CHAPTER III
REVIEW OF RELATED LITERATURE

3.1 Introduction

It is important to remember in this time that reviewing literature is an evitable prerequisite to any research. The term “review” means revision or glances over or refers back on. Since effective research is based upon past knowledge, this step helps to eliminate the duplication of what has been done. It provides useful hypotheses and helpful suggestions for significant investigation.

According to Aggarwal.J.C (1966), “The study of related literature implies locality , reading and evaluating the report of research as well as reports of casual observation and opinions that are related to the individual’s planned research project”. Citing studies that show substantial agreement and those that seem to present conflicting conclusions helps to sharpen and define understanding of existing knowledge in the problem area provides a background for the research project and makes the reader aware of the status of the issue.

In this connection it may be apt to remember the words of Best J.W(1997) " a familiarity with literature in any problem areas helps the students to discover what is already known, what others have attempted to find out”. Hence the investigator surveyed the literature, indirectly having some bearing upon the topic have been included here to probe into the problem under investigation and to facilitate comparison and understanding of research design.
A few studies pertaining to the present investigation have been reviewed. Related researches conducted in India and at world level have been reviewed by going through the websites of International Journals and Indian Educational Reviews.

3.2 Studies conducted in India

Ramganesh (2003) conducted a study on effect of metacognitive orientation on enhancing problem solving competency in mathematics among B.Ed. trainees. In this study previous studies on metacognition and problem solving are reviewed and identifying the components of metacognition used in research literature. A model was developed on metacognitive orientation to enhance problem solving competency in mathematics among B.Ed trainees. Single group pre , progressive and post-test experimental design has been adopted. Sample of 35 students were selected and experimented in seven phases spread over 8 weeks. The metacognitive awareness tool was designed by the investigator. The data were analysed using 't' test and Pearson moment correlation. The findings showed that there is a steady increase in the mean achievement scores of the experimental group from pre-test to the post-test1 and post-test2. After the treatment with metacognitive orientation on problem solving competency, results revealed that the achievement in problem solving of experimental group was more significant in post-test1 and post-test2. The study also noticed that there is a steady decrease in the mean score of anxiety towards mathematics teaching in post-test1 and post-test2 compared to pre-test. Correlation analysis was done among the variables achievement, metacognitive awareness and attitude. The coefficient of correlation obtained between metacognitive awareness and achievement and metacognitive awareness and teaching competency were
investigated high correlation. There was a high negative correlation between metacognitive awareness and anxiety. It is also observed that there is low correlation between metacognitive awareness and attitude. ANOVA revealed that there is no significant mean difference in achievement in problem solving among five subgroups of experimental group in pre-test, post-test1 and post-test2. Metacognitive strategies given by him in the year 2007, 2008 and 2009 are reviewed. The metacognitive strategies in the present study will be designed under his guidance.

Begum.J.A(2004) conducted a study on enhancing communicative competence: Effect of metacognition and mediated learning experience among DIET students. A pre-test , post-test single group design was adopted for the study. The experiment has nine phases and conducted in eight weeks. The finding of the study shows that communicative competence of the subjects is enhanced during and after the treatment. The study shows a correlation between the scores of metacognition and mediated learning experience in all the pre , progressive and post assessments.

Savithiri (2006) conducted a study on impact of metacognitive strategies in enhancing perceptual skills among high school students in learning Geometry. The study took place over a six-week period with 50 high school students. Research was conducted in single group design with pre, progressive and post-test. The study observed that student's achievement level has increased after implementation of metacognitive strategies and application of perceptual skills. The finding of the study reveal that by using metacognitive strategies perceptual skills could be enhanced in learning Geometry. It is also pointed out that both perceptual skills and metacognitive strategies are needed to learn Geometry.
Saravanakumar and Mohan (2007) conducted a study on enhancing the level of meta-cognitive orientation and attention and activation techniques towards enhancing student’s achievement in science. An experimental design has been adopted. Meta-cognitive orientation and attention activation are the independent variables and achievement in science is the dependent variable. The execution consists of six phases spread over 10 weeks. 47 students of Standard 10th of a local school were the sample subjects. Three tools were developed and validated to assess meta-cognitive orientation attention activation and achievement in science. The date for meta-cognitive orientation, attention activation and achievement in science on pre, progressives and post-assessment were collected and computed for analysis. Gradual increase in the dependent variable viz., student’s achievement in science from initial assessment to final assessment indicates the influence of the independent variables namely, meta-cognitive orientation and attention activation strategies.

