CHAPTER - II
REVIEW OF RELATED LITERATURE

2.1 OVERVIEW

This chapter presents a comparative and comprehensive analysis of review of studies related to the research chosen by the investigator for her study. It consists of nine sections. The first section outlines the overview of the entire chapter. The second section gives an account of the need for the review. The third section analyses the studies carried out in India and Foreign countries related to co-operative learning. The fourth section portrays the Indian and Foreign studies related to critical thinking. The fifth section deals with the Indian and foreign studies related to problem solving. The sixth section presents the Indian and Foreign studies related to co-operative learning and critical thinking. The seventh section deals with the Indian and Foreign studies related to critical thinking and problem solving. The eighth section is about the Indian and Foreign studies related to co-operative learning and problem solving ability. Critical review is presented in the last section.

2.2 NEED FOR THE REVIEW

The term review means to organize the knowledge of the specific area of research to evolve an edifice of knowledge to show that the proposed study would be an addition to this field. In research methodology, the term
literature refers to the knowledge of a particular area of investigation of any discipline which includes theoretical, practical and its research studies. John Best, (2006) views, “A brief summary of the previous research and the writings of recognized experts provide evidences that the researcher is familiar with what is already known and untested. This step helps to eliminate the duplication of what has been done, and provides useful hypotheses and helpful suggestions for significant investigation.”

The knowledge of related literature enables the investigator to define the frontiers in the field of research. It helps the research worker to find what is already known, what others have attempted to find out, what methods of have been adopted and what problems remain to be solved. It shows whether the evidence already available solves the problem adequately without further investigation. It is the basis of most of the research projects in various sciences, and humanities. It furnishes him with indispensable suggestions about comparative data, good procedures, likely methods and tried techniques. The study of related literature places researchers in a better position to interpret the significance of their own result and it avoids unintentional replication of previous studies. It provides ideas, theories, explanations, hypotheses and methods of research, valuable in formulating and studying the problem.

2.3 STUDIES RELATED TO CO-OPERATIVE LEARNING APPROACH

2.3.1 Indian studies
Hameed A., and Sasidharan P. (2011), made a study on ‘Effectiveness of Jigsaw II model on Achievement in Malayalam Language of standard VIII,. The results of the study proved that the experimental and the control groups revealed significant difference in the mean achievement scores. In all the comparisons, the experimental group in which co-operative learning strategy was applied, excelled the control group, for which lecture method of teaching was used. Higher mean achievement scores were associated with the experimental group. That means, pupils taught through co-operative learning achieved more over the pupils taught through lecture method of teaching.

Malini P.M. (2011) made a study on ‘Effectiveness of Jigsaw technique in the learning of Mathematics for secondary school students’. The findings revealed that the mean achievement of the experimental and the control groups differed significantly at 0.01 level of significance. The higher mean achievement score of the experimental group showed that the experimental group was superior to the control group in the achievement. Thus students taught through Jigsaw technique had better achievement than the students taught through the conventional method. The study showed that Jigsaw technique was more effective than the conventional method of teaching Mathematics.

Palalvi Kaul (2010) conducted a study on ‘The Effect of Learning Together Techniques of Co-operative Learning Method on Students Achievement in Mathematics’. The major objective was to find out the effect
of the co-operative learning method over the traditional method in teaching Mathematics in the seventh grade. It was observed that learning technique of co-operative learning method was more effective than the traditional method of teaching Mathematics in the seventh grade.

Sandhya, R. Badhe (2010), conducted a study on ‘Teaching Image Formation Through Co-operative Learning Method’. The major purpose was to study the effectiveness of co-operative learning method in terms of student's responses and to study the effectiveness of work cards in terms of response of students. The findings indicated that the co-operative learning method had positively affected the performance of students. The use of work cards for experiments on the topic 'image formation’ positively affected the performance of the students.

Hemant Lata Sharma (2008) conducted a study on ‘Effectiveness of Co-operative learning on Interpersonal Relationship among Elementary school students’. The study revealed that the co-operative learning approach had greater effect on the development of interpersonal relationship of seventh grade students. It resulted in better understanding of each other and thus provided opportunities for positive growth. The study also proved that the co-operative learning approach made relationships more positive and it inspired the learners to cherish, cultivate and develop social attitudes, goals and skills.

Vandana Mehra (2008) investigated the ‘Effectiveness of Co-operative
Learning on Achievement and Retention in Mathematics of Seventh Graders with Different Cognitive Styles. The objectives were to compare the main gain on achievement scores in Mathematics of the students taught through different instructional treatments, to study the effectiveness of the two instructional treatments for the field independent and field dependent students, to study the effectiveness of two instructional treatments for field independent and field-dependent groups of students at knowledge, comprehension and application levels of objectives, to compare the retention scores of students exposed to different instrumental treatments, to study the effectiveness of the two instructional treatments for field independent group of students with respect to retention, and to study the effects of two instructional treatments for field independent and field dependent groups at knowledge comprehension and application levels of objectives on retention scores. The results indicated that students when exposed to Co-operative learning yielded better mean gain on achievement scores and retention scores as compared to those taught through conventional group learning. Field independent and field dependent students yielded comparable mean gain on achievement scores but field independent students exhibited better retention than field dependent group of students. Through co-operative learning, students yielded better mean gains on achievement scores and retention scores on items, related to knowledge than those related to comprehensive level; but yielded comparable mean gains on item related to comprehensive levels and application levels.
Kalpana H. (2008) conducted a study on ‘The Effectiveness of Co-operative Learning on Teaching Poetry: Some Class Room Strategies’. The purpose of the study was to determine the effectiveness of co-operative learning on teaching poetry for the total sample. The study concluded that the Co-operative learning method was more effective than the traditional method for teaching poetry. Co-operative learning developed students’ social skills and boosted students’ retention. Also it facilitated students’ skill in oral communication.

Hemant Lata Sharma, and Savita Sharma (2008) conducted a study on ‘Conventional Teaching Vs Learning in small groups - Effect on student's performance in Geography at elementary level’. In this study, an attempt was made to find the effectiveness of Conventional Teaching over Learning in small groups, i.e., Student Teams Achievement Division (STAD) under Cooperative Learning method in learning Geography at elementary level. It also compared the performance of High, Average and Low achievers when taught through conventional method, and when in small groups, i.e., STAD under Cooperative Learning method. The study showed that performance of students was better when they learned under Cooperative Learning method as compared to their counterparts. The study concluded that learning in small groups resulted in "Positive Student Outcomes".

Thankarajathi S. (2007) conducted a study on ‘Co-operative Learning Approach in Learning Mathematics’. The objective was to find out the
effectiveness of the Co-operative Learning Approach over the conventional method in learning Mathematics of high school high, average, and low achievers. The results indicated that there was significant difference between the post test scores of students in co-operative learning group and conventional group. There was significant difference between the post test scores of high, average and low achievers in the co-operative learning approach group. There was significant difference between the pre test and the post test scores of the conventional method group and the co-operative learning approach group students in terms of sex, locality, tuition undergone and type of tuition.

Chinnappa Arasu P. (2006) investigated ‘The Effectiveness of Co-operative learning approach in teaching Chemistry at +1 level’. The major finding was that there existed significant difference between the control group and the experimental group in their post – test performance, (t-value in 2.75), which was significant at 0.05 level for two tailed test. This result showed the superiority of the co-operative learning approach over the traditional method of instruction.

Satya Prakash, C.V. and Patnaik, S.P. (2006), conducted a study on ‘Effect of Cooperative Learning on Achievement Motivation and Achievement in Biology’. The finding indicated that there was positive effect of Cooperative Learning on Achievement Motivation, and the Cooperative Learning had a positive effect on achievement in Biology in terms of
knowledge, understanding and application objectives as well as total achievement.

Sangeeta (2005) made a study on ‘Role of Multimedia and Co-operative Learning In Enhancing the Writing Competency of Students’. The major objectives were to find out the impact of co-operative and multimedia learning upon the writing competency of students and to compare the relative efficacy of co-operative and multimedia learning on the writing competency of students. The results indicated that the difference between the mean pre and post test scores of experimental group in writing composition was statistically significant.

Sathya Prakash C.V., and Patnaik, S.P. (2005) conducted a study on ‘Effect of Co-operative Learning on Development of Process Skills in Biology’. The objectives were to implement co-operative learning in teaching of Biology and to find out its effect on development of some of the process skills. Findings indicated that Co-operative learning significantly helped in the improvement of different components of process skills in Biology such as observation, generalisation, interpretation, inference and prediction.

Sathya Prakash C.V. and Pushpanjali B.S. (2005) conducted a study on ‘Effect of Cooperative Learning On Achievement Motivation And Anxiety’. The main objective was to find out the effectiveness of co-operative learning strategy on achievement motivation and anxiety of class
VIII students of Bangalore city. It was concluded that co-operative learning strategies had positive impact on achievement motivation of children. Hence, it was implied that this strategy could be effectively employed in teaching various subjects in the elementary school level.

Ponnusamy P. and Sudarsan.S (2005) conducted a study on ‘Student Achievement and Cooperative Learning method in Mathematics at upper primary level’. The major objectives were to study the effectiveness of Co-operative Learning in enhancing the Mathematics achievement of the students at the upper primary level and to study the effect of variables such as sex and standard on the achievement of the students who learned through Co-operative Learning method. The findings indicated that the Co-operative Learning contributed a lot to improve the academic performance of the students in 7 & 8th grades in learning Mathematics. The standard and gender had no effect on the performance of experimental group students and therefore the effectiveness of Co-operative Learning was generalized.

