numerical Aptitude Test, Mathematics Achievement Test developed by investigator, 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. The study revealed that 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 intelligence, numerical aptitude and locus of control. Overachievers had better study habits, more positive towards mathematics and less mathematics anxiety.

Kasat (1991) had made an in depth study of the cause of failures in the S.S.C examination of Marathi medium high school students in PalghatTehsil. The sample of the study comprised 200 students of 25 Marathi medium high schools of palghat. The tools used for data collection were standardised tests of numerical ability and a self made questionnaire for teachers. The major findings were, Low intelligence, poor

numerical ability, poor comprehension and poor study habits were the causes of the large failures of boys and girls. Topics such as percentage and shares were difficult in arithmetic; the circle, circle-arc and area were difficult in geometry. The parents being illiterate could not help the children at home. There were no finances for audio-visual aids in schools.

Ngailiankin (1991) identified some variables associated with achievement in Mathematics. The sample consisted of 303 students. The tools used were, Achievement Test in Mathematics, Attitude Scale, Education Aspiration Scale of Sharma and Gupta, Differential Aptitude Test and Cattell's 14 High School Personality Questionnaire (HSPQ). The study revealed that there was a significant association between attitude towards scale, education aspiration, numerical ability, abstract reasoning and personality factor with achievement in Mathematics.

Hariharan (1992) found attitude of high school students towards home work and their achievement in mathematics. The sample of the study comprised 250 students of class IX selected from the various high schools from the Madurai city. The tools used for data collection were a home work attitude scale and an achievement test constructed by the investigator. The study revealed that the attitude of high school students towards homework was related to their achievement level in mathematics.

Rosaly (1992) found the relationship between attitude of students towards mathematics and achievement. The sample of the study comprised 200 students of class X. The tools used for data collection were a mathematical attitude scale (MAS) and an achievement test in mathematics. The study found that the attitude of high school students towards mathematics and achievement in mathematics were related.

Setia (1992) found relation of socio-psychological and educational factors of differential learning rate in modern mathematics at the senior secondary stage. The sample consisted of 510 senior secondary students and 42 teachers from 19 governments, private and urban, rural recognised institutions were randomly. The tools used included the group test of General Mental Ability of Tondon, the adjustment inventory of Mittal, the SES scale of Trivedi and UdaiPareek, the Modern Mathematical Concept Test, a Mastery Criterion Test developed by the investigator, Classroom Behaviour Questionnaire and an Emotional characteristics 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) studied self-concept, reading ability in relation to achievement in mathematics. The study was conducted on a sample of 1,000 students of standard VII. The tools used for data collection were self concept Inventory, a standardised Reading Test by DaveGowda and Shivananda and Achievement Tests in mathematics. The study revealed that there was a significant difference in the achievement in mathematics of students having different level of reading ability.

Sashidharan (1992) investigated about learning intellectual skill as an educational outcome in relation to student entry characteristics and quality of instruction. The major findings were: The prevailing promotion policy gives opportunities to children to attain tenth class even though they cannot perform basic operations in mathematics. The initial deficiencies have long term damaging effect because the content of education is organized in such a way that learning in each class is depending on prior learning.

Srivastava (1992) studied the learning outcomes in terms of objectives in mathematics. The sample consisted of one thousand and thirty students selected at random 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 Fair Test of Intelligence (Form A) by R. B. Cattle. Intelligence and socio-economic status both were such which contributed significantly and positively to the development of learning outcomes in mathematics in terms of knowledge, understanding, application, and skill. 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.

Thampuratty (1994) examined the interaction effects of creativity, attitude towards problem solving and social position on the achievement of 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. Significant differences existed in the mean scores of achievement in mathematics between three groups pairs of creativity. Significant differences existed in the mean scores of achievement in mathematics between three group pairs of attitude towards problem solving. Positive, high and

significant relation existed between attitude towards problem solving and achievement in mathematics.

Sumangla (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 district of Kerala. Tools used incuded Test of Mathematics aptitude by Sumangala and Malini, Scale of Attitude towards Mathematics by Sumangaaamd Sunny, Scale of Self-concept in Mathematics by Sumangala and Jayshree. 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.

Wangu& Thomas (1995) assessed the attitude towards the achievement in Mathematics among high school students of tribal town of Aizawal. The sample of the study comprised 300 students, covering both boys and girls, studying in class IX of high schools of Aizwai. They 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 of Ram, 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.

Verma (1996) explored the main and interaction effects of intellectual ability and test anxiety on achievement in four school courses viz. English, mathematics, general science and social studies. The sample of the study comprised 500 students studying in class X in ten goverrment secondary schools of Delhi. These subjects were selected by random cluster sampling technique. The tools used to collect the data were the Group General Mental Ability(Hindi) by Jalota and Test Anxiety Inventory (Hindi) by Sharma, Sud 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 on students in the all the

four school courses. However, interaction between the two variables 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.

Prakash (2000) investigated into the relationship between each of the independent variables i.e. problem solving ability, anxiety, environment including home, school, social and physical environment and socio-economic status with each of the dependent variables i.e. mathematical creativity and mathematical achievement. The sample comprised 400 students (boys and girls) of VII class who were studying in government/private senior secondary schools of rural-urban areas of Chandigarh. The sample was selected by stratified random sampling method. Comprehensive Anxiety Scale by Sinha, Socio-Economic Status Scale by Kulshreshtha, Test for Creativity Thinking in Mathematics by Moghe, problem Solving ability Test, Environmental Factors Scale, and Achievement Test in Mathematics developed by researcher were used for data collection. The data were analysed by mean, SD, t-test and correlation technique. The finding of the study were: The variable of problem solving ability was found to be positively and significantly related with mathematical creativity and mathematical achievement separately were found to be insignificantly positively correlated separately with mathematical creativity and mathematical achievement.

Usha (2001) studied the influence of Intelligence and Creativity on the Achievement in Mathematics among X class students. The study focused on Identification of the levels of Intelligence and Creativity among X class students and their relation with the achievement in Mathematics among the class X students. For the study, sample comprised to 2000 students of class X studying in English and Telugu medium schools of Visakhapatnam district. Random technique was uses for sampling. The study was descriptive in nature. Data collection was done with the help of Standard progressive Matrices (SPM) by Raven (1941) and Creativity scale developed by investigator. Mean, Standard Deviation, Coefficient of Correlation and regression equation techniques were used for data analysis. The findings of the study were: (i) There is a significant positive relationship between Intelligence and Achievement in Mathematics, and significant positive correlation between Creativity and

Achievement in Mathematics. (ii) There exists a significant positive relation between Intelligence and Creativity.