3.3 Studies conducted in aboard

Lippmann. (2005) conducted a study to investigate student behavior in different types of laboratories, from more traditional to free inquiry labs. The study also correlates students’ behavior with their explicit metacognitive statements, which allows us to differentiate between productive and unproductive metacognition.

Adesoji. et.al (2005) conducted a study to investigate effects of Student Teams-Achievement Divisions strategy and mathematics ability on senior secondary school chemistry students’ learning outcome in chemical kinetics. A pretest, posttest control group quasi experimental
design was adopted for the study. Data were collected from a sample of 300 students made up of 110 males and 190 females from six senior secondary schools in Epe division of Lagos State, Nigeria. Analysis of covariance (ANCOVA) was used to analyze the data with pre-test scores as covariates in order to adjust for the initial differences in the sample. Multiple classification analysis (MCA) was also used to examine the magnitude of the differences among the groups. The findings revealed that there were significant main effects of treatment on students achievement and attitude and respectively. Mathematics ability had significant main effects on achievement and on attitude. The interaction effects of treatment and mathematics ability was significant for achievement and also for attitude. Based on the findings, it was recommended that mathematical background of students should be taken into consideration before allowing them to enroll for chemistry at the senior secondary level. Students with very low mathematical ability should not be allowed to enroll for chemistry. Students Teams-Achievement Divisions strategy should also be used to teach chemistry at this level.

Ponnusamy (2006) conducted a study on the impact of metacognitive strategies among lower achievers in secondary schools. Research was conducted using a quasi-experimental design with pre- and post-tests. A total of 90 Form 4 students were selected and they were divided into three groups. The first experimental group was taught metacognitive and problem solving strategies while the second experimental group received only metacognitive strategy. The control group was taught using traditional strategies. Two teachers were trained by the researcher to teach metacognitive and problem solving strategies for a period of one month. The experiment was carried out for 15 weeks. The aim of the research was to investigate whether metacognitive strategies have an
impact on teaching and learning. The results revealed that the group which received metacognitive and problem solving strategies out-performed the other two groups in objective, subjective and essay tests, reported higher metacognitive awareness, used more metacognitive strategies during problem solving, attained higher metacognitive knowledge and could answer more higher level cognitive questions. With regard to attitude, both the experimental groups showed more positive attitude towards the learning of History compared to the control group. The study showed that metacognitive and problem solving strategies had a significant impact on academic achievement, metacognitive awareness and metacognitive knowledge. Also, the ability to use and reflect on metacognitive strategies during problem solving could bring about a positive attitude towards the learning of History and the ability to answer higher level cognitive questions.

**Leutwyler (2006)** conducted a study to explore the ways in which a concept mapping task could enhance the learning experience of preschool children by facilitating metacognitive skills involving planning, prediction, correcting errors and evaluating progress. Specifically, this study used discourse analysis from transcribed videotapes to explore child-adult interactions in three small groups as each group engaged in building a concept map about pumpkins. The targeted observations specifically focused on (1) identifying scaffolding of metacognitive control by adults during the activity and (2) seeking evidence of regulation-in-action evidenced by children’s talk and behavior. Findings suggest that the extent to which preschoolers are able to engage in metacognitive processes depends on the manner in which the activity is framed and structured by the adult overseeing the activity, highlighting the importance of the social context in fostering the effective use of “metacognitive tools.”
**Anderson and Samson (2006)** conducted a study to investigate how year 11 and 12 physics students’ metacognition influences the development of their conceptual understandings of kinematics. An interpretive case study approach was used to investigate students working in collaborative groups in the context of an amusement park physics program. The metacognitive character of individual learners was demonstrated to have a strong influence on their conceptual development. Moreover, the metacognitive character of individuals within the small group contexts investigated was a key factor influencing the groups’ collective knowledge development. A coyote–rabbit metaphor was developed to interpret the resilience and weaknesses of individual and group knowledge construction processes, and elucidates new theoretical understandings regarding metacognition and its influence on knowledge construction.