Tripathy, H.H. (2004) conducted a study on the ‘Effectiveness of Co-operative language learning – A perspective’. The major objective was to find out communicative competency in a language by conversing in situations. The study concluded that the Co-operative language learning encouraged co-operation among the learners and a sense of belonging to the group. It increased interaction on the part of the learners.

Language Learning as A Perspective’. The study concluded that the Co-operative Language Learning developed communicative competence in language by conversing in socially structured situations. CLL fostered co-operation rather than competition in learning and a sense of belonging to the group. It encouraged the participation of learners with a minimum of teacher fronted learning and increased interaction among the learners. Also CL increased critical thinking of learners.

Kalayiyarasan G. (2003) conducted a study on ‘The Effectiveness of Co-operative Learning Approaches on Interpersonal Relationship at High school’. The major objectives were to find out whether the approach "STAD with Reward" was more effective than the traditional approach in enhancing interpersonal relations. The results indicated that the experimental group – I and II differed in its pre and post test in interpersonal relationship. The co-operative learning approaches proved to be more effective in enhancing interpersonal relationship among learners.

2.3.2 Foreign studies

Effandi Zakaria (2010) made a study on ‘The Effects of Co-operative Learning on Students’ Mathematics Achievement and Attitude towards Mathematics’. The purpose of this study was to determine the effect of co-operative learning on Mathematics achievement and attitude towards Mathematics. The results of this study showed that co-operative learning methods improved students’ achievement in Mathematics and attitude towards Mathematics. The researchers concluded that co-operative learning
was an effective approach, which Mathematics teachers needed to incorporate in their teaching.

Rita Rani Mandal (2009) conducted a study on ‘Co-operative learning strategies to enhance writing skill’. This study aimed to find out the effectiveness of co-operative learning strategies to enhance writing skill. In Co-operative learning, the students were given opportunity to write and to revive and to rewrite what they had written. They showed high level of enthusiasm, curiosity and involvement when being taught through co-operative learning tasks. Thus, an incorporation of these activities would be of great benefit to the student community and helped them to enhance their writing skill.

Tse - Kian Neo, Mai Neo and Joyce W.J. Kwok (2009), investigated a study on ‘Engaging Students in a Multimedia Co-operative Learning Environment: A Malaysian experience’. The purpose of the study was to determine its impact on student learning, their perceptions and learning experiences. The results were encouraging as students managed to co-operate with each other to accomplish their common goal. The use of blogs served as a tool to enhance team co-operation and to foster a learning community within the class. This multimedia enhanced co-operative environment proved to be a viable alternative to the traditional class room and was an effective strategy to enhance the students’ learning process.

Alexander Julie (2009) conducted a study entitled as ‘Student
perspectives on the benefits of Co-operative Learning Skills taught in Fifth Grade Classrooms in the Archdiocese of San Francisco and the impact of bullying behaviors school wide’. The objectives of the study were to investigate the impact of Co-operative learning skills on the bullying behaviors of fifth grade students within the three catholic elementary school classrooms in the Archdiocese of San Francisco, to explore how three fifth grade teachers within the Archdiocese of San Francisco incorporated the instruction of interpersonal skills into Co-operative learning strategies, and to examine the perception of fifth grade teachers and students within the three schools in the Archdiocese of San Francisco on bullying behaviors. The study concluded that co-operative learning had an effect on bullying. It was found out that Co-operative learning was helpful in how students dealt with bullying situations but did not cause the bullying to stop. Overall, the students perceived that there was a positive effect on bullying behaviors.

Morris John Llewellyn (2009) conducted a study entitled as, A Qualitative Investigation of Interdisciplinary Mixed Ability Co-operative Classes in an Inner Ring Suburban High School." The purpose of the study was to understand students’ perceptions of their learning environment, their peers and themselves within an interdisciplinary mixed ability co-operative educational setting and the social justice implications. Research analysis revealed an emphasis on the domains academic environment, social environment, self-perceptions and reflection. The peer environment helped
foster cross level, cross race friendships, a positive classroom climate and an understanding of both personal and academic relationships. Participants’ personal self perceptions were positively validated and challenged by their experiences. This investigation suggested the adoption of an interdisciplinary mixed ability co-operative learning approach in schools.

Gilbert Cedrick D. (2008) conducted a study on ‘The Effects of Co-operative Learning and Teaming on Student Achievement in Elementary Mathematics’. This study examined the effects of co-operative learning and non cooperative learning in 20 Mathematics classes for 6 weeks. The study concluded that co-operative learning did not have significant impact on academic success. The ANOVA with repeated measures analysed determined that Mathematics pre test, weekly test, and post test scores in grades 1-5th revealed that there was no significant difference among co-operative learning groups compared to traditional 1 lecture groups. However, when considering academic progress among groups, there was difference amongst grade levels. Students in grades 3rd, 4th and 5th posted considerably higher Maths scores in co-operative learning groups than 1st and 2nd grade students’ Maths scores for both types of classes were higher between weeks 1 & 3 than weeks 4, 5 & 6. Also the results showed substantial differences among attitudes in co-operative learning than Traditional method at 0.05 level of significance.

Griffin Kathy R., (2008) made an investigation on ‘Use of Co-operative Learning and Computer Assisted Instruction to investigate
Mathematics Achievement Scores, Student’s Attitude towards Co-operative learning and Confidence in Subject Matter’. This study concluded that there existed significant difference in Mathematics achievement scores between students working in co-operative learning groups using CAI and students working alone using CAI class. Co-operative learning using CAI changed the student’s attitude towards confidence towards subject matter, and positive attitude towards co-operative learning approaches.

Cary J. Roseth et.al. (2008) made a study on ‘Promoting Early Adolescents Achievement and Peer Relationships: The Effects of Cooperative, Competitive, and Individualistic Goal Structures’. The researchers examined the effects of co-operative, competitive and individualistic goals on early achievement and peer relationships among 12 to 15 years old adolescents. The findings suggested that when teachers structured their class rooms more co-operatively, students felt more support and connection with their peers, had better success on academic tests and tasks, and sustained higher levels of achievement due to the better peer relations.

Gomleksiz M.N. (2008), conducted a study on ‘Effectiveness of Co-operative Learning (jigsaw II) Method in Teaching English as Foreign Language to Engineering Students’. The study compared the effects of the co-operative jigsaw II method and traditional method in improving vocabulary, knowledge and active and passive voice of engineering students and the
student’s attitudes towards co-operative learning. The results revealed statistically significant difference in favour of group on the dependent variables of improving vocabulary knowledge and learning voice in English. The attitude scale results showed that the co-operative learning experience had a significant positive effect on engineering student’s attitudes towards learning English and it fostered better interactions among students as well.

Biru Jean Dufty (2008) conducted a study entitled as ‘A Preliminary Investigation Towards Initiating Co-operative Learning with Main Streamed Deaf / Hard of Hearing Students’. The purpose of the study was to investigate the potential of initiating a co-operative approach towards being helpful to deaf / hard of hearing students in the main stream, in easing communication by encouraging interaction with peers sharing common academic goals and training teachers in using small group work as an option to whole class teaching. The study indicated that the initiation and behavioral effects of co-operative learning was more successful with the elementary students than with the secondary students, The study revealed that the key issues for the success of the initiation of co-operative learning depended on teacher collaboration, teacher and student intervention in communication and social skills and the involvement of the teacher as participant - observer in the classrooms.

Hines Carlon drea (2008), conducted a study entitled as, ‘An Investigation of Teacher Use of Cooperative Learning with Low Achieving African American Students.’ The purpose of this study was to determine
which Co-operative learning strategies teachers used and how these strategies were implemented in order to increase achievement of low achieving African American students. Study findings implied that to maximize effectiveness of co-operative learning strategies in the classroom it was important that teachers know what role he/she must take for students success and the steps for implementing a particular co-operative learning strategy.

Ross Michael C. (2007) conducted a study entitled as ‘The effects of Socioeconomic Status and Learning Styles on the Achievement of Seventh-Grade African-American Students when Instructed through Co-operative Learning in Social studies’. Co-operative learning and lecture discussion methods of social studies instruction for seventh-grade low SES African-American and low SES Caucasian students were investigated for their effectiveness. The analyses of the results indicated that African-American students were field-dependent learners, which created a conflict when using co-operative learning as an instructional method with low SES African-American students.

Alhaidari Mohammed S. (2007), conducted a study entitled as, ‘The Effectiveness of Co-operative Learning to Promote Reading Comprehension, Vocabulary, Fluency and Achievement Scores of male fourth and fifth grade students in a Saudi Arabian school’. This study examined the extent to which the use of Co-operative learning on the reading performance of grade four and five students in the standard reading curriculum. The results of the
analysis indicated significant differences between the experimental and comparison groups on post measures of vocabulary and fluency, and students' attitude toward co-operative learning. Conversely, the result also showed that there were no significant differences between the experimental and comparison groups on post-measures of reading comprehension and students' motivation towards reading.

