CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Studies Related to Cognitive Apprenticeship Model

2.2 Studies Related to Achievement in Mathematics

2.3 Studies Related to Metacognition

2.4 Studies Related to Social Skills
REVIEW OF RELATED LITERATURE

One of the important aspects of research study is to review the works, which have already taken place in the concerned field of investigation. In this study, an attempt has been made to investigate the effectiveness of Cognitive Apprenticeship Model on Achievement in Mathematics, Metacognitive Outcomes and Social Skills. Therefore, the research studies related directly or indirectly to these variables are reviewed in the present chapter. The literature thus examined has been classified under the following headings.

2.1 Studies related to Cognitive Apprenticeship Model
2.2 Studies related to Achievement in Mathematics
2.3 Studies related to Metacognition
2.4 Studies related to Social Skills

2.1 Studies Related to Cognitive Apprenticeship Model

The body of research on cognitive apprenticeship has been growing steadily and in many ways overlaps with research on other constructivist learning theories and methods. In this session, the investigator seeks to include recent reports of empirical research on cognitive apprenticeship.

In the year 1991, Thornburg conducted an exploratory study of teaching higher-order reading and writing in the Social Studies. Cognitive apprenticeship approach was evaluated with 58 high-risk grade seven Social Studies students. Three teachers were trained to provide explicit instruction of higher order cognitive strategies through modelling, monitoring and collaborative role-playing activities. Students' writing showed significant improvements and was judged similar to that of a general student group.

Roth (1991) reported summary of a study on viability of cognitive apprenticeship among U.S. school students and teachers, which had two parts. During the first part, the learning outcomes were examined of grade eight students in small groups on framing, developing and completing their own research agendas. In the
second part, the interactions between a gifted tenth grade student and the researcher who acted as a mentor and a coach were reported. An interpretive research methodology was used in the study. The results of this study confirmed the viability of the concept of cognitive apprenticeship for Science teaching and learning.

Berryman (1991) presented effective learning environments through cognitive apprenticeship models. Using cognitive science as the knowledge base for the discussion, he tried to find why many school learning situations are ineffective and he introduced cognitive apprenticeship model that suggests what effective learning situations might look like. He used a wide array of knowledge and experience to design effective learning environments. He concluded that the cognitive apprenticeship model could be a good vehicle for learning and should be implemented.

Browne and Ritchie (1991) proposed a framework for designing staff development to implement technology in schools, focusing on needs assessment to ensure the transfer of knowledge and skills into regular teaching practice through cognitive apprenticeship model. Components of the model included providing teachers with instruction, modelling, coaching and empowerment. They offered examples of cognitive apprenticeship for implementing technology in more situations.

Johnson and Fischbach (1992) experimented on teaching problem solving and technical mathematics through cognitive apprenticeship at the community college level. They tested cognitive apprenticeship instruction in community college industrial technology classes. It was found that quantitative data from students in the cognitive apprenticeship group scored slightly better than the control group on a problem solving exam and the final exam. The scores of the students’ cognitive apprenticeship on a standardised exam were slightly lower than the control group, but not significant.

Collins (1994) conducted a study on cognitive apprenticeship for disadvantaged students and he argued that cognitive apprenticeship model is useful for all students, but is particularly effective for disadvantaged or at-risk students because learning is embedded in a setting that is more like work, with an authentic connection to students’ lives. He arranged cognitive apprenticeship programmes in an urban middle school in Rochester (New York) and an urban secondary school in Harlem (New York). These schools have begun fostering cognitive apprenticeship by giving students’ long-term
projects that engage them deeply and by constructing an environment embodying the principles of the described framework.

Jarvela (1994) analysed socio-emotional processes of learning interaction during classroom teaching and learning. The learning interaction was organised according to the principles of a cognitive apprenticeship model (Collins, Brown, & Newman, 1989) and applied to the technologically rich learning environment. The purpose of the learning task was to promote the mediation of modern technological thinking and problem-solving skills for 22 French male seventh grade students. Data revealed that the students interpreted same instructional arrangements differently which lead to different situational interpretations among the students. Contextual features, such as the challenging learning task, self-responsible activities and social interaction actualised different motivational coping strategies among the students.