Kumar & Singh (2011) has studied attitude towards Mathematics as correlate of achievement in Mathematics. Sample was selected by random sampling and sample consisted of 500 Higher Secondary School Students. The tools used were Attitude scale, developed and standardised by KumarLalit and the marks obtained in Mathematics by students in the Secondary Board Examination has been considered as the achievement in Mathematics. The inventory has four dimensions- Utilitarian value, Social Value, Aesthetic Value and Intellectual value. The statistical techniques used for data analysis were mean, standard deviation, percentage, correlation coefficient and t-value. The major finding of the study were 51.80%, 72.80%, 50.20% and 52.20% of the students have favourable attitude towards utilitarian, intellectual, aesthetic and composite dimensions of attitude towards Mathematics respectively. On social value dimension of attitude towards Mathematics was 47.40%. Utilitarian value, intellectual value and aesthetic value of attitude towards Mathematics are positively and significantly correlated with achievement in mathematics but social value of attitude towards Mathematics is not correlated with achievement in Mathematics positively and significantly.

Patel (2012) has studied Academic Achievement of students in Mathematics of standard IX in relation to some psycho-social factors. The sample of the study consisted of 1486 students of Standard IX and sample selected by multistage sampling technique. Data were analysed through Mean, Median, Standard Deviation, Correlated-t, Percentile and T. The study revealed that there was nosignificant effect of gender, school type and area on achievement in Mathematics. But there is significant effect of cast, intelligence and SES on achievement in Mathematics.

2.1.4. Summary of Indian Studies

Review of related literature is divided mainly in three parts, Studies conducted on diagnosis and remediation programme in Mathematics, Factor affecting achievement in Mathematics and achievement and learning in Mathematics.

S.I.E. Gujarat(1969) studied the basic arithmetic skills of computing addition, subtraction, multiplication and division by a diagnostic test and revealed that pupils did not know the entire process of addition, subtraction, multiplication and division. Rastogi(1983) attempted to diagnose weakness in arithmetic related to basic

arithmetic skills. The design of the study was experimental of nine different schools of ArunachalPradesh. Ashar(1972) constructed and standardised a diagnostic test in basic algebraic skills for Gujarati medium pupils for secondary schools. The sample consisted of 268 students and revealed that the errors of conceptual type and pupils committed errors due to lack of systematic approach. Thakor(1980) had constructed diagnostic tests and preparing remedial material on fraction for the students of grade V of Guajarati medium school in greater Bombay. The study shown that the students of class V did not have clear concept of fraction and did not understand the place value of respective figure in decimal fractions as well as addition, subtraction, multiplication and division of decimal fractions. Wagh(1991) has also conducted a study on 120 students of standard VIII and found that in fractional numbers and their operations, students were found to commit common errors in the basic process, cross-multiplication, the terms used and in mixed operations in addition, subtraction, multiplication and division. Datta(1990) diagnosed learning disabilities in the reasoning power of the students in geometry on 286 slow learners and found that there were thirty two major patterns of disabilities. Gurusamy(1990) also diagnose the errors committed by students of class IX in solving problems in geometry. Rawool(1988) studied the conceptual maturity of students belonging to the age group 11 to 14 in non-metric geometry and found that students fail to use concepts at the understanding and application levels. Raman (1989) identified the errors committed by students in calculus and revealed that the errors most students committed conceptual errors. Das and Barua(1968), Thakor(1980), Rastogi(1983) , Dutta(1990), Bhardwaj(1987), Raman(1989), Gurusamy(1990) and Wagh(1991) have found the effectiveness of remedial measure.

Mohpatra (1990) looked into the critical appraisal of the secondary school mathematics curriculum of Orissa. The sample consisted of two hundred and twenty secondary school teachers and five hundred and fifty six students. The study revealed that the mathematics teachers were conservative in their outlook as far as the objectives of teaching mathematics were concerned. They emphasised the Fundamental mathematical operations, familiarity with mathematical concepts and terms, development of mathematical skills, objectives like development of discipline, determination and a sense of proportion were given the least importance. The students were, by and large, pragmatic in their approach and considered mathematics to be a utilitarian subject. The teacher provided high ranking to the traditional topics and

resisted the intrusion of new topics. Sarangapani(1990) used the piagetian view for analysing curriculum design and materials for critical evaluation of the NCERT primary mathematics series. Document analysis was used in the study. And it found that there was overall mismatch between the various tasks and objectives prescribed the operational level of the age-group for which they were meant. Problems were either numerical computation or involve situations removed from the child's reality and did not encourage operativity. All the concepts were sequenced logically rather than psychologically. Nalayini(1991) attempted experimental study to find out the effectiveness of Using Number games to teach Arithmetic at Primary level. The sample comprised students of classes I to IV of kendriyaVidyalaya Coimbatore. It was concluded that number games motivated children to develop the computational skills. Sharma(1999) studied the effect of mathematical instructions on students' performance interactions in mathematics and found that there was a significant difference in mathematics attainment of the learners studying through mathematical instructions as compared to conventional instructions. Patel(2007) also developed a programme for enhancing achievement of the students of class X in mathematics. It was a single group pre-test post-test design. Multi-stage cluster sampling was used and the size of the sample was seventy students. It was found using t-test that the programme was effective and students were able to score high in the achievement test. 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. 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 teacher did not differ because of their qualification, place of work, type of management, type of school and number of periods of teaching mathematics. Patel(2002) worked on Construction and Standardization of an Achievement Test in Mathematics for the student of Grade IX. A sample of 3012 students of grade IX was selected by stratified random sampling method from among the secondary schools of 25 districts of the state of the Gujarat. The study revealed that there was no significant difference in the achievements of mathematics between boys and girls of state of Gujarat. Students of Kutch had higher achievements in mathematics as compared to the students of Northern Gujarat, Central Gujarat, Southern Gujarat and Saurastra. Difference in the

achievement in mathematics of boys and girls of Central Gujarat, Southern Gujarat and Saurastra was found significant and hence separate norms for boys and girls were developed for those areas.

Researcher has reviewed 25 studies on factors affecting Mathematics achievement. Analysis of those studies is given in the following table.

Table: 2.1

Analysis of the studies conducted in Indiarelated to factor affecting Mathematics achievement

Studies	Place	Sample	Sampling Technique	Correlates of mathematics achievement
Lalithama (1975)		732 pupils of standard IX	StratifiedRandom basis.	intelligence, interest in mathematics, study habits and SES
Sharma (1978)	Assam	1295 students of secondary school		Impartation of limited knowledge, blind use of the rules, heavy syllabus, defective textbooks, lack of natural urge among pupils, insufficient drill work
Jain (1979)	Jammu division	High school		intelligence, abstract reasoning, numerical ability, and knowledge of mathematical concepts, rules and principles, attitude towards mathematics
Manika (1983)		524 pupils from grade I through grade V		good language, individualised instruction
Patel (1984)		pupils of classes IX and X		reasoning ability, space visualisation and favourable attitude towards mathematics
Shah(1985)	Choryashi Bock	897 Students of 1st standard	Purposive sampling	Inattentiveness of parents, No special programme in the school, under qualified teacher
Deshmukh (1988)		1,008 subjects selected by using the	stratified random sampling procedure	cognitive abilities