**Zakaria et.al (2007)** conducted a study to examine whether there was a correlation between metacognitive awareness and students’ achievement on mathematical problem solving tasks. In addition, the study investigated whether there were differences in metacognitive awareness in mathematical problem solving in relation to gender and discipline of study. The sample consisted of 378 matriculation college students, 123 males and 255 females. The data were analyzed using a t-test, one-way ANOVA and Pearson correlation. The findings showed that there was a significant relationship between metacognitive awareness and students’ achievement in mathematical problem solving. There were no significant differences in metacognitive awareness in mathematical problem solving with respect to gender. Nevertheless, there was a significant difference in the dimension of self-checking between males.
and females. There were also significant differences in metacognitive awareness depending on discipline of study.

**Kleitaman and Stankov (2007)** designed a study to investigate the effects cognitive-metacognitive framework on the problem-solving performance of Year 6 students with different ability levels. A quasi-experimental design was employed using one experimental and two control classes. Four different techniques were applied to identify above average, average, and below average students. There was a significant improvement in problem solving performance for the experimental class compared with both control classes. Furthermore, higher ability students appeared to gain more from the experimental instruction than lower ability students.

**Coutinho (2007)** conducted a study to construct an assessment tool for metacognition for Turkish regular and gifted preadolescents. The study was composed of two phases. In the first phase, a metacognition inventory was developed. The inventory, which consisted of four subscales, namely evaluation, self-checking, awareness, and cognitive strategies, was found to have high internal consistency and adequate construct validity. In the second phase of the study, correlations of metacognition with reading comprehension, achievement, and aptitude were tapped. The results showed that the awareness and cognitive strategies subscales of the inventory were significantly and positively correlated with reading comprehension. Self checking and evaluation subscales of the inventory were significantly and positively correlated with science course grades of the gifted students.

**Lin. (2008)** conducted a study on toward teacher's adaptive metacognition. This study compares conventional uses of metacognition
with the kinds of metacognition required by the teaching profession. Teaching has unique qualities that differentiate it from many of the tasks and environments that metacognitive interventions have supported. Teachers often confront highly variable situations. This led us to believe that successful teaching can benefit from what we call adaptive metacognition, which involves change to oneself and to one’s environment, in response to a wide range of classroom social and instructional variability. The study presents several examples to illustrate the nature of metacognition required by teachers and the challenges of helping teachers recognize situations that require adaptive metacognition.

Suraya..et.al. (2008) conducted a study on relationship between motivation and level of metacognition. This study reports findings of the survey instrument that focuses on determining (i) students’ level of motivation and level of metacognition in solving mathematical problems, (ii) relationship between level of motivation and level of metacognition with mathematics achievement and overall academic achievement, and (iii) determining relationship between motivation and metacognition. The dimensions of motivation were found to be significantly correlated with performance in university mathematics courses. Significant correlation was also established between levels of metacognition with level of motivation. In conclusion, this study reveals some of the factors that influence one’s performance in mathematical problem solving.

Ozsoy..et.al. (2008) conducted a study to investigate the effect of using metacognitive strategy training on mathematical problem solving achievement. The study took place over a nine-week period with 47 fifth grade students. The experimental group (n=24) instructed to improve their metacognitive skills. At the same time the students in the control group (n=23) received no additional activities and continued their normal
lessons. Students were pre- and post-tested with the Mathematical Problem Solving Achievement Test and Turkish version of Metacognitive Skills and Knowledge Assessment (MSA-TR). The results indicated that students in the metacognitive treatment group significantly improved in both mathematical problem solving achievement and metacognitive skills.

**Berardi-Coletta. et.al. (2008)** examined the role of metacognitive instruction in prompting generalized problem-solving behavior to two analogous physics problems. Experiment 1 included 28 students distributed into four groups--control, added metacognitive understanding instruction, added monitoring & control instruction, and added metacognitive understanding and monitoring & control instruction. There were no quantitative differences in transfer among the four groups but qualitative observations pointed to the deployment of learned strategies for the groups with added metacognitive understanding instruction and added metacognitive understanding and monitoring & control instruction. This result prompted the refinement and augmentation of strategy and metacognitive instructions for Experiment 2. Experiment 2 included 60 students distributed into four groups identical to Experiment 1--control, added metacognitive understanding instruction, added monitoring & control instruction, and added metacognitive understanding and monitoring & control instruction. The results of Experiment 2 strongly supported the transfer-promoting effects of metacognitive understanding instruction added to task-specific strategy instruction, without further training on the second and third uninstructed simple physics problems.