Adkinson Jane Ellen (2007) conducted a study entitled as ‘Does Co-operative Learning Affects Girls’ and Boys’ Learning and Attitudes towards Mathematics Transformation Skills in Single Sex and Mixed - Sex Class Rooms? The purpose of the study was to investigate 4th and 5th grade single sex classrooms (SSC) and mixed - sex class rooms (MSC). Existing all girls SSC, all boys SSC and MSC were presented with a co-operative learning using the student team achievement divisions STAD technique. No significant differences were found between girls and boys learning scores for the main effects of classroom environment. There was no significant differences between all classrooms combined based on the presence of a co-operative learning treatment. The results also showed no significant differences between girls in SSC, without SSC, without CL and girls in MSC without CL. However boys learning in SSC with CL were significantly lower than boys learning in MSC without CL. In terms of CL treatment, girls in SSC scored significantly higher than girls in the MSC environment. There were no significant difference in learning scores for boys in SSC and MSC
environment. The data analysis for students’ attitude towards learning Mathematical transformation skills found one significant interaction between instructional strategy and classroom environment specifically for boys’ attitudes toward their teacher perception. The data analysis also found two significant main effects for classroom environment in boys’ confidence in (m) Math (c) & girls usefulness of Math (u) attitude scores. No significant main effects for instructional strategy were found. The data analysis for attitudes showed no significant interaction or main effects on instructional strategy & classroom environment for boys & girls perception of Math as a male domain.

Ayhan Dikici (2006) conducted a study on “The Effect of Co-operative Learning on the Abilities of Pre-Service Art Teacher Candidates in Lesson Planning in Turkey.” In this study, the effect of co-operative learning on the abilities of the pre-service art teacher candidates to plan lessons were emphasized. The results of research showed that there was no significant difference between the pre-test. However, there was significant difference between the post-test points in favour of the experimental group, and also it showed that the co-operative learning method was an essential learning method in training our fine arts teachers. Also it supported the co-operative learning as a learning preference of art teachers.

Jean Thompson (2005), conducted a study on ‘Co-operative Learning in Computer Supported Classes’. This study examined students' discourse
patterns and skills and behaviours when working at computers through co-operative work. The findings indicated that students worked cohesively together through building and accumulating ideas. The ability to monitor, control and reflect on their own use of oral and body language would enhance students’ understanding and appreciation of group work. Thus students at all levels of education were increasingly being asked to work co-operatively and collaboratively.

Mary Baumberger Henry (2005) investigated, ‘Co-operative learning and Case Study : Does the Combination Improve Students' Perception of Problem Solving and Decision Making Skills?’. The purpose of this study was to investigate the effectiveness of co-operative learning techniques combined with case study on nursing student's self perception of problem solving and decision making skills in comparison with other teaching – learning methods. The results, showed that the experimental group obtained scores indicating better self perception of both problem solving and decision making skills.

William L. Anderson, et.al., (2005) conducted a study on, ‘Comparison of Students’ Performance in Co-operative Learning and Traditional Lecture Based Bio-Chemistry Classes’. Student performance in two different introductory Biochemistry curricula was compared based on standardized testing of student content knowledge, problem solving skills and student opinions about the courses. In conclusion it was determined that problem based small group co-operative learning approach to undergraduate
Biochemistry education was a more effective educational tool for engaging students in the course material while also improving students’ performance.

Elen B. Susman (2004) conducted a study on, ‘Co-operative Learning - A Review of Factors that Increase the Effectiveness of Co-operative Computer –Based Instruction (CBI)’. This meta analysis concentrated on the presence of two factors, Co-operative learning and Problem Solving in CBI, which compared Co-operative CBI and Individual CBI. This study provided more evidence that co-operative learning and problem solving CBIs were important factors in increasing achievement and group interaction.

Kristie L. Rama (2003) conducted a study on, ‘The influence of Co-operative Learning on Academic Performance and Students Perception of the Educational Benefits of Peer Collaboration in a Suburban, Ninth grade Global Studies Course’. The purpose of this study was to determine if co-operative learning improved academic performance, and if students believed peer collaboration benefits them personally. Also aimed to assess the achievement of academically less successful students and more successful students. Using co-operative learning in a ninth grade global studies course increased learning. Lower achieving ninth grade students acquired more educational benefits through co-operative learning than higher achieving students. Lower achieving students believed they learned more by working in co-operative groups than did the higher achieving students. Higher achieving students felt they did more work than some other members of their group. Higher achieving students expressed a preference
for teacher – directed instruction and working independently more often than their lower achieving peers.

Ghazi Ghaith, (2003) investigated the, ‘Effects of the Learning Together model of Co-operative learning on English as a Foreign language Reading Achievement, Academic Self Esteem, and Feelings of School Alienation’. The results indicated no statistically significant difference between the control and the experimental groups on the dependent variables of academic self esteem and feelings of school alienation. However, the results revealed a statistically significant difference in favor of the experimental group on the variable of EFL reading achievement.

Shlomo Sharan (2002) investigated, ‘Co-operative Learning in Small Groups: Recent Methods and Effects on Achievement, Attitudes, and Ethnic Relations’. Five recently published methods for conducting co-operative small group learning in the classroom and the experimental studies conducted by the authors of these methods were examined, evaluated, and compared in this study. Findings were considered from experimental studies with these five methods, in terms of their differential effects on academic achievement, students’ attitudes and on ethnic relations in desegregated class rooms.

Maddox Jean Viola (2002), conducted a study entitled as, ‘Teacher Training in Multiple Intelligence Strategies and Cooperative Learning Structures to Effect a Change in the Classroom’. The purpose of this study
was to train a selected group of teachers from the Norwalk-La Miranda Unified school District in various teaching strategies and model lessons for them to use in the classroom, and to determine if there was a change in their classroom strategies after the training was completed. The researcher discovered that fifteen of the twenty-five teachers in this study did not have student teaching before entering the classroom. There were three phases in the study. Phase one consisted of an assessment of teaching styles of the teachers before training. The teachers completed the content rubric and a checklist that determined their prior knowledge and use of multiple intelligence strategies and co-operative learning structures. Phase two consisted of teachers attending sixteen hours of training in multiple intelligences strategies and co-operative learning structures. In Phase three, the teachers re-assessed the content rubric and the teacher checklist to determine if there was a change in their teaching style after the training was completed. During the training the teachers worked together and experienced the teaching strategies themselves, they shared with each other how they themselves, learned best and how they could apply this training to benefit the students. As the training proceeded, the teachers expressed a clearer understanding of the multiple intelligence. They decided that the activities were fun even for them. The training improved teachers' strategies and styles in most of the specific areas assessed.

Linda Kay (2002) conducted a study entitled as, ‘Co-operative
Techniques versus Lecture in the High School Social Studies Classroom in, Georgia. In an attempt to determine the most effective teaching methodology, Co-operative techniques were used to teach one class of high school Geography and lecture method was used to teach the other class of high school Geography. The sex of the students in each class was also compared to the final averages to determine if males or females did better in the class of cooperative teaching or in the class taught by lecture. The co-operative learning method class achieved higher final averages than the lecture method class in the grade categories of A and B using the quantitative data supplied by this study. The C students achieved higher final averages in the lecture method class. The failure rate in the lecture method class was almost twice the failure rate of the cooperative class. The female students achieved higher grades as compared to the male students regardless of the method used.

Eleanor Myers, (2001) conducted a study ‘Enhancing Education through Co-operative Learning’. Research findings indicated positive outcomes associated with co-operative learning. The goals of the college developmental education instructor were interconnected with the benefits of co-operative learning. These goals involved creating classroom conditions in which students were given the freedom to become active, construct meaning, think critically, find relationships, clarify thinking and respond to challenges. Listening skills were honed as students read, report and communicated ideas to each other to make them engage in problem solving. Students not only
learned by teaching, analyzing and synthesizing information, but also
developed social skills. Small groups demanded a degree of metacognitive
awareness by which students constantly monitored their teammates and
progressed toward a goal. Collaboration between the teacher and students
also developed an atmosphere that built a community of learners.

Krsch, Kyra (2001) conducted a study entitled as, ‘The Effect of
Group Training on Adolescent Cooperative Learning Teams’. This research
focused on the following outcomes, (1) individual student achievement, (2)
perceptions of personal and academic team support, (3) team cohesiveness
(4) positive vs negative attitudes towards teams and (5) attitudes towards co-
operative learning before and after the experiment. The results showed that
students in the trained condition did feel that they were personally supported
in their groups than did their counterparts in the untrained condition. In
general, students in the trained condition had a more positive experience
engaging in Co-operative learning activities, and a more positive attitude
towards their particular group. While results showed no significant difference
between the two conditions in the area of student achievement, it was
concluded that educators who more concerned with the affective benefits of
cooperative were learning might consider training to ensure a more positive
group experience for the adolescent students.

Ming Ming Chiu (2000) conducted a study entitled as, ‘Teacher
Effects on Student Motivation during Co-operative Learning’. This study
examined how teacher’s interactions with students during co-operative problem solving increased or decreased students’ motivation. In three co-operative learning studies, teacher interventions influenced student motivation, which in turn affected group outcomes. Controlling for past student achievement, higher student motivation increased co-operative problem solving success in the first study. In the second study, increased student autonomy and greater teacher responsiveness to students increased student motivation. Finally, the study discussed one intervention in detail, showing some conditions of use, exceptions to the above effects, and specifying how a compliment helped increase student motivation.