Jain and Burad(1988)	Rajasthan			Non-availability of Mathematics teacher, Lack of physical facilities, Non-availability of textbooks, lack of timely correction of homework, uninteresting curriculum, Lack of child centre teaching and teaching aids, insufficient time for teaching Mathematics
Pal(1989)		600 Students		Self concept ,anxiety, Mathematics attitude, academic motivation
Sarala (1990)	The Trivendram revenue district	800 pupils of secondary schools	stratified sampling procedure	Sex, locality of the school, management of the school, intelligence, study habits and socio-economic-status,.
Baskaran(1991)			stratified sampling technique	Achievement motivation, attitude towards Mathematics
Rajyaguru(1991)		1093 students	Stratified proportionate sampling	Intelligence, numerical aptitude,
Kasat (1991)	PalghatTehsil	200 students of 25 Marathi medium high Schools		Low intelligence, poor numerical ability, poor comprehension and poor study habits, illiterate parents.
Ngailiankin (1991)		303 Students		attitude, education aspiration, numerical ability, abstract reasoning and personality factor
Hariharan (1992)	The Madurai city	250 Students of SlassIX		The attitude of high school students towards homework
Rangappa (1992)		1,000 students of Standard VII		reading ability
Rosaly (1992)		200 students of class X		The attitude of high school students towards mathematics
Setia (1992)		510 senior secondary students and 42 teachers from 19 governments, private and urban,		The intellectual level, SES

		rural recognised institutions were randomly		
Sashidharan(1992)				Initial deficiency
Srivastava(1992)		1030 students	Multi-stage random sampling	Intelligence, SES,
Thampuraty(1994)		700 secondary school pupils		Creativity, Attitude towards problem solving , social position
Sumangla(1995)	Five revenue district of Kerala	750 students of standard IX	Stratified sampling technique	Mathematics aptitude, Attitude towards Mathematics, self-concept in Mathematics
Wangu and Thomas(1995)	Aizwal	300 students of standard IX	Stratified random sampling	Attitude towards Mathematics
Verma(1996)	Delhi	500 students of standard X		Intellectual ability, test anxiety
Prakash(2000)	Chandigarh	400 students of standard VII		Problem solving ability, anxiety, (home, school, social and physical environment), SES

Review of related literature reveals that SES is positively related with mathematics achievement. Lalithama (1975) has conducted study on 732 pupils of standard IX and Sarala (1990) has conducted study on 800 pupils of secondary students in the Trivendram revenue district. Stuudies revealed that achievement in mathematics is positively related to SES. Patel (1997) has found that socio-economic level of parents had a large impact on the achievement. Nagalaksmi (1996) found that SES facilitated problem solving ability, while Srinivasan (1999) did not find any such relation. There are some studies which have attempted to understand the role of intelligence as a correlate of Mathematics achievement. Srivastava (1993), Sumangala (1995) and Patel (1997) have found that the higher level of intelligence leads to higher achievement in mathematics. Lalithama (1975) has conducted study on secondary school pupils of standard IX and revealed that the achievement in mathematics positively related to intelligence and study habits. Sarala (1990) has also analysed conceptual errors of secondary school students and found that errors are influenced by intelligence and study habits. Researchers have also attempted to study attitude as an important correlates of mathematical achievement. Jain (1979) studied correlates of

high school failures in mathematics of Jammu division and found that the factor played a vital role in learning mathematics were attitude, abstract reasoning and numerical ability. For the data collection the measuring devices used were Numerical Ability Test, Abstract Reasoning Test, a scale to assess attitude towards mathematics. A similar findings has been obtained by Patel (1984) and Ngailiankin (1991), Srinivasan (1999), Singh,Ahluwalia and Verma (1994); Sumangala (1995), Wangu, and Thomas (1995), and Thampuratty (1994). Rangappa (1993) has found that higher the level of reading ability, higher the level of achievement in mathematics. Sood (1999) found that the problem-solving ability is correlated significantly with mathematical achievement of students. Among the correlates such as creativity, problem solving, study habits, personality, aptitude, anxiety, different abilities have been studied by researchers.

2.2. Studies Conducted Abroad In Mathematics

Many studies have been conducted in the field of mathematics education, investigator has tried to review most pertinent studies related to the present study. Some of the studies are as below:

2.2.1. Studies On Different Relationship In Mathematics

TzwngShwu-Rong (1987) studied the relationship among gender, attitudes towards Mathematics, and Mathematics attributions of sixth grade high, average, and low achievers in Taiwan, Republic of China. Numerous researchers have tried to "understand variables that affect a student's achievement in Mathematics. 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 were classified to three levels- high, average and level. The Fennema-Sherman Mathematics Attitudes Scales and the Mathematics Attribution Scale were used to measure student's attitude towards Mathematics and attributions of success/ failure in Mathematics. The results showed that: (i) the higher the achievement, the more positive were attitude towards Mathematics; (ii) there were no significant differences between male and female students in attitude towards 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

task, and to a too effective teachers or facilitative peer groups. The lower the achievement, the more there were attributions of failure to not having ability, to task difficulty, and to lack of effective teachers or facilitative peer groups, (iv) there were no significant differences between male and female students in attributions of success/ failure in Mathematics, except for the variables of 'success-effort' and 'success-environment', where female students were more likely to attribute their success to appending time studying, effective teachers, or facilitative peer groups; and (v) in general, there were significant positive relationships among the variables under "attitudes towards Mathematics", among variables of attitudes toward Mathematics and variables of Mathematics success attribution, and among the variables under " Mathematics failure attribution". However, the relationship among variables of attitudes toward Mathematics and variables of Mathematics failure attribution were significant and negative.

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. The organization of the class was based on the social constructivism of Vygostsky. There was an attempt to create an atmosphere that was sensitive and nurturing in which students could trust their classmates to be supportive of their efforts to solve Mathematics problems. Students were made to work 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 indicate that the relationships within the classroom enhanced the development of viable relationships with Mathematics. There were also indications that the students were all females may have contributed to the workable relationships with Mathematics.

Duncan (2000) studied the relationship between math preparation in high school and Mathematics skill 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 earn the material sufficiently enough to acquire man 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.

Martin(2002) explored the math attitude of gifted students in grades three, four, five and six participants in an accelerated math program with a focus on gifted girls in the

elementary grade. Eight of the nine domains of the Fennama-Sherman Mathematics attitude scale (MAS) were used to survey the math attitudes of 267gifted boys and girls, in grades three through six. The domains explored the math attitudes of students within the following areas: attitude towards success, mother's attitude, father's attitude, anxiety, motivation, usefulness, teacher's attitude and confidence. Survey responses were used to compile descriptive and inferential statistics. Using the statistical package for the Social Sciences (SPSS) and a predetermined alpha level of 0.05. A multivariate analysis of variance (MANOVA) compared the groups within the domain clusters. Data analysis yielded two significant main effects in anxiety (0.0002) and motivation (0.0008). Anxiety emerged as most significant finding of the study. Girls revealed more negative math attitudes compared to the boys at all grade levels. Interaction in motivation between fourth and sixth grade and fifth and sixth grade were significant at the 0.05 level.