**Sabin (2009)** conducted a study with a quasi-experimental control and treatment design with 537 and 464 participants, respectively, was implemented. Assessment of metacognition was accomplished by using a
multi-method instrument that consists of a self-report (Metacognitive Activities Inventory, MCAI) and a concurrent, web-based tool (Interactive Multimedia Exercises, IMMEX). IMMEX has been shown to allow rapid classification of problem solvers according to their regulatory metacognitive skills. Compared to the control group, the treatment group showed a significant increase in metacognition awareness, as evidenced by the MCAI, increased ability in solving non-algorithmic chemistry problems of higher difficulty, and with higher per cent correctness (IMMEX). These findings are consistent with an overall increase in the use of regulatory metacognitive skills by the treatment group. We propose that the meaningful, purposeful social interaction and the reflective prompting instantiated by the intervention act as promoters of metacognition development. It is of particular relevance that these factors are not exclusive to the intervention employed here and can be embedded by practitioners in their instruction.

Simsek and Balaban (2008) conducted a study to assess the most commonly used learning strategies of undergraduate students and how these strategies were related to their academic performance. Toward this purpose, a 60 item Likert scale was administered to a sample of 278 undergraduate students. The students were selected based on their cumulative grand-point-average as the most successful and the least successful five senior-year students from each majoring area in the faculties of arts, engineering, science, communication, and sports. The Cronbach’s Alpha reliability coefficient of the scale was 0.93. Results showed that successful students used more, varied, and better learning strategies than unsuccessful students. Female students were more effective in selecting and using appropriate strategies than male students. There were a variety of differences among fields of study; students of fine
arts used the strategies least, while students of sports used them the most. The most preferred group of strategies was metacognitive strategies, whereas the least preferred group was organization strategies. The same pattern was found for the level of success, gender, and field of study. The results overall imply that certain strategies contribute to student performance more than other strategies, and majority of university students are aware of this situation.

Chunanlin (2009) conducted a study with the teacher trainees in the English department. Within this study, students have been taught metacognitive strategies for reading in a five-week program they have joined voluntarily. The students have used the reading logs to reflect on their own thinking processes as they have been engaged in reading tasks. The purpose of the study is to determine the effectiveness of systematic direct instruction of multiple metacognitive strategies designed to assist students in comprehending text. Specifically, the reading comprehension and vocabulary achievement of 130 third-year university students has been investigated to determine whether instruction that incorporated metacognitive strategies has led to an increase in the reading comprehension of expository texts. In addition, the investigation is also designed to determine the impact of the metacognitive strategies on vocabulary.

Zhang and Christine(2009) conducted study to investigate 278 Singaporean students’ knowledge and use of 40 listening and speaking strategies, and the relationship between these two variables. Distinctions were made among use-focused and form focused learning strategies, comprehension strategies and communication strategies. The results showed that the students tended to believe in the usefulness of all four groups of strategies but seemed more often to use use-focused ones. Of the 40 strategies, 32 were perceived as useful by half the students,
whereas only 13 were reported as used frequently. The discrepancy indicates that, while the students were generally aware of the usefulness of the strategies, they were not yet conscious and confident strategy users. There seems to be a need to increase their repertoire of strategies. Correlations were found between perceptions of the usefulness and perceived use of the strategies. The paper ends by considering teaching implications and future research.

Ibe(2009) conducted a study on effects of metacognitive strategies on classroom participation and student achievement in Senior Secondary School Science classrooms. The design for the study was a quasi-experimental design involving 3 intact groups namely two treatment groups:- Think –Pair-Share (TPS) strategy and the Metacognitive Questions (MQ) and a control group. The study lasted for 11 weeks. The sample comprised of 24, 22 and 21 subjects for control, TPS and MQ respectively. A researcher made achievement test in the topic-density was used to measure achievement in the 3 groups. The research question was answered using descriptive statistics as in mean and standard deviation while the hypothesis was tested using analysis of covariance (A_COVA). Results revealed that the Metacognitive strategies were most effective in enhancing academic achievement followed by the TPS. The researcher recommends that Metacognitive strategies and questions be infused in the classroom so as to help students learn material more efficiently, retain information longer and generalize skills.