Chin Yung Huang (2000) conducted a study entitled as ‘The Effects of Co-operative Learning and Model Demonstration Strategies on Motor Skill Performance during Video Instruction’. The purpose of the study was to investigate the effects of different types of model demonstration strategies and student ability on the performance and attitudes of students working co-operatively or individually during video instruction. Results revealed that students who engaged in co-operative learning significantly outscored those working alone. Students who were in the co-operative and video model tests achieved higher than students in the no model test. Furthermore, the co-operative model was more effective with high ability students. There were, however, no significant difference between the cooperative model and video model for low ability students. The results also indicated that co-operative
learning promoted a more positive attitude than did working alone. Low ability students had more positive attitudes than high ability students.

Regina M. Shia and et. al. (2000), conducted a study entitled as ‘Mectacognition, Multiple Intelligence and Co-operative Learning’. The purpose of this study was to see the relationship between the independent variables of metacognitive awareness and intelligence type (creative, practical, and analytic) and the dependent variable, contribution to co-operative groups. In this study, it was found that metacognition and creative intelligence were significantly related to the scores that the students received from other members in their group. After further analysis, it was found that metacognition was the better predictor of co-operative learning abilities. From this it was concluded that when students were placed in an unfamiliar, ill structured situation, they needed metacognition to assist them in monitoring, evaluating and solving problems. Furthermore, creative abilities helped students to excel in these situations, which were novel in nature.

James Jennifer (1998), conducted a study entitled as, ‘The Effects of Educational Attitudes on the Acceptance of Co-operative Education as Academic Learning by College Faculty’. The study determined the relationship between what faculty believed about teaching and learning educational philosophy and faculty acceptance of co-operative education and to assess the attitudes of faculty in using co-operative education for undergraduates’ students’ development. The study revealed that the Co-
operative education was more effective. The faculty showed positive attitude towards co-operative education.

Rosini B. Abu (1997) conducted a study entitled as, ‘The Effect of Co-operative Learning Methods on Achievement, Retention and Attitudes of Home Economics Students in North Carolina’. The purpose of the study was to determine the effect of the co-operative learning approach of Student Team Achievement Divisions (STAD) on the achievement of content knowledge, retention and attitudes toward the teaching method. There was no significant difference in student attitudes toward the teaching methods.

Dabarthe Linda (1997), conducted a study entitled as, ‘Effects of Gender Grouping and Social Structure on Co-operative Learning in Collegiate Instruction’. This study examined whether college students learned more effectively in single gender versus mixed-gender co-operative learning structures and whether females benefited differentially from greater organization of such structures. The findings revealed that there existed no significant differences in learning (as measured by post test scores) for either males or females based on the gender of their co-operative learning groups. Furthermore, males learned equally well in the control and experimental conditions. The interaction of gender and group composition did appear to impact female's perceptions. Females in single-gender groups reported higher levels of group process than females in mixed groups. Males reported no difference in group process between group compositions, or between treatment conditions.
Bono, (1996) conducted a study entitled as ‘The Effects of First – time College Co-operative Education Work Experience On Maturity, Self esteem and Problem Solving Skills’. The main objective was to determine the effect of Co-operative Education Work Experience on self esteem, maturity and problem solving skills. The study revealed that the co-operative learning method enhanced the self esteem and problem solving ability.

Marshall and Robert Lester (1995), conducted a study on, ‘The Effect of Co-operative Learning and Academic Teams on Ninth Grade Student Success in Three Selected Texas High Schools’. The major objective was to determine the effectiveness of intervention of the co-operative learning and academic teams on the failure rates of students during their high schools career. The study concluded that implementation of interventions of co-operative learning and academic teaming increased students’ success and classroom socialization.

Janice Flake (1995), conducted a study on Small Group Co-operative Learning and Field Dependence, Independence Effects on Achievement and Affective Behaviour in Mathematics’. The major objectives were to develop the group patterns and to identify the problem solving activities of the students. The study revealed that co-operative learning method was more effective on achievement in Mathematics and developed affective behaviours in Mathematics.

Johnson and Johnson (1995) surveyed 193 studies in which Co-
operative Learning was compared to more Traditional Forms of Instruction using Group Productivity as an Outcome Measure. In over 50% of the cases, the Co-operative Learning Approach was more effective than mere traditional forms of instruction while in 10% of cases competitive or individualistic approaches to instruction produced higher productivity.

Brancov Teodor (1995) conducted a study entitled as, ‘Co-operative Learning in Mathematics with Middle School Indian Students: A focus on achievement and On task behaviour’. The purpose of the study was to determine whether cooperative learning would improve achievement, time on task, classroom climate, and perception of classroom environment. Relative to achievement, statistically significant difference was revealed favoring the experimental groups in Mathematics specifically in problem solving. Additionally, statistically significant differences were found favoring the co-operative learning group with respect to attitude toward in relation to time on task. Related to classroom climate, a statistically significant difference was revealed favoring the experimental group.

Wilson Paraston (1994) conducted a study on ‘Co-operative learning As An Instructional Strategy With Gifted Students’. The study revealed that gifted students in their groups more often took the role of answer sharer to the group and more often worked on basic skill tasks and reported knowing most of all of the lesson content prior to the lessons.

Nancy Armstrong, (1994), conducted a study on ‘The effects of Co-operative Learning on Gifted Students in Heterogeneous and Homogenous
Groups’. The study revealed that co-operative learning was more effective on gifted students in heterogeneous and homogenous groups.

2.4 STUDIES RELATED TO CRITICAL THINKING

2.4.1 Indian studies

Meera. K.P. and Jumana. M.K. (2010) conducted a study on, ‘Effectiveness of Critical Pedagogy in Developing Creative Thinking Skills’. This study looked into how far our present curriculum was equipped for developing creative thinking abilities. The findings of the study revealed that critical pedagogy had significant effect on developing creative thinking.

Harish.G.C. (2010) conducted a study on ‘The Impact of Integrated Critical Thinking on Achievement in Mathematics on Secondary Students’. The study revealed that there was a significant difference between the post test achievement in Mathematics of control and experimental groups, there was no significant difference between the Mean scores of boys and girls in the post test achievement and there was a significant interaction between group and gender on total integrated critical thinking skills on achievement after the intervention program.

Mathew (2008) conducted a study on ‘The Impact of Religious Schema on Critical Thinking skills’. The purpose of this study was to examine the relationship between critical thinking and religious orientation. This study found that primed religious schema did not account for the relationship between paranormal / religious belief and critical thinking skills.
This study did not find out that poor critical thinking performance was predicted by higher level of extrinsic religious orientation.

2.4.2 Foreign studies

Stobaugh Rebecca, et.al. (2011) conducted a study on ‘Enhancing the Cognitive Complexity in Social Studies Assessment’. The study concluded that Teachers should strive to create assessments that require students to make inferences and exhibit critical thinking skills. Designing and delivering Instructional experiences and assessments that incorporate higher-level thinking skills are Important for Improving student achievement as well as developing students that are strategic In their thinking and planning. Therefore teachers could implement several strategies that enhance the rigor and cognitive complexity of instructional experiences and assessment Items. The use of graphics, scenarios, and quotes can help social studies teachers conquer the challenge of creating higher-level assessments that incorporate the use of critical thinking skills.

Bensley D.Alan (2010) conducted a study on Teaching and Accessing Critical Thinking Skills for Argument Analysis in Psychology. The study found that the group receiving explicit critical thinking skills instruction showed significantly greater gains In their argument analysis skills than the groups receiving no explicit critical thinking Instruction. These results support the effectiveness of explicitly teaching critical thinking skills infused directly Into regular course Instruction.
Boulter, Maria Lynn (2010) Conducted a study on “The influence of Socratic Questioning in Online Discussions on the Critical Thinking Skills of Under Graduate Students”. This study examined the influence of instructor-facilitated Socratic questioning in online discussions on the critical thinking skills of undergraduate students enrolled in a proprietary Institution with nonselective admissions criteria. The findings of the study revealed that Socratic questioning, compared with traditional instructional methods, did not have a statistically significant Influence on the critical thinking of students with diverse critical thinking skills. Frequency of participation also was not affected by Socratic questioning.

Choy, et.al. (2009) conducted a study on ‘Teacher Perceptions of Critical Thinking among Students and its Influence in Higher Education’. It was found out that teachers perceived that they were teaching critical thinking to their students believed that critical thinking provided the intellectual stimuli that facilitated critical thinking. Teachers did not seem to understand the requirements needed to cultivate critical thinking among students. Although teachers perceived that they were encouraging critical thinking in the classroom they were merely focusing on the comprehension of the subject matter.

Finkel (2008), conducted a case study on, ‘Critical Thinking Activities Used in the School of Education at Community College’. The purpose of this study was to examine which of the critical thinking activities was
implemented at a large suburban community college on the east coast of the United States. Findings indicated that critical thinking activities were to be effective in helping students to best understand the course content and to develop critical thinking skills in general.