Wilson(2002) has examined the attitudes and career choice for eight grade students at one East Tennessee middle school. Each participant completed the modified Aiken Mathematics Attitude scale survey and a career selection form. The attitude scale and the career selection form were both administered by the researcher. Percentage comparisons were made to see if attitudes towards mathematics made an impact on the future career choice. The participant's were compared to see if male attitude towards mathematics were different from female attitudes towards mathematics. Students in the school system are required to choose a career track as they leave the eighth grades. Evaluation of student's career selections had previously been examined and program had been put in place to help students make better career choice. Participants were divided into three groups depending on the career they selected. The participants in the group had differences in percentages of yes/no responses on eighteen of twenty statements. However, differences between pairs of groups were less frequent. There were no statistical difference found between the male attitudes towards Mathematics and the female attitudes towards mathematics. Both the male and female average attitude towards mathematics was positive. There was also no statistical difference between the attitudes of the participants in each group. The group means are relatively the same and the group means shows that the participants are positive towards mathematics. Differences in percentages of yes/no responses were found; thus, the researcher concluded that attitude towards mathematics is related to career choice.

Abrams (2008) investigated the effect on the mathematics achievement and motivation of 33 urban elementary and middle school students as a result of their having played topical computer games prior to receiving direct instruction. The participants in the study were required to attend an extended day period a week because they were below their grade standards in mathematics and reading. The experimental student's mathematics achievement was measured by comparing pre and post unit test results with students in a control group. Teachers and parents of the experimental students supplied the researcher with supplement information through responses from pre- and post- study questionnaires. Statistical tests did not support playing computer games for enhancing student's achievement. However, an analysis of frequencies and percentages conducted of student, teacher and parent responses on pre- and post-study questionnaires supported playing computer games for motivating students to learn mathematics, improving students self efficacy for learning mathematics, improving students ability to receive mathematics instruction and improving their interest in mathematical activities.

Deevers(2010) investigated relationships among teacher practices, student motivation and student achievement on standardized mathematics assessments using an achievement Goal Theory Framework. From 2006 through 2009, 800 public school students participated in mathematics assessments and completed surveys measuring perceptions of teacher practices and student achievement goal orientations. Hierarchical Linear Modelling (HLM) was used to assess relationship among teacher goal endorsement practices, student goal orientations and student mathematics achievement. Finding indicated teacher mastery goal endorsement was positively related to student mastery and performance-approach orientations and negatively related to student performance-avoidance orientation. Performance goal endorsement was positively related to student performance-approach and performance-avoidance orientations. Student mastery goal orientation was positively related to initial mathematics achievement and to rates of improvement over time. Performance-approach and performance-avoidance goal orientations were negatively related to initial mathematics achievement.

2.2.2.Studies Conducted On Factor Affecting Mathematics Achievement

Aviles' (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 environments of eight students identified as Mathematics low achievers admitted to Puerto RicoJunior College. The aspects considered in the study were prior experiences in the familial and/ or academic environments. The study was based on personal familial and academic observation and interviewing. The study also considered visits to the familial and former high school environments. Moreover, written documents, such as academic records and autobiographical statements, were carefully analyzed. 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. These questions were not individually discussed, as they were interrelated. The study followed a naturalistic approach; students were observed in their natural environment; homes and former high schools were visited and observed in order to obtain a real view of these environments. 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.

Kalamaros (1991) tried to study instructional method and decreased student errors on math worksheets. Teachers often express concern about student's poor performance on classroom math worksheets. Performance deficits may be attributed in part to personal internal variables and/ or to external factors such as materials or instructional methods. Unfortunately, student's math ability often is evaluated based on performance on math worksheets, regardless of the many factors that may be impacting the individual. The purpose of this study was to explore the effect that instructional methods have on student performance on math worksheets. A multiple baseline single organism study was completed with 11 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 regarding ability and math performance. When teachers are interested in determining students' skills in math, 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 math ability have on

student performance. Controlling for these influences increases the likelihood that students will demonstrate their true math skills.

Owens(1999) investigated relationship of cognitive learning styles, mathematics attitude and mathematics achievement for student instructed with problem posing activities. If was conducted with pre-algebra, students at Walters state community college in MorristownTennessee. For one semester, three control classes (45 students) were taught in a traditional manner and three treatment classes (46 students) were taught in a traditional method plus one third of the class time devoted to problem posing activities. Pre-test and post-tests of mathematics achievement, using the final examination of the course, and mathematics attitudes using Fennema-sherman mathematics attitude scales, were given. Learning styles were evaluated with Kolb's learning style Inventory (LSI-IIa). Due to the low number of converger learners, students were grouped for analyses in two ways: (1) concrete experience versus conceptualization learners and (2) reflective observational versus active experimentation learners. Achievement gain, for hypothesis one, was analysed by ANOVA with factors of learning style and treatment group membership, pre-attitude was tested as a covariate. No significant differences in achievement gain was seen between concrete learners in control and treatment groups. Mathematics pre-attitudes of students showed no significant effect on mathematics achievement gain. Changes in mathematics attitudes were analysed by repeated measures ANOVA with factors of learning style and treatment group membership's attitude tests were repeated over time. For attitude domains of anxiety and confidence in doing mathematics, abstract learners in the treatment group showed significantly lower attitude improvement than abstract learners in the control group. Abstract learners in general found mathematics more useful than did concrete learners.

Haralambos (2000) examined how students conceptualize various geometric concepts on tenth-grade geometry. It provides the suggestion of additional strategies for the improvement of the teaching and learning of geometric proofs. Further results of the research indicated that students write proofs that are better organized through shared knowledge than the proofs presented in the textbooks.

Barker(2003) has examined the effects of motivational conditions on the mathematics performance of students on the NAEP assessment.The research that formedthe basis for this study was generated through the use of a multiple regression model. The study consisted of two instruments: 1996 NAEP mathematics assessment

and a self-assessment survey. A subset of mathematics questions from the 1996 NAEP assessment were used to measure student performance. A modified self-assessment measured any links in performance differences to various affective variables. Participants included a sample of eight grade middle school student in the Atlanta city public school system. Data indicated that goal orientations, gender, and metacognition did not significantly affect student performance. Ethnicity, item format, recall of directions, effort and worry did significantly affect the performance of the students on assessment.

Shirvani-Arani(2004) has examined the effect of teacher communication with parents on students mathematics achievement. In the Fall 2003, the investigator selected a total of 52 students from four Algebra I classes taught by a teacher and randomly placed two classes in the control group and other two classes in the experimental group. The parents of the students in the treatment group received monitoring sheets twice a week, which contained students daily homework grades, tests, conduct levels, and engagement levels. The parents in the control group did not receive monitoring sheets. The study investigated five questions: First, What are the effects of teacher communication with parents on student achievement in mathematics courses? Second, are female and male students affected differently when their teachers have communication with their parents or guardians? Third, how does teacher communication with parents affect lower performing students when they are compared with other lower performing students in the control group? Fourth, how does teacher communication affect parent's engagement in their children's mathematics classes, which is measured by home work survey, number of parental conferences, and number of phone calls? Fifth, how does teacher's communication with parents affect student's attitude? The study revealed that with respect to Mathematics achievement, students in the experimental group outperformed the students in the control group. With respect to gender, teacher communication with parents did not affect student's achievement differently. The results from parent surveys showed that parents in the experimental group had developed more positive attitudes towards homework compared with the attitudes of the parents in the control group. Moreover, the MANOVA test showed that students in the experimental group had developed higher self confidence in themselves and these students felt that their mother had higher confidence in their ability to do mathematics problem than did the students in the control group. In addition, study showed that students in the

experimental group had significantly higher level of engagement and conduct than the students in the control group.