Sami and Ozgul(2009) conducted a study with two phases. The first one was to investigate the relationship among science achievement, metacognition, and epistemological beliefs for both 4th and 5th grade and 6th through 8th grade students. The second phase was to explore the
relationships among gender, socioeconomic status (SES), metacognition, and epistemological beliefs. Altogether 941 elementary students participated in this study. For 4th and 5th grade students, knowledge of cognition, regulation of cognition, and quick learning contributed to science achievement. For 6th through 8th grade students, knowledge of cognition, regulation of cognition, innate ability, and quick learning contributed to science achievement. For both group of students, while metacognition was related both to gender and SES, epistemological beliefs were mostly related to gender.

**Sevgi turani et.al (2009)** conducted a study to investigate the acquisition of metacognitive awareness and self-regulated learning skills in medical schools using different curricular models. The study was carried out in four medical schools implementing different curricular models. Eight hundred and sixty two medical students took part in the study and two scales (self-regulated learning perception scale – SRLPS and metacognitive awareness inventory – MAI) were used. There were no statistically significant differences in MAI scores according to gender, curricular language, or previous exposure or not to a learner-centered method during secondary school, but the differences in scores according to the phase and curricular model were found to be significant. With regard to SRLPS total scores, no difference was found according to gender, but significant differences were found according to phase, curricular language, and curricular model. MAI and SRLPS scores of students from the medical school using a learner-centered curriculum were higher than the other schools’ students. This study suggests that students who experience a learner-centered curriculum, such as PBL during their medical education demonstrate improved metacognitive awareness and self-regulated learning skills.
**Pulmones (2009)** conducted a qualitative study on metacognition, on how academic tasks in Chemistry are designed and structured in a constructivist environment that promotes students metacognitive behaviors and meaningful learning of Chemistry. Sample metacognitive profiles of two cases (low and high metacognitive index), generated from analyses of various qualitative data are also presented. As a conclusion, the paper reiterates a research finding which indicates that prolonged engagement of students in classroom activities designed in a constructivist environment gives ample opportunities for students to demonstrate their overt planning, monitoring and evaluation behaviors. Purposely asking students to answer metacognitive questions afforded them the opportunity to reflect on their thinking, thus fostering their metacognition.

**Ozsoy and Ataman (2009)** conducted a study (1) to identify the strategies used by the students and the teachers in the School of Foreign Languages at Erciyes University, (2) to find out whether there is a difference between the strategies used by the two groups, (3) to investigate the effect of the students’ gender, age and department on their strategy preferences, (4) to see the relationship between the language learning strategies of the learners and their academic success, and (5) to investigate the effect of the relationship between the language learning strategies of the students and language teaching strategies of teachers on the academic achievement of the students. A statistically significant difference was found among all types of strategies used by the learners and the teachers. While the relationship between the compensation strategy and the academic success of the students was statistically significant, the affective strategy was found to have a negative
meaningful relation with the academic success of the students. No relationship was found between the other strategies and the learners’ academic success. However, the mostly favored strategies used by both the students and the teachers were metacognitive strategies and compensation strategies. At the end of the present study some recommendations for foreign language teachers to use these strategies effectively were made.

**Fenghua et.al. (2010)** conducted a study on carried out an empirical study to investigate the effect of metacognitive strategy training on students’ writing performance in the hope of finding an optimal teaching approach for English teachers of vocational colleges. This teaching approach really embodies the teaching idea “student-centered” and is targeted to foster students’ metacognitive strategy, monitoring and evaluating abilities in English writing.

**Gulsum .et.al.(2010)** examined the differences in the level of 7th-grade Turkish students' cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) in science and investigated the contribution of cognitive and metacognitive strategy use to students' science achievement. The present study also explored the relationships between students' background characteristics (gender, prior knowledge, socioeconomic status) and their cognitive and metacognitive strategy use and science achievement. The statistical analyses revealed significant differences in the level of students' cognitive and metacognitive strategy use scores. Besides, elaboration, organization, and metacognitive self-regulation strategy use were found to make a significant contribution to students' science achievement. Moreover, prior knowledge, parents' educational level, number of reading materials at home, frequency of buying a daily
newspaper, presence of a separate study room, and presence of a computer with internet connection at home were significantly not associated with cognitive and metacognitive strategy use and science achievement.