Yu-Chu Yeh (2007) conducted a study on, ‘Integrating e-learning into the Direct – Instruction Model to Enhance the Effectiveness of Critical Thinking Instruction’. The primary findings were as follows: a) All participants preferred the instructional design used in the study b) the experimental instruction effectively improved the pre service teacher's critical thinking ability as well as their professional knowledge and personal teaching efficacy concerning critical thinking instruction c) the mechanisms contributing to the effectiveness of the experimental instruction mainly included discussing and sharing observational learning, self reflection, guided practice and the learning community.

Scott Burris and Bryan L. Garton, (2006) made, ‘An investigation of the Critical Thinking Ability of Secondary Agriculture Students’. The purpose of the study was to examine the relationship between student characteristics and critical thinking. Mean scores for critical thinking indicated that critical thinking was present in secondary agriculture students. Males and females were similar in their ability to think critically. Upper classmen outperformed lower classmen on critical thinking. Students categorized as higher academic achievement levels exhibited higher critical thinking skills than those students categorized as lower achievement levels
and moderate relationship existed between achievement level and critical thinking ability.

Clifford, J.S., Magdalen, M.B. and Kurtz, J.E. (2004) conducted a study on, ‘Personality Traits and Critical Thinking Skills in College Students’. Personality Dispositions were found to contribute significant variation to the prediction of critical thinking, especially in relation to openness to experience. Thus, a combination of verbal ability and openness to experience were strongly contributing factors in the measurement of critical thinking. These studies confirmed that both disposition and cognitive abilities contributed to critical thinking ability.

Tsui, L. (1999) conducted a study on, ‘Courses and Instruction Affecting Critical Thinking’. Results indicated that a high correlation for giving class presentations and a student's self reported critical thinking skills (r = 41). Working on a class project also had a high correlation with critical thinking. 9 of the 11 types of courses analyzed contributed to the growth of critical thinking with writing course, interdisciplinary courses, honours program, history courses and ethnic study courses to be effective and were listed in the order of having the greatest magnitude.

Gadzella, B.M., Ginther, D.W., and Bryant, W.G. (1996), conducted a study on, ‘Teaching and Learning Critical Thinking Skills’. The purpose of the study was to determine whether educators could teach critical thinking to students by having them engage in critical analysis of issues. Results
indicated higher scores to the responses of the second assessments measures on the interpretation and evaluation of arguments section of the assessment. The authors concluded that critical thinking scores improved using their teaching method.

Clabaugh, M.G., Forbes, J.L., and Clabaugh, J.P. (1995) conducted a study on, ‘Bloom's Cognitive Domain theory: A Basis for Developing Higher Levels of Critical Thinking Skills in Reconstructing a Professional Selling Course’. The learning objectives included focus questions to ensure the course in development which function with the existing curriculum as well as meeting its specific learning goals. Students were required to make recommendations and support those with arguments. Other learning skills included the course culminating in a sales role – play, which was critiqued by the other students, fostering critical thinking in both participants and observers. The outcome of this selling course include higher levels of critical thinking (as outlined by Bloom) as well as increased satisfaction with the course by students and instructors. The authors reason that such an approach could be taken to the business degree program as a whole, where learning objectives were the starting point for restructuring the program and produced better skilled and better prepared graduates.

and Sixth – Grade Students’. The objective of the study was to find out if there was any significant difference in thinking skills instruction and academic achievement of students. The study concluded that thinking skills instruction in the fourth and sixth grades made a significant difference in the development of creative and critical thinking skills. The result also indicated that thinking skills instruction had a significant impact on the achievement of students in the fourth grade in areas of language and Mathematics.

2.5 STUDIES RELATED TO PROBLEM SOLVING ABILITY

2.5.1 Indian studies

Nisha Mary Jose & Rinal P. Thomas (2011) conducted a study on ‘Problem Solving Ability and Scholastic Achievement of Secondary School Students’. The findings indicated that there existed significant difference in the problem solving ability of secondary school learners with respect to gender, locale and type of school. Boys had higher problem solving ability than girls. The problem solving ability of rural school students were greater than the students in the urban school. Private school students had significantly higher problem solving ability when compared to the government school students. There existed high positive correlation between problem solving ability and scholastic achievement.

John Louis Manoharan, R. and Ramganesh, E. (2009), conducted a study on, ‘Creative Problem Solving Ability of XI standard students’. The objectives of the study were to identify the level of creative problem – solving
ability of XI standard students and to find out, if any, the significant differences in creative problem solving ability in terms of background variables namely, sex, type of school, type of syllabus and locality. The finding showed that students who completed their high school under matriculation syllabus were more creative than the students who completed their high school under the syllabus prescribed by the government of Tamil Nadu.

John Louis Manoharan, R. (2009), conducted a study on "Problem Solving Ability in Mathematics of IX Standard Students in Villupuram district". The objectives of the study were to identify the level of Problem Solving Ability in Mathematics of IX standard students and to find out, the significant difference between the IX standard students in their problem solving ability regarding the background variables sex, type of school, locality, subject group, extra coaching, community, parental educational qualification and parental occupation. The results revealed that the Problem Solving Ability in Mathematics of IX students was low. They did not possess the general ability of solving any type of problem in Mathematics. Except sex, the other variables namely type of school, locality, subject group and extra coaching had influence on problem solving ability in Mathematics. It was found out that private schools, urban, computer science group students and who went for tuition in Mathematics had better problem solving ability in Mathematics.

Biswajit Behera, (2009), conducted a study on ‘Problem Solving Skills
in Mathematics Learning’. The objectives of the study were to study the
cognitive skills of high mathematical ability students on Mathematics
problem solving, to study the cognitive skills of low mathematical ability
students on Mathematics problem solving and to ascertain the gender
difference in Mathematics problem solving skill. The mean difference
between high ability and low ability groups, between boys and girls within
each ability group was quite large. There was no significant difference
between the mean of performance of boys and girls within each ability group
in any of the component skills. The summary of ANOVA revealed significant
effects on problem solving ability and the main effects of problem solving
ability were highly significant.

Umadevi M.R. (2009), conducted a study on ‘A study on the
relationship between Problem Solving Ability and Academic Achievement of
Secondary School Students’. The objectives of the study were to investigate
the problem solving ability of IX standard students based on sex and type of
school, to investigate the mean difference if any between the level of problem
solving ability of IX standard students with their academic achievement and
to investigate the relationship between problem solving ability and academic
achievement of IX standard students. The findings indicated that there was no
significant difference in problem solving ability of boys and girls. There was
significant difference in problem solving ability of students studying in
government and private schools and there was a significant relationship
between academic achievement of students with high, moderate and low
problem solving ability.

Preety N. Tripathi (2008), conducted a study on, ‘Problem Solving in Mathematics: A Tool of Cognitive Development’. The objectives of the study were to find out students' beliefs about Mathematics teaching and learning be influenced via the teaching of a course in problem solving and what strategies might promote this belief. The results indicated that problem solving in Mathematics emphasized metacognition and critical thinking and mathematical thinking. Also student’s beliefs about Mathematics teaching and learning had influenced and brought Mathematical reasoning.

Indira Sharma (2007) conducted a study on, ‘Problem Solving Ability and Scientific Attitude as Determinant of Academic Achievement of Higher Secondary Students’. The major objectives were to study the scientific attitude of higher secondary students in relation to sex and three levels of achievements and to study the relationship among academic achievement, scientific attitude and problem solving ability of higher secondary students. Higher Secondary students had shown average problem solving ability and there was no difference in problem solving ability of boys and girls. The present school science curriculum was able to develop only average level of scientific attitude and problem solving ability among higher secondary students and positive relationship existed among achievement, problem solving ability and scientific attitude.

Nagaraju M.T.V. (2006), conducted a study on ‘Mathematics
Problems of X class Residential and Non-Residential School Students in Relation to Certain Demographical Variables’. The major objectives were to examine the problems of Mathematics in class X Mathematics syllabus perceived by the students of Residential and Non – Residential school with respect to sex, caste and income. There was a significant variation at 0.05 levels regarding the Problems in Mathematics of the Residential and Non-Residential school students. The mean score (100.25) of the Non-Residential school girls students in mathematics achievement test was more than the mean value (93.62) of Residential girls students. The mean score (95.58) of the Residential school boy students were more than the mean score (81.16) of the Non-Residential school boy students. On the whole Non – Residential school girl students had the highest mean score on Problems in Mathematics. The students from SC/ST community on Non-Residential school had the highest mean score (96.25) on the problem of Mathematics. The students from Backward class community of Residential schools had the highest mean score (97.68) in problems of Mathematics. On the whole, the students from other community (O.C) from Residential schools had the least mean score (76.75) on the Mathematics problems. The students of the Non-Residential schools whose family income was between Rs.2001 to 5000 had the highest mean score (90.38) on the problems of the Mathematics. The Residential school students hailing from families with income up to Rs.2000 had the highest mean score (95.83) in problem of Mathematics. On the whole, Non-Residential school students whose family income was Rs.5001 and above
have the least mean score (83.13) on the Mathematics problems.

Swarupa Rani, T. (2006) conducted a study on, ‘Effectiveness of the Synthetic and Polya's Heuristic Approaches on the Acquisition of Problem Solving Skills in Mathematics’. The objectives of the study were to find the effectiveness of Synthetic method and Polya's heuristic problem solving method in teaching Mathematics. A significant difference was seen between the Synthetic method group and Polya's method group on post test scores. A study of the gain scores differed significantly between Synthetic and Polya's method group. The experimental students taught by Polya's method were functioning well in the four problem solving stages. The Synthetic method students fared very dismally in these phases and stages except on the understanding of the problem stage. The teachers who participated in the experiment had proved their competence to implement different methods and produced significant results in a short time. The high ability group did not get influenced by any method deferentially.