Mriano(2005) investigated the relationship between students attitude towards learning mathematics and mathematics achievement with respect to gender in 10^{th} grade students in AmmanJordan. Three instruments were used in the study to collect data: A mathematics achievement test (MAT), consisting of questions selected by the researcher from the (2004) Ohio Graduation Practice Test, An attitude questionnaire (ATM) developed by Taylor (1997) from the Aiken scale (1976), and student interview developed by the researcher. The overall results of the study indicate that there was significant difference in attitude and achievement between male and female students in the 10^{th} grade ($F=10.3$, $P<0.01$).It also shows, using a Pearson correlation that there is a significant correlation between the two dependent variables attitude toward learning mathematics and mathematics achievement.

Um(2005) has developed and tested a model, based on self determination theory(SDT), describing the effects of motivational resources on mathematics performance. The model incorporates the assumption that intrinsic motivation positively affects mathematics performance. Whereas external regulation negatively affects mathematics performance. Furthermore, it is assumed that mathematics performance both directly and indirectly through the mediating variable of intrinsic motivation. Finally, autonomy support can affect mathematics performance both directly and indirectly through the mediator of mathematics self-concept. The model was tested using data from the Third international Mathematics and Science Study-Revised (1999), or TIMSS-R (1999), on the mathematics performance of eight grade students in the USA. The conclusions drawn from the study were consistent with the predictions or SDT. Both structural equation modelling and multilevel path modelling analyses confirmed that intrinsic motivation positively influenced mathematics performance, where as external regulation negatively. A positive mathematics self-concept significantly affected mathematics performance both directly or indirectly through the mediator of intrinsic motivation. Finally, autonomy support in the classroom significantly and indirectly through the mediator of mathematics self-concept.

Carmichael(2005) examined the effects of Socio-Economic Status on the academic performance of all fourth and sixth grade students in the white country TennesseeSchool system. An equal sample population of fourth grade students

(45.4%) and sixth grade students (51.6%) were analysed as well as a relatively equal number of students classified as economically advantaged (46.7%) and economically disadvantage (53.3%). The hypotheses were tested using an independent samples t-test, Chi-square and 2-way ANOVA. The results showed a significant difference in the achievement scores of 4^{th} grade reading, 6^{th} grade reading and 6^{th} grade mathematics. The Chi-square test found a significant difference in the proficiency level of the 6^{th} grade reading and mathematics. An ANOVA was used to analyse the interaction of Socio-Economic Status and grade level. A significant main effect of SES and significant interaction effect of grade level and SES were found on reading scores. The same analysis in Mathematics found a significant main effect of grade level but no significant interaction between grade level and SES. Individual ANOVA tests were conducted to identify significant differences in achievement between the eight schools and the two dependent variables, reading and mathematics. There was no significant main effect of reading between schools but there was a significant difference found in mathematics scores between the schools.

Chen(2006) has examined the difference in learning style preference of 704 11 and 12 year old female and male Taiwanese adolescents and then determined whether their learning styles correlated with their mathematics or reading test scores by age, gender and SES. Learning style was identified with Learning style: The clue to you! (LS: CY!) (Burke &Dunh, 1998). Mathematics and reading test score data were obtained from two Taipei Municipal elementary schools, and Socio-Economic Status (SES) was determined by Stevens and Cho's Socio-Economic Index (SEI) (Stevens & Cho, 1985).The result of two multiple regressions and two Correlation analyses revealed a significant relationship between a model composed of all predictor variables and Taiwanese student's achievement Scores in mathematics and reading.

Anderson (2007) examined the relationship of Locus of control (i.e., internal, external)**,** metacognition (i.e., awareness, planning, strategies, and self-checking), test status, age and gender in college algebra achievement among African American undergraduate students. A total of one hundred eight African American students enrolled in college algebra participated in this investigation. The demographic variables were computed by age, gender, test status, locus of control reinforcement and metacognition were used to classify the data. In this study, 66 female and 42 male students participated. The Chi-square test of independence was used to analyze the data. All the participants were enrolled in a college algebra course and were given the

JulianRotter's (1966) Locus of control scale and the O'Neil and Abedi (1996) state Metacognitive Self Assessment Questionnaire. Study revealed that Locus of Control reinforcement and testing status did have a significant relationship between college algebra achievements among African American undergraduate students. Metacognition, gender, and age did not have a significant relationship between college algebra achievements among African American undergraduate students.

McCullough(2007) investigated the impact of positive reinforcement on student's achievement in Mathematics and to investigate the impact of positive reinforcement on student's attitude. A pre-test post-test design was conducted in which the researcher taught all four classes in the study. The study consisted of four eighth-grade general math classes, for a total of 32 students, 7 in class A, 6 in class B, 12 in class C and 7 in class D. Class A and B were randomly chosen to receive positive reinforcement(treatment group) Class C and D were randomly chosen not to receive positive reinforcement(control group). The findings in the study indicated that students receiving positive reinforcement changed their perception about mathematics after 10-week period as opposed to students who did not receive positive reinforcement. The findings also indicated that gender had no affect on students attitudes towards mathematics or on students achievement in mathematics. However, the findings indicated that positive reinforcement does have an effect on student's achievement in mathematics.

Choi & Chang (2011) examined the important factors influencing the mathematics achievement of students in middle schools by hierarchically specifying the personal and contextual variables. The study focused on the effect of school climate at the class level and the effects of student gender, attitude toward mathematics, educational aspiration, parent education level, and language spoken at home at the student level. A multilevel analysis was conducted on United States middle grade student data for 8,912 eighth-grade students from 212 schools who participated in the Trends in International Mathematics and Science Study (TIMSS) 2007. The results revealed that teacher perceived school climate showed a significant relationship with the average student math performance. A cross-level interaction effect for the student's attitude toward mathematics and teacher perceived school climate was also statistically significant. Five predictors at the student-level were found to be significantly related to middle school student mathematics achievement: a student who had a positive attitude toward Mathematics, who was male, who spoke English as a primary

language, and whose parents were highly educated was likely to display a high level of mathematics performance.

Mohamed, Mustafa, LazimHamdan (2012) studiedthe key factors that influencing Libyan students' achievement in mathematics. A questionnaire of 30 items was distributed for Libyan students in Kuala Lumpur,Malaysia. The total number of the respondents was 201 (74 male and 127 female). One hundred and five students were in grade 4-6, eighty one students grade 7-9 and fifteen students from secondary school. Students were asked to respond to a 5-point Likert scale. Factor analysis technique was used and based on the Eigen values over one, six factors were identified. The combination of items, with loadings greater than 0.50, were considered as separate factors. These factors were Teaching Practices (which was recorded highly on loading), teacher' attribution, classroom climate, students' attitude towards mathematics and students' anxiety, in addition to students' mathematics achievement. Subsequently, confirmatory factor analysis was conducted using the Structural Equation Modelling. The results showed that the teacher' attribution and students' attitude towards mathematics were the highest and lowest factors influencing the students' achievement, respectively. Moreover, the relationship among Teaching Practices and teacher attribution was high (0.68). Generally, good correlations were found among these factors in one hand and student's achievement in mathematics in the other hand.