**Coskun.(2010)** conducted a study to investigate the effect of metacognitive listening strategy training on the listening performance of a group of beginner preparatory school students at a university in Turkey. Two beginner groups, a control group (n: 20) and an experimental group (n: 20), were chosen as the participants of the study. The experimental group received five weeks of metacognitive strategy training embedded into a listening course book, while the other group did not. At the end of the training, a listening test taken from the teacher’s manual of the same course book was administered to both groups. The analysis of the test scores using t-test revealed that the experimental group did statistically better in the test. The implication of the study is that metacognitive strategy training should be incorporated into the regular listening teaching program to help students become more effective listeners.

**Hamdan..et.al.(2010)** conducted a study to investigate the use of cognitive and metacognitive strategies for 3rd semester students majoring in English in reading an English text. The respondents were 57 students from one of the Teachers Education Institute in Malaysia. The study also examined the differences between metacognitive reading strategies adopted by students across demographic factor, and significant relationship between cognitive reading strategies with demographic factor namely former type of school attended. The result of the study showed that students employed high level of cognitive reading strategies but medium users of metacognitive reading strategies. Students exploited problem solving, the most amongst the other categories of the
metacognitive strategies. Rereading, guessing, contextualizing, visualizing and using dictionary were the most exploited strategies in both cognitive and metacognitive strategies. Strategies which are greatly needed at tertiary level such as the ability to differentiate between facts and opinions, thinking about topics that cover both sides of the issue and reflecting on what was being read were not too popular. The study also confirmed the hypotheses that there was no significant difference between metacognitive strategies with demographic factor and there was also no significant relationship between cognitive strategies and demographic factor namely former school type. The results would benefit both students and lecturers as it would be the focus in monitoring and evaluating students' own reading strategies particularly metacognitive strategies and this would pave the way to a better reading comprehension.

**Abdullah. (2010)** made an attempt to investigate the patterns of Physics problem-solving among 6 Key Stage 4 (14-16 years old) students in Cambridge through the lens of metacognition. In order to match the students with ‘real’ problems (i.e. that are difficult for them but solvable), 54 students from 2 schools were given a Physics Problems Test consisting of 6 problems on Linear Motion and followed by 2 questions designed to measure the level of difficulty of each problem. Later, 6 students were selected to undergo a session of individual problem-solving using thinking-aloud and observation by the researcher, followed by retrospective semi-structured interviews. The thinking-aloud was recorded, transcribed and coded using the constant comparative method of Grounded Theory. The analysis of the thinking-aloud protocols was supported by the analyses of data from the interviews, observations and analysis of answer sheets. Though this small-scale project has not reached the stage of theoretical saturation, the use of an open coding technique,
constant comparison method and theoretical sampling provide a concrete foundation for generating some working hypotheses about the pattern of Physics problem-solving among these students.

**Magno. (2010)** investigated the influence of metacognition on critical thinking skills. It is hypothesized in the study that critical thinking occurs when individuals use their underlying metacognitive skills and strategies that increase the probability of a desirable outcome. The Metacognitive Assessment Inventory (MAI) by Schraw and Dennison (Contemporary Educational Psychology 19:460–475, 1994), which measures regulation of cognition and knowledge of cognition, and the Watson-Glaser Critical Thinking Appraisal (WGCTA) with the factors inference, recognition of assumptions, deduction, interpretations, and evaluation of arguments were administered to 240 college students from different universities in the National Capital Region in the Philippines. The Structural Equations Modeling (SEM) was used to determine the effect of metacognition on critical thinking as latent variables. Two models were tested: (1) In the first model, metacognition is composed of two factors while (2) in the second model; metacognition has eight factors as they affect critical thinking. The results indicated that in both models, metacognition has a significant path to critical thinking. The analysis also showed that for both metacognition and critical thinking, all underlying factors are significant. The second model had a better goodness of fit as compared with the first as shown by the RMSEA value and other fit indices.

**Santiago et.al. (2010)** conducted study on the effectiveness of a collaborative intervention in promoting college general chemistry students' awareness and use of metacognition. The intervention starts with a cognitive imbalance experience as a trigger for metacognitive
reflection, which is then followed by reflective prompting and peer interaction. A quasi-experimental control and treatment design with 537 and 464 participants, respectively, was implemented. Assessment of metacognition was accomplished by using a multi-method instrument that consists of a self-report (Metacognitive Activities Inventory, MCAI) and a concurrent, web-based tool (Interactive Multimedia Exercises, IMMEX). IMMEX has been shown to allow rapid classification of problem solvers according to their regulatory metacognitive skills. Compared to the control group, the treatment group showed a significant increase in metacognition awareness, as evidenced by the MCAI, increased ability in solving non-algorithmic chemistry problems of higher difficulty, and with a higher per cent correctness (IMMEX). These findings are consistent with an overall increase in the use of regulatory metacognitive skills by the treatment group. We propose that the meaningful, purposeful social interaction and the reflective prompting instantiated by the intervention act as promoters of metacognition development. It is of particular relevance that these factors are not exclusive to the intervention employed here and can be embedded by practitioners in their instruction.