Anice James and Marice P.V., (2005) conducted a study on Selected Variables as Determinants of Problem Solving Ability’. Two determinants are suggested as Reasoning ability and Brain Hemisphericity. The objectives of the study were to explore the relationship among the variables namely, Problem Solving Ability, Reasoning Ability and Components of Reasoning Ability among XI standard Science group students and to predict the problem solving ability of the students in Science group in terms of the selected variable in the study viz., reasoning ability in Science, gender region, school
management type, socio-economic status of the parents, and brain hemisphericity. There was significant relationship between problem solving ability and reasoning ability in Science. Reasoning ability and gender independently contributed towards problem solving ability and were significant predictors of problem solving ability.

Students from rural and urban areas differed significantly in their problem solving ability and reasoning ability, favoring those from urban areas. Students differed in reasoning ability owing to differences in brain hemispheric dominance, favoring students with right brain hemisphericity dominance. However no significant differences in PSA were found between students with right brain hemisphericity and left brain hemisphericity. Students following different religions (ie, Christians, Hindus & Muslims) showed significant differences in their problem solving ability and reasoning ability, favoring Hindu students. Students studying in Government aided and unaided schools differed significantly in their problem solving ability and reasoning ability in science favoring those studying in Government schools. Students of varying socio-economic status differed significantly in their problem solving ability and reasoning ability in science favoring those from high socio-economic strata. Students who had left brain hemisphericity dominance differed significantly in their problem solving ability owing to difference in gender, region, school management type and socio-economic status. Students who had left brain hemisphericity dominance differed significantly in their problem solving ability owning to difference in gender,
region, school management and socio-economic status. However, left brain hemisphericity dominant students did not differ in PSA owing to variations in religious affiliations.

Manivannan, S.S., and Nallaiappan, N.O. (2004), conducted a study on ‘Hemisphericity and Problem Solving Ability in Mathematics’. The main objective of the study was to investigate the relationship between Hemisphere dominance and Problem Solving Ability in Mathematics. Findings showed that right hemisphere and left hemisphere dominant students did not differ significantly in the following skills of problem solving; recall / recognition skill, induction skill, more than one principle skill, logical reasoning skill, surplus information skill and synthetic thinking skill.

Kavitha (2004), conducted a study on, ‘The Effectiveness of Problem Solving Method for Learning Zoology at Higher Secondary Level’. The main objectives were, to test the effectiveness of the problem solving method for learning Albinism by comparing the achievement scores of the Problem Solving method group and Lecture method group and to find out the extent of use of Problem Solving method for teaching Zoology. The problem solving method was more effective than Lecture method in learning Zoology. Rating of teachers regarding the extent of the use of problem solving method for teaching Zoology revealed that a great majority of the teachers often used Problem Solving method for teaching Zoology.

Jolly and Anju (1998) conducted a study on ‘The Effectiveness of
Learning with Concept Mapping on the Science Problem Solving of Sixth grade children. The main objectives were to analyze the relationships of Concept Mapping to Science Problem Solving in sixth grade elementary school children, to determine whether the student's ability to perform higher cognitive processes was a predictor of students’ performance in solving problem in Science. There was no significant difference in the analysis of the performance of males and females. No pattern emerged regarding the influence of socio-economic status on problem solving performance.

Kumar, (1996) conducted a study on, ‘The Verbal Problem Solving Ability in Mathematics of Pupils of Standard III’. The main objective was to study the Verbal Problem Solving Ability in Mathematics of pupils in standard III. There was no significant difference in the verbal problem solving ability of boys and girls. The verbal problem solving ability of the pupils whose parents were teachers was significantly higher than that of pupils whose parents were not teachers.

Saminathan, B., and Mohan, S. (1995) conducted a study on, ‘Developing the Problem Solving Ability Among the Higher Secondary Students in Solving Physics Problems’. The main objective was to identify the problem solving strategies in solving Physics Problems among IX students. The experimental group I and group II students’ post and pre-test scores differed significantly. The experimental group I and control group students differed significantly in the post test scores.

Baskaran, K. (1991) conducted a study on "Achievement – Motivation,"
Attitude towards Problem – Solving and Achievement in Mathematics of standard X students in Devakottai Educational District”. The main objectives were to identify the level of student achievement – motivation, attitude towards problem solving and achievement in Mathematics, to identify the significant relationship if any between the pairs of variables among themselves. There was significant relationship between achievement motivation and achievement in Mathematics, and attitude towards Mathematics problem solving. There was a positive relationship between the attitude towards problem solving and achievement in Mathematics. Urban and Rural students did not differ in their (a) achievement motivation (b) and attitude towards Mathematics.

2.5.2 Foreign studies

Ching-Chih Kuo, June Maker and Fang-Liu Su., (2010), conducted a study on ‘Identifying Young Gifted children and Cultivating Problem Solving Abilities and Multiple Intelligences’. The objectives of the study were to introduce the identification model and to analyze the participants' performance in problem solving activities and in demonstrating their special talents and to offer enrichment services for gifted young children. The results of this enrichment program showed that most students performed well on five kinds of problem solving types. From children's archives, participating children presented scientific thinking characteristics, such as rich knowledge with fascinating imagination and the ability to seek many approaches to solve problems. They were delighted to challenge others and pleased to be
challenged. The twice exceptional children also performed well in the program, especially those children with autism whose progress in social skills and group adaptability were remarkable.

Riasat Ali, et.al. (2010) conducted a study on, ‘Effect of Problem Solving method in Teaching Mathematics on the Achievement of Mathematics’. The major purpose of study was to investigate the effects of using problem solving method on student's achievement in teaching Mathematics at elementary level. The result showed that there was significant difference between the effectiveness of traditional teaching method and problem solving method in teaching Mathematics at elementary level.

Effandi Zakaria and Normah Yusoff (2009) conducted a study on, ‘Attitudes and Problem - Solving Skills in Algebra Among Malaysian Matriculation College Students’. The purpose of the study was to determine the attitudes and problem solving skills of Malaysian Matriculation college students. The study examined whether there were difference in attitudes towards solving algebra problem and problem solving skills in algebra based on gender and course of study. The findings showed that Matriculation students had moderately favorable attitudes towards algebra problem solving. There were no significant difference in attitudes and problem solving skills based on gender. However, the findings indicated that there were significant difference in attitudes – specifically, with regard to self confidence and problem solving skills between students in different courses of study.

Sakorn Pimta, et.al., (2009) conducted a study on ‘Factors Influencing
Mathematics Problem – Solving Ability of Sixth Grade Students’. This study aimed to investigate factors influencing Mathematics Problem Solving ability of sixth grade students. Teacher's behaviour took both direct and indirect effects on the student’s Mathematics problem solving. The teachers were supposed to study the methods to develop this ability deeply and then brought them to manage the activities in class that encouraged students to be enthusiastic to learn and had good attitude towards Mathematics learning or to get students concentration.

Joakim Samuelsson, (2009) conducted a study on, ‘The Impact of Teaching Approaches on Students’ Mathematical Proficiency in Sweden’. The present study examined the effect of two differently structured methods, traditional and problem solving, of teaching Mathematics for the first five years in school as well as differences between boys’ and girls’ achievement depending on teaching methods. The results showed that there was no significant difference between teaching methods when assessing procedural fluency. Students' progress in conceptual understanding, strategic competence and adaptive reasoning was significantly better when teachers taught with a problem based curriculum. In order to develop aspects of self efficacy, the results showed that pupils benefited more from a traditional curriculum. Boys and girls who were taught with similar methods performed equivalent in both the traditional and the problem solving group.

Zeynep Sonay Polat, (2009) conducted a study on ‘The Effects of
Problem Solving Methods on Students’ Problem Solving Performance and Achievement’. The general purpose of the study was to compare the effects of problem solving method and traditional instruction on students' problem solving performance and their achievement. The findings indicated that problem solving methods improved students’ problem solving performance and their achievement.

Carole R. Beal and Erin Shaw (2008), conducted a study on ‘Working memory and Mathematics Problem Solving of Blind Middle and High School Students: Implications for Universal Access’. The study investigated how the blind students solved Maths word problem varying in text length and grade level readability, in the context of an existing web – based tutorial. Text to speech software allowed blind students to access word problems in audio format. Results were used to adapt the software to select Maths word problem that were appropriate for blind students.

Margaret Wu and Raymond Adams (2006), conducted a study on ‘Modelling Mathematics Problem Solving Item Responses using a Multidimensional IRT Model’. This research examined students’ responses to Mathematics problem solving tasks and applied a general multidimensional Item Response Theory (IRT) model at the response category level. It was proved that multidimensional IRT models were powerful tools for extracting information from a limited number of item responses. A problem solving profile for each student could be constructed from the result of IRT scaling.