In the year 1995, Jarvela conducted a study on cognitive apprenticeship model in a technologically rich learning environment. The study described the qualitative features of teacher-student interaction during classroom teaching and learning while modern technological thinking and problem solving skills were mediated for 22 seventh grade boys in Finland. He found that the reciprocal understanding between teacher and student is necessary for the teachers’ special instructional assistance to be successful.

Lee (1995) conducted an experimental study to find out the effectiveness of cognitive apprenticeship in a regular classroom setting. In this study, senior high school students received literature instruction based on the cognitive apprenticeship model. All students were from African American community and their experience with a specific form of social discourse was used as a scaffold for teaching skills in literacy interpretation. Furthermore, small group discussions, sequenced phasing of control of teachers and the students’ prior knowledge were the elements of cognitive apprenticeship present in the lessons. The results showed that the pupils from the experimental group outperform the pupils from the control group on a reading comprehension test.

De Bruijn (1995) developed a computer programme for arithmetic in which the use of the operationalised cognitive apprenticeship method was studied together
with effects of modelling and coaching on student performance. Results showed that students make little use of optional materials in a computer program.

Casey (1996) examined the use of cognitive apprenticeship as a framework for instructional design to help the needs of a distributed learning environment. He described the applications of a multimedia training course that helps weather forecasters. He found that cognitive apprenticeship can be implemented in multimedia training courses to meet the cognitive demands of diverse learners.

Duncan (1996) conducted a study for industrial and technical teacher education programme on cognitive apprenticeship in classroom instruction. Community college students (N=159) were taught writing using one of the treatments: modelling with scaffolds, scaffolds without modelling and without any treatment to control group. Test scores, observations and instructor interviews showed that think-aloud modelling increased writing skills; implementation of scaffolding was too idiosyncratic to compare; and integration of modelling required scheduling adjustments and considerable instructor training.

Shyu (1997) determined the effects of computer-aided videodisc-based anchored instruction on promoting elementary school students' problem solving skills in Taiwan. Anchored instruction combined theories such as situated cognition, cognitive apprenticeship, cooperative learning and constructivist theories. With the help of interactive videodisc and computer technology, anchored instruction presented situations of daily life in the way of storytelling by providing an inquiry and real-life learning environment and authentic tasks that help students enhance their problem-solving skills. Fifth-graders (n=37) from an elementary school in suburban Taipei (Taiwan) were randomly selected and divided into six groups according to their mathematical and science abilities, with two high-ability, two middle-ability and two low-ability groups. Students were given a pretest and posttest to measure different problem solving strategies used before and after the video instruction. The findings showed that students’ problem-solving skills improved significantly with anchored instruction. Anchored instruction provided more motivating environment which enhanced all students' problem solving skills, regardless of students' Mathematics and Science abilities.
Cash and Others (1997) conducted a study on the effectiveness of cognitive apprenticeship instructional methods in college automotive technology classrooms. In two automotive air-conditioning classes, an experimental group (n=12) conducted laboratory activities structured by cognitive apprenticeship principles and control group (n=14) attended lectures. The study revealed that cognitive apprenticeship is significantly more effective in increasing information acquisition, troubleshooting knowledge and diagnostic skills.

De Jager, Reezigt and Creemers (2002) examined the effect of teacher training based on new insights from the learning and the instructional field. They compared the performance of two groups of teachers, one trained in a cognitive apprenticeship environment and the other having received no training. They found that, compared to counterparts in the control group, the cognitive apprenticeship teachers successfully changed their teaching behaviour and demonstrated significant improvement in their instructional quality even though they were not successful in fully implementing their learned skills in their teaching practices.

Lowther and Clark (2002) investigated the impact of the cognitive apprenticeship model of learning on preparing pre-service teachers to plan effectively for the use of technology in instruction. Findings indicated that this approach positively affected the pre-service teachers. At the end of the study, participants indicated that they felt confident in their overall ability to (1) use and integrate technology effectively into the elementary classroom, (2) use and teach basic skills and design a lesson that included meaningful use of database, spread sheet, internet, and desktop publishing and (3) manage a learning environment which includes multiple computers.