Zachariah, Komen, George, & George (2012) has found factors contributing to students' poor performance in Mathematics at Kenya and to establish the strategies that can be adopted to improve performance in Mathematics by students in secondary schools in Baringo County in Kenya. The study to determine the school based factors that affect students' performance in Mathematics in secondary schools, socio-cultural factors that affect them and their personal factors that affect performance in Mathematics, and established the strategies that can be adopted to improve performance in Mathematics. Descriptive survey research design was adopted for the study. The target population was 1876 respondents which comprised of Form Three secondary school students in Koibatek District, 132 Mathematics teachers and 9 head teachers. The data for the research was collected by use of three questionnaires; student, teachers and head teachers questionnaires. Factors contributing to poor performance include under staffing, inadequate teaching/ learning materials, lack of motivation and poor attitudes by both teachers and students, retrogressive practices.

Improving on these factors and sensitization of the local community to discard practices which prohibit student's effective participation in learning mathematics could improve performance in Mathematics. It is anticipated that the findings of this study will give curriculum developers new insights into emerging issues on performance and influence the Ministry of Education on policy formulation. Students are also expected to benefit from the findings; because improved mathematics performance will give them opportunities to pursue science related courses in higher institutions of learning and middle level colleges.

Suan(2014)studied the factors that affect underachievement in mathematics. There were three suspected identified factors that will scaffold this study. First is teacher factor, which is compose of mastery of the subject matter, instructional techniques and strategies, classroom management, communication skills, and personality. Second is student factor which include study habits, time management, and attitude and interests towards mathematics. Third is environmental factor such as parents' values attitudes, classroom settings, and peer group. The design of this study is descriptive – correlation method utilizing teacher – made questionnaire. Based on the findings, student factors such as study habits, time management, and attitude towards mathematics are the factors that affect underachievement in mathematics.

2.2.3. Studies Based on Comparison In Mathematics

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. Both classes had students of varying ability and diverse demographics. The regular classroom teacher taught the control group of 25 students using a traditional textbook and methods. The researcher presented the experimental group of 27 students with meaningful problem tasks that were solved in small groups and then presented to the class of validation. Data sources from both groups included a pre-test and post-test, students 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 in the involved stakeholders. Students came to view Mathematics in a more positive light, enjoyed the class, and felt they had learned more than usual. They believed attitude and achievement were measurable increased. The test scores gave strong evidence to support these convictions because the problem centered group had a highly significant increase in achievement compared to the traditional curriculum. Thus, problem centred learning appeared promising and worth further investigation.

Makanong(2000) investigated student's mathematics problem solving processes and to compare the mathematics problem solving processes and achievement levels between students being taught mathematics based on constructivist theory and those being taught mathematics based on traditional teaching on Thailand. The constructivist Teaching Based Model was developed based on a framework of constructivist theory and was composed of three teaching steps: Construction of cognitive conflict; reflection and discussion; and occlusion of the results from cognitive conflict; reflection and discussion; and conclusion of the results from cognitive restructuring. Lesson plans for constructivist teaching were constructed based on the constructivist Teaching Based Model. Activities in these lesson plan focused on student's existing knowledge, Collaborative working, real word context, use of manipulative, cognitive conflict, reflective teaching approach and Lash's translation model. The study is a quasi-experimental research using pretest-posttest non-equivalent control group design. Four classes comprising 164 9th –grade students were involved. Students in the experimental group were taught 9^{th} grade algebra based on constructivist teaching and these in the control group were taught based on traditional teaching. Four types of instrument the mathematics problem solving process test, the mathematics achievement test, the interview task problems and the classroom observation protocol were employed to collect data. Data were analysed quantitatively and qualitatively. The quantitative data indicated no significant differences of mathematics problem solving process and achievement between students in the two treatment group. The qualitative data indicated that constructivist teaching was a promising approach capable getting students more involved in learning mathematics. Students in this study who learned mathematics based on constructivist teaching tried harder, as measured by the interview task problems, than those who learned based on traditional teaching. A variety of institutional methods for teaching

algebraic problem solving and applying mathematics to the outside world were explored.

Hopkins(2004) investigated achievement difference of middle school and high school students in Tennessee as well as high school mathematics course enrolment as related to gender, school locate, school location and SES. Using data accessed from the Tennessee Department of education's 2003 report card, median male and female mathematics scores from the Tennessee comprehensive assessment program (TCAP) were used to examine middle school student's achievement. Scores from the ACT mathematics subtest were obtained from students completing the test during the 2002-2003 school years to explore achievement difference at the high school level. Finally, surveys were sent to each high school in Tennessee to study mathematics course enrolment figures. Collected data were analysed to investigate differences in gender over school locate (Rural, Large central city, other Non rural), Location (Appalachian or Non Appalachian) and SES. A school's SES was categorised by the percentage of disadvantage d students, those receiving free or reduced lunch, as low to moderate (less than 50%), high (50 to 74.99%) and highest (75% 0r more). Statically significant gender differences were found at both the middle school and high school level in mathematics achievement. Expected differences were also found with respect to mathematics achievement and SES. Several other interactions of gender, locate and SES were found with respect to high school achievement. Of special note was the interaction between locate and SES. A similar pattern of interaction between these two variables was found for each of the middle grades as well as high school mathematics achievement.

Kamp(2007) examined the impact of standards based method (JBHM) and traditional method on student mathematics achievement. The research design was a qusi-expremental design, with 65 students of seventh-grade participating. Group A received a traditional method of instruction through the use of mathematics applications and connections course 2 and group B received a standard based method of instruction through the use of JBHM Achievement connections. The test instrument administered for the pre-test and post-test was the PLATOedu test. An analysis of the pre-test and post-test scores was conducted. T-tests were run to examine the differences between pre-test and post-test scores and gender based on the method of instruction. Analysis of variance (ANOVA) was computed to examine difference in performance based on class period representation. A paired t-test was computed to

examine differences between the pre-test and post-test scores after students were exposed to a method of instruction. The findings showed that there were no statistical differences in student achievement between both the methods. The students taught by both the instruction, increased mathematics outcomes. However, the students taught using JBHM achievement connections standards based method of instruction had a higher mean score and a greater degree of gain between pre-test and post-test scores than the students taught using Mathematics Applications and Connections, course 2 traditional method of instruction.

Caraisco (2008) compared the mathematics achievement, attributes and attitudes of fourth-, sixth- and eighth-grade students (gifted and non gifted). A focus of this researcher was an analysis of different relationship outcomes between gifted and non gifted boys and girls (n=172). The research design of this study was non-experimental and ex-post facto. The result of this found significant difference in the mathematics attributes, mathematics attitude, mathematics attribution and mathematics achievement between boys and girls; Significant differences in mathematics attributes, mathematics attitude, mathematics attribution and mathematics achievement between elementary and middle school level; Significant differences in mathematics attributes, mathematics attitude, mathematics attribution and mathematics achievement between family structures; significant direct and direct effects of exogenous and endogenous variables for the mathematics achievement of the full sample, the gifted, the non gifted, the elementary and the middle school students.