Style, Strategy Use, Personalization of Mathematical Word Problems Responses of Students with Learning Disabilities’. The primary purpose of this study was to examine the effects of learning style, strategy, use, and personalization of mathematical word problems on the selection of appropriate operations and the execution of correct computational responses by students with learning disabilities (LD). Results of this study revealed that learning style did affect students with learning disabilities (LD), selection of appropriate operations and execution of correct computational responses of mathematical word problems. While other outcomes from this study revealed no statistically significant results, further investigations were merited regarding the affect learning style, strategy use, and or personalization had on the Mathematical responses of students with learning disabilities.

Chan Kah Yein and Judith Mousley, (2005), conducted a study on ‘Using Word Problems in Malaysian Mathematics Education: Looking Beneath the Surface’. This study focused only on "Fostering meaningful learning by using word problems in Post – Secondary Mathematics" that pertain to deep and surface learning in the use of word problems with non-English speaking students in a college programme. It concluded that most of the students felt a need to practice sufficient examples before they developed adequate confidence and curiosity for more independent and diverse ways of solving problems.

Ronald N. Cortright, et.al., (2005), conducted a study on ‘Peer
Instruction Enhanced Meaningful Learning Ability to Solve Novel Problems’. They tested the hypothesis that peer instruction enhanced the meaningful learning or transfer, and the students’ ability to solve novel problems or the ability to extend what has been learned in one context to new contexts. The first factor that influenced meaningful learning was the degree of mastery of the original material. Importantly, peer instruction significantly enhanced mastery of the original materials. Furthermore, the student's ability to solve novel problems was significantly enhanced following peer instruction. Thus pausing two to three times during a 50 minutes class allowed peer instruction, and enhanced the mastery of the original material and enhanced meaningful learning, i.e. the student's ability to solve novel problems.

Efklides, Anastasia, et.al. (2004) conducted a study on, ‘Effect of Cognitive factors and Affective factors, on School Mathematics’. The study aimed to investigate the effect of cognitive factors both general and domain specific and affective factors, such as anxiety and achievement motivation, on school Mathematics. The results indicated strong effects of cognitive abilities on Mathematics performance and only minor effects of affective domain. The interaction of task difficulty with affective domain was significant.

Maria Teresa Esquivias Serrano (2003) conducted a study on, ‘Problem – Solving: Evaluative study of three pedagogical approaches in Mexican schools’. The purpose of this research was to obtain real data that
provides information about the way of problem solving manifested in different pedagogical approaches. Results showed that children from the Freinent school obtained the highest scores in both groups and that the lowest scores correspond to the traditional public school. There was significant statistical difference between the different pedagogical approaches in regard to problem solving in their basic educational process.

Lucia Mason, (2003) conducted a study on, ‘High school students’ beliefs about Maths, Mathematical problem solving, and their achievement in Maths: A cross sectional study’. The main aim of the study was to identify Italian high school students' (n = 599) beliefs about Maths and mathematical problem solving by exploring the use of a 36 items (six scales) self report questionnaire. Results showed a substantial replication of the instrument with the exception of one scale (importance of word problems) which was not reliable. A MANOVA revealed differences for three scales (ability to solve time consuming problems; problem which cannot solve by routine procedures; the usefulness of Mathematics) related to grade and a difference for one scale related to gender (importance of understanding Maths). It also emerged that the four scales mentioned predicted achievement in Maths to different extents. Data regarding the reasons underlying students' beliefs showed how their convictions were adaptive or maladaptive to learning.

The concern of the study was to examine the impact of mathematical symbolism on students' problem solving performance. The researcher reported the findings of the effects of an instructional strategy using mathematical symbolism on students' problem solving skills in college algebra when taught at the beginning and throughout a mathematical course. The students' performance indicator was their problem solving achievement test scores. Mathematical symbolism had powerful influence on students' problem solving performance especially in translation of word problem into equation. This instructional strategy enhanced their problem solving ability.

Alison King (1999), conducted a study on ‘Verbal interaction and problem solving within computer assisted Co-operative learning groups’. The purpose of the study was to identify problem solving behaviours which related to success within that context. Results indicated that there was no relationship between success and ability, and that successful groups asked more task related questions, spent more time on strategy, and reached higher levels of strategy elaboration than did unsuccessful groups. High ability groups made a greater number of long task statements than did average groups. Findings were discussed within the theoretical frameworks of social cognition and modelling. Instructional implications, including those for the development of computer assisted learning materials for peer group problem solving, were also discussed.

Colaull and Rosemary (1998) conducted a study on ‘Effects of teaching
mathematics to learning style perceptual preference on academic achievement of seventh grade middle school students’. This research investigated the effects of teaching Mathematics to the preferred perceptual preference of the students in terms of academic achievement. The findings of the study indicated that teaching through students’ perceptual learning preference did not appear to be significantly more effective than teaching in traditional manner.

Voyer, Daniel, Voyer, Susan, and Bryden, M.Philip (1995), conducted a study on ‘Magnitude of Sex difference in Spatial Abilities: A meta – Analysis and Consideration of Critical Variables’. The study examined the issues in the context of spatial abilities. Results showed that sex differences were significant in several tests. Partial support was found for the notion that the magnitude of sex differences has decreased in recent years. Finally, it was found out that the age of emergence of sex difference depended on the test used.

Noor Azlan Ahmad Zanzali, and Lui Lai Nam, (1995), conducted a study on ‘Evaluating the levels of problem abilities in Mathematics’. Research findings showed that students had fairly good command of basic knowledge and skills, but did not show the use of problem solving strategies as expected. Generally, these students had a low command on problem solving skills. Most of the students were unable to use correct and suitable mathematical symbols and vocabulary in providing reasons and explanations for certain problem-solving procedures.

Ann M. Gallagher and Richard De Lisi, (1994), conducted a study on
‘Gender differences in Scholastic Aptitude test - Mathematical problem solving among high ability students’. This study examined whether male and female students of high mathematical ability used different solution strategies on Math problems that had previously yielded gender differences in correct responding. Female students were more likely than male students to use conventional strategies. SAT-M scores were correlated with positive attitudes (confidence and persistence) towards math; use of conventional strategies was correlated with negative attitudes, (dislike, non relevance) towards Maths and male students outperformed female students on unconventional problems.

Nail Sohin, (1993) conducted a study on ‘Psychometric properties of the Problem solving inventory in a group of Turkish University students’. This study examined the psychometric properties of the PSI in a Turkish cultural context, specifically with regard to normative, reliability, and validity information. Finally, the study provided cross cultural information that increased knowledge about the utility of problem solving constructs across diverse environments, particularly with regard to an approach / avoidance dimension across problem solving strategies.

2.6 STUDIES RELATED TO CO-OPERATIVE LEARNING AND CRITICAL THINKING.

2.6.1 Indian Studies

Anuradha A. Gokhale, (1995) conducted a study on, ‘Collaborative
Learning Enhances Critical Thinking’. This study examined the effectiveness of individual learning versus collaborative learning in enhancing drill and practice skills and critical thinking skills. The study concluded that collaborative learning fostered the development of critical thinking through discussion, classification of ideas and evaluation of other ideas. Hence collaborative learning was more beneficial to enhance critical thinking and problem solving skills.

2.6.2 Foreign studies

Michael McInerney and Dee Fink. L., (2004) conducted a study on ‘Team - Based Learning Enhances Long Term Retention and Critical Thinking in an Undergraduate Microbial Physiology Courses’. The study concluded that Team - Based Learning significantly improved student’s attitudes about the amount of information they learned and promoted critical thinking. However, retention of the materials as judged by final examination scores were still poor. The inclusion of the team projects significantly improved final examination scores compared to the previous year without team projects. Overall team based learning with challenging projects improved the students’ comprehension and retention of information, critical thinking, and attitudes about the course and focused student instructor interactions on learning rather than grades.

Nageow and Karen Yeok-Hwa, (1998), conducted a study on ‘Enhancing Student Thinking Through Collaborative Learning’. The results indicated that group learning promotes dialogical interchange and reflexivity
among learners. Also learners shared alternative viewpoints, and developed critical thinking skills that included the ability to reflect and improved on their own learning.

2.7 STUDIES RELATED TO CRITICAL THINKING AND PROBLEM SOLVING ABILITY

2.7.1 Foreign studies

Rong Jyue fang, et.al. (2008), conducted a study on ‘The Study of increase the Critical Problem Solving Abilities by Web – based instruction’. The purpose of this study was to understand the experimental effects of web based critical thinking instruction program for promoting students’ abilities. The study found out that students’ critical thinking and problem – solving abilities were promoted after performing web-based critical thinking instruction. The results can be given as reference for teachers to innovative instruction and performance in web – based instruction.

Seibu Mary Jacob and Hong Kian Sam (2009), conducted a study on ‘Critical Thinking Skills in Online Mathematics: Discussion Forums and Mathematical Achievements’. Critical thinking in Mathematics problem solving was the focus of the study. The preliminary research study set out to examine the problem solving sessions activated through online Discussion Forums in Mathematics classes in a first year university course supported by the Blackboard Learning System. The study involved a group of 46 participants and had the following purposes: (a) to adapt a model to evaluate
critical thinking at individual level in mathematical problem solving sessions of online Discussion Forums; (b) to examine the relationship between mathematical achievement, as measured by the final examination grades and critical thinking in online Discussion Forums incorporated into a university mathematics course; (c) to check whether there had been a progression of critical thinking skills based on the discussion forum postings from forum / (Week 3) to forum 2 (Week 11) of the 14 week-long course. The analysis based on the model showed an overall increase in the total number of messages in forum 2 over forum 1. But lower phase of critical thinking was seen dominant and a slight dependence between mathematical achievement and students’ communication variables was observed.