Noble (2002) determined effect of internship on the development of expertise among graduate students in the field of educational technology. He investigated whether the presence or absence of selected characteristics of cognitive apprenticeship model influenced changes or lack of change in two interns' performances over time using qualitative research design. To provide a detailed in-depth longitudinal description of the interns' experiences, only two interns were selected as participants, each at a different site—one site reflecting characteristics of the cognitive apprenticeship model, the other not. The conclusion emerged was that the presence or
absence of the selected characteristics of the cognitive apprenticeship model of instruction-modelling, coaching, scaffolding and articulation-critically contributes to the development or lack of development of expertise.

Glazer (2004) described the critical experiences of a middle school mathematics teacher as she progressed from a novice to a knowledgeable creator of technology-enhanced learning activities for her classroom. During an eight week intervention, cognitive apprenticeship strategies (Collins, 1991) were utilised in a partnership with a teacher until she felt empowered to independently create these activities without further coaching or support. Qualitative research methods were used to determine the primary factors that lead to such empowerment, as well as the instructional and learning values that the teacher promoted in the activities. This research effort showed that autonomy, confidence and awareness are the prevalent characteristics shown with successful design, development and implementation of technology-enhanced learning activities. In addition, it was found that the teacher's creation of activities is influenced by the teacher's learning values associated with challenging inquiry and continual improvement.

In the year 2005, Liu designed a seven-week web based course and conducted a field experiment on web based cognitive apprenticeship model for improving pre-service teacher's performance and attitudes towards instructional planning. Experimental results revealed that the course based on the web-based cognitive apprenticeship model improves pre-service teachers’ performance and attitudes on instructional planning are more effective than the traditional course.

Darabi (2005) reported a case study describing how the principles of a cognitive apprenticeship model of learning applied to a graduate course on performance system analysis and the differences. He analysed the requirements for the cognitive apprenticeship learning environment and identified the contributions of instructor, students and the course based on those requirements. He could not find difference in the student performance.

Mathes et al. (2005) investigated the effectiveness of combining enhanced classroom instruction and intense supplemental intervention for struggling readers in first grade by comparing two supplemental interventions proactive reading and responsive reading. ‘Proactive reading’ was aligned with behavioural theory and was
derived from the model of direct instruction. ‘Responsive reading’ was aligned with a cognitive theory and was derived from a cognitive apprenticeship model. These interventions were provided to small groups of first-grade students who were at risk for reading difficulties. Students were assessed on various reading and reading-related measures associated with success in beginning reading. Results indicated that (a) first-grade students who were at-risk for reading and who received supplemental instruction in the responsive or proactive interventions scored higher on measures of reading and reading-related skills than students who received only enhanced classroom instruction and (b) the two interventions were equally effective even though they reflected different theoretical perspectives.

Nichol and Turner (2006) pointed out that cognitive apprenticeship helps in the teachers’ professional development. They found that cognitive apprenticeship underpinned the teachers’ assimilation and implementation of a wide range of expert teaching protocols in their own classroom teaching.

Dickey (2007) conducted a study on barriers and enablers in integrating cognitive apprenticeship methods in a web-based educational technology course for primary and secondary teacher education programme. He found that various tools, methods and media can be used to foster the integration of a cognitive apprenticeship model in a web-based learning environment.

Dickey (2008) conducted another study to investigate the integration of cognitive apprenticeship model in a web-based educational technology course for pre-service teacher education students and to find out how the cognitive apprenticeship methods impact student learning processes of technology skills and technology integration methods for teaching. The methodological framework for this qualitative investigation was an interpretive case study. The results revealed that modelling, coaching, scaffolding and exploration are the key to fostering skill knowledge and the use of cognitive apprenticeship methods foster an understanding of integrating technology for teaching and learning.

Kashihara, Shinya, Taira and Sawazaki (2008) addressed the issue of how to develop metacognitive skill. They described a cognitive apprenticeship approach to enable learners to accumulate experiences of metacognitive process with cognitive tool. They argued that cognitive apprenticeship approach develops metacognitive
skills. In particular they propose a learner adaptive scaffolding/fading, in which functions of the tool can be fadable according to metacognitive skill.