3.4 Studies conducted about the influence of intervening variables

i) Study habit

Ozsoy.et.al (2009) conducted a study to investigate the relationship between fifth grade students’ metacognition levels, and their study habits and attitudes. Participants of the study consist of 221 students, 125 female and 96 male, enrolling to six public primary schools in Turkey. The results revealed that there is a medium positive relationship between metacognitive knowledge and skills and study habits
($r = .351, p < .05$), study attitudes ($r = .415, p < .05$) and study orientation ($r = .434, p < .05$). Additionally, the results of the study showed that there is no significant relationship between metacognition and study habits and attitudes.

**Laut (2008)** conducted a study on the impact of social and cultural factors on cognitive development in children. Piaget acknowledged the impact of social factors and peer interaction on cognitive development. However, there has been relatively little work on the impact of social and cultural factors on the development of metacognition in first-year university students. Using the *Learning and study strategies inventory* (LASSI) as a measure of metacognition, this study samples first-year undergraduates in Hong Kong ($N = 1815$) and identifies significant differences in metacognitive abilities between students living in their home environment and those who have moved away from their family and, in some cases, culture, to pursue undergraduate education.

**Singh et al. (2007)** examines the nature, type and characteristics of study habits in high school children in relation to various orgasmic variables like gender, age, class or grade level and scholastic achievement. The sample for the study was drawn from two private English medium schools in Indore, Madhya Pradesh, India, comprising of 250 high school students including equal number of boys and girls from class/grades VIII, IX and X. A 40-item questionnaire was used to elicit study habits of the sample. The questionnaire focused on four selected indicators of study habits (study organization; study methods and strategies; motivation and feeling for study; location and time for study). Each indicator had ten items which the student respondents were instructed to answer along a 3-point scale of either ‘yes’, ‘no’ or ‘sometimes’ respectively. The results indicate an overall mean study habits score for
the total sample is 42.33 (SD: 8.21). This matches closely with the gross percentage class teacher ratings on their academic performance (Mean: 56.74; SD: 15.04). The girls have better study habits than boys-which is matched with similar lower ratings given by their class teachers for boys than girls. It is also seen that study habits improve with age and class or grade levels in children. A second level analysis in relation to the four indicators revealed no statistically significant difference between students in relation to gender, grade/class of study or age of students. The Cronbach's alpha correlations coefficients of reliability of the sub scales are found to be high and the internal consistency of the total scale is 0.68. In sum, the present study highlights the possibility of objectively measuring study habits in high school students using a self rating tool as well as using it as predictor for academic performance.

**Jain(1997)** conducted a study on the study habits and academic achievement of students in Uttapardesh Colleges. The aim of the study was to develop a study habit inventory of University students of Uttarpradesh. The study also aimed to exploring the relationship between study habit and student's achievement. A study habit inventory was developed from 8 areas such as understanding, planning, working habits, note taking, concentration, interest in studies and memorization habits. The data was collected from a sample of 960 drawn from universities of Uttarpradesh. The scores on study habits inventory correlated with attainment.

**ii) Home learning environment**
The case study of **Mehra(1986)** came out with the conclusion that the amount of science home work and number of books at home were positively correlated with achievement in science.

**Schibeci and Rliey(1986)** recorded a substantial influence of home environment on student achievement in science.

**Agarwal (1984)** study was aimed at understanding the effect of parental encouragement upon the educational development of secondary school students. He found that the high achieving group had been getting the higher parental encouragement. The study also revealed that high achieving boys and girls in the urban area is getting higher parental encouragement than their counterparts in rural area.