Fengfeng, K. (2008) has examined the use of educational computer games in a summer math program to facilitate 4th and 5th graders' cognitive math achievement, metacognitive awareness, and positive attitudes toward math learning. The results indicated that students developed more positive attitudes toward math learning through five-week computer math gaming, but there was no significant effect of computer gaming on students' cognitive test performance or metacognitive awareness development. The in-field observation and students' think-aloud protocol informed that not every computer math drill game would engage children in committed learning. The study findings have highlighted the value of situating learning activities within the game story, making games pleasantly challenging, scaffolding reflections, and designing suitable off-computer activities.

Garo(2008) compared algebraic achievement and educational practices of 9th graders in Albania and the U.S., as well as identifying those educational practices that appear to be significant predictors for algebraic achievement of students in each country. In April and May 2007, 242 9th grade American students from four high school in Grand Forks of the state of North Dakota (U.S.) and 219 students from four high schools in Durres (Albania), participated in the study. The data collection instruments consisted of an achievement test and a student questionnaire. The test adopted a Texas Publicity Released Standardized Test. It was focused on the algebra 1 knowledge covered by schools of the two countries during the academic year 2006-07. While one part of the U.S. sample (145 students) did not use calculators on the test, the other part (97 students) used calculators. The entire sample of Albania students did not use calculators on the test. The questionnaire attempted to measure students perceptions of educational practices exercised in classrooms and communities of each country. The study did not found significant difference in the overall algebraic achievement of students in the two countries. Albanian students significantly outperformed American students in the specific domains of knowledge and applying. The difference in the specific domain of reasoning was not significant. Furthermore, American calculator users significantly outperformed by Albanian in the cognitive domains of applying and reasoning but significantly outperformed in the cognitive domain of knowing. The study also found significant differences in many instructional and non-instructional practices used in the cultures of these countries. Some practices such as taking multiple-choice tests, spending time with friends, re-teaching of a topic and self competence in mathematics appear as significant predictors of achievement of students in both countries.

Yuliang (2013) has studied effect of multimedia to improve Math learning. This quasi-experimental study was to design, develop, and implement one multimedia math lesson in third grade to improve students' math learning. The non-equivalent control group design was used. The experimental group had 11 third grade students and the control group had 15 third grade students in an African American predominated elementary school in the Midwest of USA. The independent variable was the multimedia math lesson and the dependent variable was students' math performance. It was hypothesized that the (a) teacher and students scored favourably about the multimedia math lesson, (b) students were very attentive to multimedia math instruction, and (c) the students scored statistically higher on the posttest at the

end of the intervention in the experimental group than in the control group. The findings have theoretical and practical international implications for K-12 education.

2.2.4. Summary of Studies Conducted Abroad

Researcher has reviewed total 18 studies from 1999 to 2010. The foreign studies have focused on attitude towards mathematics, achievement in mathematics, effect of certain variables on mathematics achievement, comparison of different method of teaching mathematics etc.

Martin(2002) explored the math attitude of gifted students in grades three, four, five and six participants in an accelerated math program with a focus on gifted girls in the elementary grade. A multivariate analysis of variance (MANOVA) compared the groups within the domain clusters. Girls revealed more negative math attitudes compared to the boys at all grade levels. Interaction in motivation between fourth and sixth grade and fifth and sixth grade were significant at the 0.05 level. Wilson(2002) has examined the attitudes and career choice for eight grade students at one East Tennessee middle school. Both the male and female average attitude towards mathematics was positive. Differences in percentages of yes/no responses were found; thus, the researcher concluded that attitude towards mathematics is related to career choice. Abrams (2008) investigated the effect on the mathematics achievement and motivation of 33 urban elementary and middle school students as a result of their having played topical computer games prior to receiving direct instruction. However, an analysis of frequencies and percentages conducted of student, teacher and parent responses on pre- and post-study questionnaires supported playing computer games for motivating students to learn mathematics, improving students self efficacy for learning mathematics, improving students ability to receive mathematics instruction and improving their interest in mathematical activities. Deevers(2010) investigated relationships among teacher practices, student motivation and student achievement on standardized mathematics assessments using an achievement Goal Theory Framework. Finding indicated teacher mastery goal endorsement was positively related to student mastery and performance-approach orientations and negatively related to student performance-avoidance orientation.

From 18 total 9 studies on factor affecting Mathematics achievement, analysed in the following table.

Table: 2.2

Analysis of the studies conducted in abroad related to factor affecting Mathematics achievement

Investigator	Place	Type	Correlates of Mathematics achievement
Ownes(1999)	Walters state community college in MorristownTennessee	Experimental design	- Cognitive learning style -Mathematics attitude
Barker(2003)	Eight grade middle school student in the Atlanta city public school system		-Motivational conditions
Shirvani-Arani(2004)		Experimental design	-Teacher communication with parents
Marino(2005)	10^{th} grade students in AmmanJordan		-Attitude towards learning Mathematics
Um(2005)	8^{th} grade students in USA		-Motivational resources
Carmichael(2005)	4^{th} and 6^{th} grade students in the white country Tennessee school		-SES
Chen(2006)	11 and 12 year old female and male Taiwanese adolescents		-Learning style with reference to age, gender and SES
Anderson(2007)	African American undergraduate students		-Locus of control -Metacognition. Test status, age,

			gender
McCullough(2007)		Experimental design	-Positive reinforcement

Owens (1999) investigated relationship of cognitive learning styles, mathematics attitude and mathematics achievement for student instructed with problem posing activities. If was conducted with pre-algebra, students at Walters state community college in MorristownTennessee. For attitude domains of anxiety and confidence in doing mathematics, abstract learners in the treatment group showed significantly lower attitude improvement than abstract learners in the control group. Abstract learners in general found mathematics more useful than did concrete learners. Barker(2003) has examined the effects of motivational conditions on the mathematics performance of students on the NAEP assessment. Data indicated that goal orientations, gender, and metacognition did not significantly affect student performance. Ethnicity, item format, recall of directions, effort and worry did significantly affect the performance of the students on assessment. Shirvani-Arani(2004) has examined the effect of teacher communication with parents on students mathematics achievement. With respect to gender, teacher communication with parents did not affect student's achievement differently. The results from parent surveys showed that parents in the experimental group had developed more positive attitudes towards homework compared with the attitudes of the parents in the control group. Mriano(2005) investigated the relationship between student's attitude towards learning mathematics and mathematics achievement with respect to gender in 10^{th} grade students in AmmanJordan. The overall results of the study indicate that there was significant difference in attitude and achievement between male and female students in the 10^{th} grade. Um(2005) has developed and tested a model, based on self determination theory(SDT), describing the effects of motivational resources on mathematics performance. Both structural equation modelling and multilevel path modelling analyses confirmed that intrinsic motivation positively influenced mathematics performance, where as external regulation negatively. A positive mathematics self-concept significantly affected mathematics performance both directly or indirectly through the mediator of intrinsic motivation. Carmichael(2005) examined the effects of Socio-Economic Status on the academic performance of all