Barbara Adamcik, Steve Hurley and John Erramouspe, (1996), made a study on ‘Assessment of Pharmacy Students’ Critical Thinking and Problem Solving Abilities’. The study reports the findings from 40 clerkship students who completed a computer program (CAP) developed to assess problem solving skills, as well as various instruments to assess cognitive and learning styles as they related to clinical decision – making. In addition, preceptors’ evaluations of students' problem solving skills were collected. Findings revealed similarities among students in temperament, learning styles, information – processing modes, problem solving strategies, and critical thinking strengths. Correlations of overall and individual problem set CAP scores with the other instruments were weak.
Allmaras & Devon (1992), conducted a study on ‘The effects of Thinking skills training on high school students accounting problem solving ability’. Objectives of the study were to determine if and to what degree the post test problem solving scores were related to the students training using the inclusion process, to find out the students Mathematics and reading on the comprehensive test of basic skills, and to know the students’ grade point average as measured on basic academic subjects. A total of 120 students in the St. Vain Valley School in Colorado participated in the study. Findings indicated that the students trained in inclusion process performed significantly better on an end of quarter problem solving test in introductory accounting than the students not trained. Concurrent enrollment programs provided multiple motivations for them increased opportunities for students to acquire problem solving skills, and bridge the gap between high school and community college.

2.8 STUDIES RELATED TO CO-OPERATIVE LEARNING AND PROBLEM SOLVING ABILITY

2.8.1 Foreign studies

Ismail, Nor Azilah Nagah (2010) conducted a study on, ‘The Effects of Mind Mapping with Co-operative Learning on Programming Performance, Problem Solving Skill and Metacognitive Knowledge among Computer Science Students’. The purpose of the study was to investigate the effects of mind mapping with co-operative learning (MMCL) and co-operative learning
(CL) on: (a) programming performance; (b) problem solving skill; and (c) metacognitive knowledge among computer science students in Malaysia. The moderating variables were the students’ logical thinking level with two categories: high logical thinking (HLT) ability and low logical thinking (LLT) ability. The results showed that the students in mind mapping with cooperative learning (MMCL) groups had significant positive overall effects in programming performance, problem solving skill, and metacognitive knowledge. Students taught via the MMCL method significantly outperformed the students taught via the traditional method in programming performance and metacognitive knowledge. Meanwhile, students taught via the CL method significantly outperformed the students taught via the traditional method in their metacognitive knowledge. Even though there was no significant effect between MMCL and CL on any dependent variables, the descriptive statistics for programming performance and metacognitive knowledge between the three instructional method groups did show some positive effects. For the effects of instructional methods on programming performance mean scores, there were two major findings.

First, the results showed that the overall mean scores for programming performance for the students taught via MMCL method were higher than the CL group whose scores were, in turn, higher than the scores of the students taught via the traditional method. Second both HLT and LLT students' mean scores in programming performance for MMCL method were higher
compared to the mean scores acquired by the CL and traditional methods. For the effects of instructional methods on metacognitive knowledge mean scores, there were two major findings. First, the results showed that the mean scores for metacognitive knowledge for the LLT students taught via MMCL method was higher than LLT students via CL method whose scores, in turn, were higher than the LLT students taught via the traditional method. Second, the results showed that the HLT students taught via the CL method outperformed the HLT students taught via the traditional method in metacognitive knowledge. The results of this study also showed that the difference between HLT and LLT students taught via the same method in problem solving skills. Finally, the results also showed there were no significant interaction effects between the instructional methods and students logical thinking levels for programming performance, problem solving skills, and metacognitive knowledge scores. The findings of this study suggested that mind mapping with co-operative learning method (MMCL) was preferred compared to CL and traditional methods in programming performance, problem solving skills, and metacognitive knowledge for students of all logical thinking levels.

Sean, P. (2010), conducted a study on, ‘Co-operative learning to master the skill of multiplication problem solving ability of third grade students.’ This study attempted to find out the effect of co-operative learning on mastering multiplication problem solving ability of third grade students.
The results of this data indicated that co-operative learning had been contributing to increased multiplication problem solving ability. Data also indicated that students liked working co-operatively, exposed students to other problem solving strategies and helped them understand multiplication word problem better.

Kamuran Tarim (2009) conducted a study on ‘The Effects of Co-operative Learning on Preschooler's Mathematics Problem – Solving Ability’. The aim of this study was to investigate the efficiency of co-operative learning on preschoolers’ verbal Mathematics problem solving abilities and to present the observational findings of the related processes and the teachers’ perspectives about the application of the program. Results found that preschoolers in the experimental groups experienced larger improvements in their problem – solving abilities than those in the control group. Findings also revealed that the co-operative learning method could be successfully applied in teaching verbal Mathematics problem – solving skills during the preschool period. The preschoolers’ skills regarding co-operation, sharing, listening to the speaker and fulfilling individual responsibilities in group work were improved.

Babatunde A. Adeyemi (2008), conducted a study on, ‘Effects of Co-operative learning and Problem Solving Strategies on Junior Secondary School Students’ Achievement in Social Studies’. The study investigated the effect of three teaching strategies (co-operative learning, problem solving and
conventional) on junior secondary school students’ achievement in social studies. The results showed that students exposed to co-operative learning strategy performed better than their counterparts in the other groups. The results of the study also indicated that the effect of teaching strategies were gender sensitive.

Bobbette M. Morgan (2008), conducted a study on, ‘Co-operative learning, Mathematical Problem solving, and Latinos’. The purpose of the study was to conduct research regarding the perceptions of students working in co-operative learning environment to solve mathematical word problems. Results indicated four changes in students’ behaviour. 1) Students became more engaged in problem solving, 2) Students moved from competitive to co-operative stance, 3) students discovered there were several correct ways of finding a solution, and 4) students code – switched between Spanish and English to ensure everyone in the group understood. Hence students became more motivated, less competitive, more aware of problem solving process and developed language skills in Spanish and English.

Shammi Sahni, (2008) conducted a study on, ‘Designing a Module to Enhance the Skill of Solving Word Problems amongst Class III Children’. The objectives were; (i) to design different strategies to teach word problem in addition (ii) to design different strategies to teach word problems subtraction (iii) to design the module and try it out and (iv) to design the module for teachers and parents. The findings showed that the performance of children in
the post test was better (mean = 22.58) than the pre-test (mean = 11.28) and there was a significant difference in the performance of children after training with the module. The module was very useful for the teachers to train children in solving word problems without difficulty. Co-operative learning enhanced the interest of children and developed their self confidence.

Jeremy Cannella (2005), conducted a study on, ‘Effects of Computer – supported Collaborative Learning on ill Structured Problem Solving Ability’. The study investigated the effect of computer supported collaborative learning versus individual computer supported learning on student performance in an ill structured problem solving task. The results indicated that computer supported collaborative learning enhanced more performance in an ill structured problem solving task than individual computer supported learning.

Steven Poris (1997), conducted a study on ‘Effects of Computer – Based Co-operative Learning on the Problem Solving Skills of Grade Six Students’. The study was designed to determine if sixth grade students’ problem solving skills were improved by means of their experience with a computer based logical puzzle game designed to increase reasoning skills, and, in turn, problem solving ability. The results indicated that students who participated in a computer based co-operative learning experience using software that fostered the use of problem solving skills showed significant improvement in their problem solving ability. Students who used the same software as individuals showed no such improvement, nor did students who
participated in a computer based co-operative learning experience using social studies software. Therefore, the data was interpreted to suggest that the combination of co-operative learning and the use of computer based puzzle solving game led to increased problem solving ability.

2.9 CRITICAL REVIEW

This section attempts a summary of the review of studies cited in this chapter. The investigator reviewed studies in all the areas namely co-operative learning, critical thinking and problem solving ability by Indian and Foreign scholars. The majority of the studies have been done as experimental studies with pre test and post test equivalent design. The samples of these studies include school level, college level students and teachers. Most of the foreign studies are related to the effectiveness of co-operative learning in critical thinking and problem solving ability, and achievement in Mathematics. All the studies have proved that co-operative learning has a positive effect on achievement in Mathematics, critical thinking ability and problem solving ability. The above findings are in tune with Steven Poris (1997), Michael McInerney (2010), Gokhale (1995), Sean P. (2010), Tarim (2009), and Morgan (2008). The results of the studies indicate significant differences between experimental and control groups on post test measures of achievement in Mathematics, English vocabulary, interpersonal skills, self esteem, achievement motivation, writing skill and attitude towards co-operative learning. These findings are in tune with Malini P.M. (2011), Pallavi kaul
(2010), Kalpana H.(2008), Hemant Lata Sharma (2008), Sangeeta (2005), Kathy (2008) and Sharan (2002). Thus Co-operative learning has been found to be a very effective method for the students. And, the review of related studies has provided a sound theoretical conception regarding the problem under investigation. Among the above studies mentioned, only a few studies have been attempted to investigate the effect of the co-operative learning approach in developing critical thinking ability and problem solving ability in Mathematics among higher secondary students in India. Hence the researcher has chosen this topic for her study.