**Ekeocha(1986)** identified home learning environment correlates student's science achievement and found that home background and classroom constructs have a positive effect on science achievement.

iii) **Attitude**

**Adams,W.K et.al (2006)** conducted a study on The Colorado Learning Attitudes about Science Survey (CLASS) is a new instrument designed to measure student beliefs about physics and about learning physics. This instrument extends previous work by probing additional aspects of student beliefs and by using wording suitable for students in a wide variety of physics courses. The CLASS has been validated using interviews, reliability studies, and extensive statistical analyses of responses from over 4000 students. In addition, a new methodology for determining useful and statistically robust categories of student beliefs has been developed. This paper serves as the foundation for an extensive study of how student beliefs impact and are impacted by their educational experiences. For example, this survey measures: that most teaching
practices cause substantial drops in student scores; that a student’s likelihood of becoming a physics major correlates with their ‘Personal Interest’ score; and that, for a majority of student populations, women’s scores in some categories, including ‘Personal Interest’ and ‘Real World Connections’, are significantly different than men’s scores.

Selcuk et.al.(2009) conducted a study on the influence of learning strategy instruction on student teachers’ physics achievement, attitude towards physics, and achievement motivation. A pre-test/post-test quasi-experimental design with matching control group was used in the study. Two groups of student teachers (n=75) who were enrolled in an introductory physics course participated in the study. In the experimental group, questioning, summarizing, and graphic organizers were taught. The control group did not receive any presentation on strategy learning. Data were collected via the pre- and post-administration of the Physics Course Achievement Test, the Scale of Attitudes towards Physics, and the Achievement Motivation Scale. Univariate and multivariate analyses of variance on the data revealed no significant differences in the attitude and achievement motivation between the strategy and control groups. However, the strategy group students were observed to have a tendency of more positive attitude and motivation than the control group students. Results also showed that explicit learning strategy instruction was more effective than traditional instruction in improving physics achievement of the participating students. The implications of these results for physics education are discussed.

Karakuyu (2010) conducted a study to investigate the effect of students’ concept mapping on their physics achievement and attitudes
toward physics lesson. Participants were 58 ninth-grade students from the two classes enrolled to general physics course in a high school in Turkey. One of the classes was randomly chosen as experimental group (28), constructed electricity concept map and the other was control (30) group, did not receive any presentation on concept mapping. Data were collected via the pre- and post-administration of the Physics Achievement Electricity Test (PAET) and Concept Maps Attitude Scale towards Physics (CMASTP). The study conducted in six weeks in a class that met two times a week. The material covered was about electricity. Results showed that while there were no significant differences in the attitude and achievement between the experimental and control groups. However, the experimental group students were observed to have a tendency of more positive attitude than the control group students. Results also showed that drawing concept map instruction was more effective than traditional instruction in improving physics achievement of the participating students.

3.5 Critical summary

The studies on the title of metacognition are reviewed. The investigator has reviewed 30 studies among them four are Indian and twenty three are foreign studies. Of the 26 foreign studies, nineteen studies have employed pre and post test quasi experimental design with control and experimental groups. All of them have used the random sampling technique to select the sample. All the four Indian studies have employed single group design with pre, progressive and post-test level. The variables included are anxiety, attitude, socio economic status and
learning disabled. Statistical techniques such as 't' test, paired 't' test, ANOVA and correlation analysis were used to analyse the data.

On critical review of the earlier research in metacognition, the investigator summarize the following

- Metacognitive strategy has an impact on cognitive level of the students. Students can meaningfully grasp the material to be studied. Students in the metacognitive classroom experienced a more permanent restructuring in understanding.
- Earlier research indicated that metacognitive activity was related to academic achievement of college students, teacher trainees and primary school students.
- Metacognitive activities are implemented in problem solving, mathematical ability, Chemistry and English comprehension.
- Metacognitive activities are not discipline specific. It was investigated in science, social studies and mathematics.

3.6 Insights gained from the reviews

The previous studies on metacognition revealed that research has been done in the area of Mathematical problem solving and English comprehension in foreign studies. Particularly in India, only few studies have been carried out in metacognition. The importance of metacognition is realized by Indian researchers only in recent times. So far no experimental study has been done in metacognition on achievement of physics at higher secondary level and present work is the first of its kind.
3.7 Conclusion

From the review of related studies could be observed that in India rarely few attempts have been made so far in metacognition. These studies focused on Mathematics among DIET and College students. None of them was dealt with effectiveness of metacognitive strategies in physics among higher secondary students.

The investigator feels that the review will definitely help him to design an experiment, sample, tools and statistical analysis of data. The next chapter deals with design of the study.