Stalmeijer, Dolmans, Wolfhagen, and Scherpber (2009) examined whether the cognitive apprenticeship model fits students' experiences during clinical training. In focus group interviews, three groups of sixth-year medical students (N = 21) discussed the six teaching methods of cognitive apprenticeship model and the learning climate in order to explore the perceived occurrence of the teaching methods, related problems and possibilities for improvement. The students had experienced all six teaching methods during their clerkships. Modelling, coaching and articulation were predominant, while scaffolding, reflection and exploration were mainly experienced during longer clerkships and with one clinical teacher. The main problem was variability in usage of the methods, which was attributed to teachers' lack of time and formal training. The students proposed several ways to improve the application of the teaching methods. The results suggested that the cognitive apprenticeship model is useful for teaching strategies in undergraduate clinical training and a valuable basis for evaluation, feedback, self-assessment and faculty development of clinical teachers.

Boling and Beatty (2010) studied cognitive apprenticeship in computer mediated feedback for creating a classroom environment to increase feedback and learning. This qualitative case study of one teacher and ten students in an advanced placement English class explored the role of computer-mediated feedback in the creation of a classroom learning environment that was supported through hybrid learning experiences. Data sources included classroom observations, online conversations, interviews with ten high school students and informal conversations with a high school English teacher. The study revealed how online discussion forums can provide an excellent medium where students observe models of writing, engage in the writing process observe, reflect upon and discover expert strategies in context.

The purpose of the study conducted by Ramganesh and Amutha (2010) was to find out the effectiveness of cognitive apprenticeship model on enhancing teachers’ metacognitive and comprehension skills. Twenty high school teachers of English at government schools in Pondicherry region were taken as sample for the study and among which ten teachers were in the experimental group and ten in the control
The result revealed that cognitive apprenticeship model is effective in enhancing teachers' metacognitive and comprehension skills.

The design-based research study by Boling et al. (2011) explored educators' experiences in an online course to better understand how course design and pedagogical delivery can best support student learning. Using the cognitive apprenticeship model as a theoretical lens, researchers investigated the following: 1) what methods of instruction, as described by the cognitive apprenticeship model, assisted educators in learning how to use technology to support online communication and collaboration? How were these methods introduced and used? and 2) What evidence exists to show that these methods of instruction had a positive impact on students' changing knowledge, skills and/or dispositions of technology integration? Interviews and course artifacts were collected from one online course instructor and 11 graduate students from various fields of study. Findings highlighted specific methods of instruction that can inform educators' uses of online courses, illustrating how the cognitive apprenticeship model can be used to inform online course development.

Kuo, Hwang, Szu-Chuang, and Sherry (2012) examined the effects of human factors on problem-solving effectiveness in the cognitive apprenticeship model. Among various human factors, this study focused on cognitive styles, with an emphasis on Witken's field dependence. The results showed that field dependent learners could get great benefits from the cognitive apprenticeship model via collaborative learning.

Kuo, Hwang, and Lee (2012) examined students' problem solving performance in hybrid approach that integrates the cognitive apprenticeship model with the collaborative learning strategy proposed for conducting web-based problem-solving activities. The experimental results showed that middle and low achievement students in the experimental group gained significant benefits from the hybrid approach in comparison with those who learned with the traditional approach.

Bouta and Paraskeva (2013) examined how the use of a three dimensional virtual world facilitates the teaching of Mathematics in primary education by combining design principles and guidelines based on the cognitive apprenticeship theory and the teaching method. They focused specifically on fifth and sixth grade students' engagement (behavioural, affective and cognitive) while learning fractional
concepts over a period of two class sessions. Quantitative and qualitative analyses indicated considerable improvement in the engagement of the students who participated in the experiment. The students' cognitive engagement in the process of comprehending basic fractional concepts was hard for students to master.