fourth and sixth grade students in the white country TennesseeSchool system. Individual ANOVA tests were conducted to identify significant differences in achievement between the eight schools and the two dependent variables, reading and mathematics. There was no significant main effect of reading between schools but there was a significant difference found in mathematics scores between the schools. Chen(2006) has examined the difference in learning style preference of 704 11 and 12 year old female and male Taiwanese adolescents and then determined whether their learning styles correlated with their mathematics or reading test scores by age, gender and SES. The result of two multiple regressions and two correlation analysis revealed a significant relationship between a model composed of all predictor variables and Taiwanese student's achievement Scores in mathematics and reading. Anderson (2007) examined the relationship of Locus of control (i.e., internal, external), metacognition (i.e., awareness, planning, strategies, and self-checking), test status, age and gender in college algebra achievement among African American undergraduate students. Study revealed that Locus of Control reinforcement and testing status did have a significant relationship between college algebra achievements among African American undergraduate students. Metacognition, gender, and age did not have a significant relationship between college algebra ach-ievement among African American undergraduate students. McCullough (2007) investigated the impact of positive reinforcement on student's achievement in Mathematics and to investigate the impact of positive reinforcement on student's attitude. The findings indicated that gender had no affect on student's attitudes towards mathematics or on student's achievement in mathematics. However, the findings indicated that positive reinforcement does have an effect on student's achievement in mathematics.

Makanong(2000) investigated student's mathematics problem solving processes and to compare the mathematics problem solving processes and achievement levels between students being taught mathematics based on constructivist theory and those being taught mathematics based on traditional teaching on Thailand. The quantitative data indicated no significant differences of mathematics problem solving process and achievement between students in the two treatment group. The qualitative data indicated that constructivist teaching was a promising approach capable getting students more involved in learning mathematics. Students in this study who learned mathematics based on constructivist teaching tried harder, as measured by the interview task problems, than those who learned based on traditional teaching.

Hopkins(2004) investigated achievement difference of middle school and high school students in Tennessee as well as high school mathematics course enrolment as related to gender, school locate, school location and SES. Expected differences were also found with respect to mathematics achievement and SES. Several other interactions of gender, locate and SES were found with respect to high school achievement. Kamp(2007) examined the impact of standards based method(JBHM) and traditional method on student mathematics achievement. The students taught by both the instruction, increased mathematics outcomes. However, the students taught using JBHM achievement connections standards based method of instruction had a higher mean score and a greater degree of gain between pre-test and post-test scores than the students taught using Mathematics Applications and Connections, course 2 traditional method of instruction. Caraisco-alloggiamento (2008) compared the mathematics achievement, attributes and attitudes of fourth-, sixth- and eighth-grade students (gifted and non gifted). Garo(2008) compared algebraic achievement and educational practices of 9^{th} graders in Albania and the U.S., as well as identifying those educational practices that appear to be significant predictors for algebraic achievement of students in each country. The study did not found significant difference in the overall algebraic achievement of students in the two countries. Albanian students significantly outperformed American students in the specific domains of knowledge and applying.

2.4. Implications for the Present Study

From the review of related literature to the present study, it is found that most of the studies were related to diagnosis and remediation in different areas of Mathematics, achievement and learning in Mathematics and factor affecting Mathematics achievement or correlates of Mathematics achievement.

From the Indian studies Das and Barua (1968), Thakor (1980), Trivedi (1980), Rastogi (1983), Chel (1990), Bhardwaj (1987), Raman (1989), Wagh (1991), Subramaniam and Singh (1996) Warute (1998), Venkateshwarlu (2001), George (2003) has found that there were significant effect of remedial measures in different areas of Mathematics. S.I.E.Guj. (1969) has revealed that pupils did not know the entire process of addition, subtraction, multiplication and addition. Even Takore (1980) has found that students did not understand addition, subtraction, multiplication and division of decimal fractions.Chel (1990) shown that underachievement was

caused due to lack of understanding of Mathematics concepts of the earlier stage and the abstract nature of Mathematics. Ashar (1972) found that pupils committed errors due to lack of systematic approach and trends of errors continued to a greater extent in the higher grades.

Further Chitkara (1985) studied the effectiveness of different strategies of Teaching on Achievement in Mathematics. Kothari (1985) investigated the efficacy of different instructional media into the teaching of Mathematics and pupils enjoyed studying through this media as it was activity oriented, Visual projection is comparatively more effective than any other Instructional media like Activities and experiment or even programmed learning material for teaching of Mathematics and the low achieving pupils are comparatively more benefited by programmed learning material than the high achievers and the average achieving pupils. Nalayini (1991) revealed number games motivated children to develop the computational skills. Anderson (2007) examined Locus of control (internal and external) reinforcement and McCullough (2007) investigated positive reinforcement on student's achievement. Kapur&Rasario (1992) conducted intervention strategies for students with problems in learning Arithmetic. Singh (1992) found the effectiveness of the CAI teaching method. Sharma (1999) studied the effect of mathematical instructions as well as Mukherjee (2001) developed a Mastery Learning programme based on competencies in Mathematics and found effective.

Researches also explore some significant correlates or variable which affects Mathematics achievement. Lalithama (1975), Jain (1979), Sarala (1990), Rajyaguru (1991), Kasat (1991), and Srivastava (1992) have shown that intelligence one of the significant factor affecting Mathematics achievement. Jain (1979), Patel (1984), Pal (1989), Baskaran (1991), Rosaly (1992), Wangu and Thomas (1995), TzwngShwu-Rong (1987) also found the impact of attitude towards Mathematics on Mathematics achievement.Saun (2014) has given that attitude towards mathematics responsible for under achievement. Marino (2005) investigated that attitude towards learning Mathematics is related with Mathematics achievement. WhileWilson (2002) has conclude that attitude towards Mathematics is related to the career choice. Lalithama (1975), Setia (1992), Prakash (2000), Chen (2006) found that SES is also one responsible factor.Srinivasan (1999) did not discover any such relation.Lalithama (1975), Sarala (1990), Kasat (1991) also revealed that study habits is also one important correlates. While Saun (2014) has revealed that one of the factors study

habit was responsible for under achievement.Thampuraty (1994) and Prakash (2000) also in favour of problem solving ability which is one of the significant factors responsible for Mathematics achievement. Jain and Burad (1988) found the causes as responsible for low results in secondary mathematics were lack of timely correction of homework; overburdened and uninteresting curriculum; lack of child centered teaching; insufficient periods for teaching mathematics; and lack of suitable teaching aids.Sashidharan (1992) investigated the initial deficiencies have long term damaging effect because the content of education is organized in such a way that learning in each class is depending on prior learning. Taking the evidence from the studies that variables like intelligence, attitude, SES as well as initial deficiencies are also responsible for Mathematics achievement which provides importance support for the present study.