**An Overview of the Review on Cognitive Apprenticeship Model**

From the above studies it is evident that the theory of cognitive apprenticeship model has got due importance and significance among the educational researchers. The research review on cognitive apprenticeship model focused on three aspects: studies that investigate holistic approaches to educational applications of the process of cognitive apprenticeship, studies that investigate portions of the process such as scaffolding or mentoring and studies that investigate cognitive activities within communities of practice. All these aspects were tested with school students, college students and pre-service and in-service teachers as samples.

Research on cognitive apprenticeship has been growing steadily. Cognitive apprenticeship is especially appealing to designers of web-based learning environments who are embracing a more constructivist approach to learning and instruction. Liu’s (2005) study showed that cognitive apprenticeship model improved pre-service teacher’s performance and attitudes toward instructional planning. Dickey (2007) found out that various tools, methods and media can be used to varying degree of success to foster the integration of a cognitive apprenticeship model in a Web-based learning environment. Again in the year 2008, Dickey found that the use of cognitive apprenticeship methods fostered an understanding of integrating technology for teaching and learning.

De Jager, Reezigt, and Creemers (2002) used Cognitive apprenticeship learning environment to train the pre-service teachers and they found that it helped to make good teaching-learning environment in the school and the college levels. Glazer (2004) described the critical experience of a middle school Mathematics teacher as she progressed from a novice to a knowledgeable creator of technology- enhanced learning activities. Nichol and Turner (2006) also pointed out that cognitive apprenticeship helps in the teacher’s professional development. Berryman (1991) presented an effective learning environment through cognitive apprenticeship model. He found out why many school learning situations are ineffective and he introduced
cognitive apprenticeship model and he pointed out that it is a good vehicle for effective learning situations. Johnson and Fischbach (1992) tested the cognitive apprenticeship instruction in community college classes on teaching problem solving and technical Mathematics. They recommended exploring the model and testing it in other Mathematics based classes. In the year 1994 and 1995, Jarvela analysed the learning interaction in the classroom organised according to the principles of a cognitive apprenticeship model and that model was applied to the technologically rich learning environment.

Kashihara, Shinya, Taira, and Sawazaki (2008) found that cognitive apprenticeship approach develops metacognitive skills. In particular they proposed a learner adaptive scaffolding/fading, in which functions of the tool can be fadable according to students’ metacognitive skills. The study conducted by Ramganesh and Amutha (2010) also revealed that cognitive apprenticeship model is effective in enhancing teacher’s metacognitive and comprehension skills.

The research on cognitive apprenticeship is still fragmented, with bits and pieces situated in different subfields of educational research such as teacher education, adult education, school education and multimedia–based education. The review of the above studies revealed that there is not even one experimental study conducted in the area of cognitive apprenticeship model on teaching Mathematics especially in the secondary school level in India. This influenced the investigator to select the cognitive apprenticeship model as the treatment variable for the present study.

2.2 Studies Related to Achievement in Mathematics

The investigator reviewed the studies on achievement in Mathematics especially to find out the effectiveness of different teaching methods/strategies to teach Mathematics in the classroom. A detailed review of the research studies conducted in this area is presented here.

Maria (1998) studied on cognitive style and non cognitive variables in relation to achievement in Mathematics of the pupils of standard ten. She found out that the relationship between achievement in Mathematics and the independent variables under study is significant and positive except for level of aspiration. In case of urban
sample, cognitive style, attitude towards Mathematics and home environment for Mathematics showed significant and positive relationship with achievement in Mathematics. No significant gender difference was found in the correlation between achievement in Mathematics and each of the selected independent variables.

Natesan (2001) found out the effectiveness of teaching concepts in Mathematics through video-cassette, by adopting an equivalent group design. The study concluded that the increased level of academic achievement of experimental group is due to the teaching of mathematical concept through video-cassette. There was a significant difference between boys and girls in all groups. In all the cases, girls’ performance was superior that of boys.

Upadhyay (2003) determined the effectiveness of constructivism on students’ achievement in Mathematics with respect to overall performance of students in terms of immediate learning, retention and net gain in knowledge and skills, in terms of content area taught i.e. fraction, measurement, equation and angle and in terms of cognitive aspects i.e. knowledge, comprehension and application of grade five students in Nepal. In this study, constructivism proved to be a better technique of teaching Mathematics as it helped students in immediate learning and net gain but did not prove to be an effective approach in retention. He found that students of experimental group used their own novel method and engaged more than the students of control group in the activities of self-learning and self-correcting.

The purpose of the study conducted by Ravindra, Basavayya, and Basti (2003) were to identify the areas in which sex difference exists regarding mathematical ability and to find the extend of these differences that affect the overall development of the careers of individuals. The study revealed that boys are good in abstract thinking and symbolising concepts in Mathematics, whereas girls are good in logical thinking and mathematical modelling. Also both males and females have the same perception of Mathematics and same level of liking Mathematics.

Sharma (2005) evaluated various methods of teaching Mathematics to determine a method of teaching that linked with students and which enhances performance. There were discussions about the present state of Mathematics teaching in Ajmer and also a trend in students’ expectations from teachers as well as their performance in the subject. The study concluded that the use of blackboard to explain
Mathematics is the most commonly used method. However there were few teachers who also use new methods like the visual aids and other laboratory equipment to make the students understand better. The students said that they like the subjects when taught from the basics and in a simple and lucid way. For enhancing their performance the researcher had organised a brainstorming session and he found that majority of the participants who came from various premier institutions of Ajmer city felt that simplicity of presentation, clarity of the topic covered and the ability to read students’ mind in order to make him understand made a good Mathematics teacher. Therefore, with such characteristics of teaching, students will like the teacher, the subject and perform well in the subject.

Nirmala, Merlyn, and Kumaran (2006) conducted a study to find the optimising variables of academic achievement in Mathematics using linear programming approach. Also they studied the contributing factors of academic achievement in Mathematics. Normative survey method was employed to describe and interpret the factors. They found that mathematics information skills, decision making skills and attitude towards Mathematics have made a significant contribution towards the achievement. All the four factors of attitude towards Mathematics (confidence, usefulness, success and teacher) have made a significant contribution towards the maximisation of the aggregate performance in Mathematics.

Rohde and Thompson (2007) made a study to know the variation in academic achievement with general cognitive ability and scientific cognitive abilities. In a sample of 71 young adult male’s measures of general cognitive ability continued to add to the prediction of academic achievement. But none of the specific cognitive abilities accounted for additional variance in academic achievement after controlling general cognitive ability. However, processing speed and spatial ability continued to account for a significant amount of additional variance when predicting scores for the mathematical portion of SAT while holding general/cognitive ability.

Subrata (2007) studied academic achievement in Mathematics in relation to cognitive style and attitude towards Mathematics. The study attempted to analyse the more discrete cognitive and affective abilities and their influence on the academic achievement of primary children in Mathematics. She found that cognitive style and
attitude of the learners are the important correlates of their academic achievement. Boys performed significantly better than their counterparts on all the variables.

Thangarajathi (2008) explored the effectiveness of mind mapping technique over conventional method in teaching Mathematics at high school level in terms of sex, parental qualification and parental income. The sample of the study comprised of 60 ninth standard students in Tuticorin district. Two equivalent groups pretest-posttest experimental design was employed for this study. The study revealed that the mind mapping technique is more effective than the conventional method.

Gulhane (2008) conducted a study to bring out the relative effectiveness of inductive, deductive and analytical methods of teaching in solving linear equations in two variables. The study revealed that there is a significant difference between inductive, deductive and analytical methods on the achievement of students in solving linear equations. Of these methods, inductive and deductive are more effective than the analytical method.

Manjunath (2009) developed a strategy for teaching Mathematics in a Mathematics laboratory. A strategy consisting of three methods: Expository method, cooperative learning method and problem solving method coupled with modelling was developed. The strategy developed was used for ten weeks on the experimental group to teach Mathematics in a Mathematics laboratory atmosphere; whereas, the control group was taught the same Mathematics content using normal classroom teaching. The findings showed that the strategy evolved to teach Mathematics in a Mathematics laboratory is more effective than the traditional methods of teaching. The study reflected that Mathematics teachers should be provided ample training in using this strategy, by inducting this strategy in teacher training curricula.

Singaravelu (2009) made a study to find the relationship between test anxiety and academic achievement in Mathematics of high school students in Puducherry. The sample consists of 300 high school students selected using cluster sampling technique from Puducherry region. Finding of the study revealed that higher the test anxiety, lower was the academic achievement in Mathematics. Also students with average level of test anxiety achieved more than the students with high and low levels of test anxiety.
Umadevi (2009) explored the relation between problem solving ability and academic achievement. The study revealed that there is no difference in problem solving ability with regard to gender and significant difference with regard to type of management. The study found high relation between problem solving ability and academic achievement.

Ganihar and Wajiha (2009) found that several factors affect academic achievement of ninth standard students in Mathematics. They concluded that factors like mathematical creativity, attitude towards Mathematics, achievement motivation and low level of anxiety influence the academic achievement in Mathematics at secondary stage.

Behera (2009) investigated cognitive skills in solving mathematical problems of learners at the terminal stage of elementary education. Contrast group of achievers with equal number of boys and girls constituting higher ability and lower ability were selected on the basis of Mathematical Ability Test result. The study revealed that higher ability group is superior to lower ability groups irrespective of sex. The higher performance of high achievers over the low achievers in both core and non-core problems revealed that those who can verbalise the process of solution are better at solving problems.

Pandya (2010) explored the effect of cooperative learning model on the academic achievement in Mathematics among students with different learning styles. He concluded that cooperative learning model is more effective on achievement in Mathematics for students with predominantly dependent, participant and collaborative learning styles as compared to the students with predominantly independent, avoidant and competitive learning styles respectively.

Mahmood and Khatoon (2010) conducted a study on gender, anxiety and achievement in Mathematics. This study proposed a set of independent variables (gender, school types and mathematical achievement of the secondary school students) that have a relationship with mathematical anxiety. It was found that nearly half of the secondary school students have moderate level of anxiety and females display more anxiety towards Mathematics than the male. Students of government and governmental aided schools evidence a higher level of Mathematics anxiety than
those of missionary schools. A significant negative relationship between Mathematics anxiety and Mathematics achievement was found in this study.

Li and Ma (2010) examined the impact of computer technology (CT) on Mathematics education in K-12 classrooms through a systematic review of existing literature. A meta-analysis of 85 independent effect sizes extracted from 46 primary studies involving a total of 36,793 learners indicated statistically significant positive effects of CT on Mathematics achievement. CT showed larger effects on the Mathematics achievement of special need students than that of general education students. The positive effect of CT was greater when combined with a constructivist approach to teaching than with a traditional approach and studies that used non-standardised tests as measures of Mathematics achievement reported larger effects of CT than studies that used standardised tests.

Sarsani and Maddini (2010) investigated the differences in Mathematics achievement test in relation to gender, caste, type of school, nativity and medium of instruction. They found that girls’ performance is better than boys, caste had no influence on performance, type of school and nativity influence performance and English medium students perform better than Telugu medium students.

Prakash and Sharma (2010) assessed the influence of gender and area on Minimum Levels of Learning (MLL) attainment in Mathematics among fifth standard students of Shimoga district. MLL based test was adapted and used for assessing selected MLL competencies, which had seven competencies. Results revealed that girls excelled boys only in one competency, namely, fundamental operations. Area-wise comparisons indicated that in competencies-number, decimals, addition and subtraction with mixed operations and in total competency scores rural children were found to be better than urban children.

Naik (2010) investigated the effect of 5E learning cycle techniques on the achievement of Mathematics in the constructivist classroom. Pretest-posttest control group design was adopted for the study. The results of the findings showed that the students taught through 5E learning cycle techniques perform better and enhance their Mathematics achievement than those taught with conventional learning method. There was no significant gender difference in the performance of students taught with 5E learning techniques.
The aim of the study conducted by Kaul (2010) was to find out the effect of learning together techniques of cooperative method on students’ achievement in Mathematics. This study was conducted with 70 pupils studying in seventh standard in N.S public school, Uttar Pradesh. Learning together technique of cooperative learning method had been applied to the experimental group and traditional method had been applied to the control group. Conclusions showed that there is a significant difference between the results of experimental and control groups. Learning together technique of cooperative learning method is more effective than traditional teaching method.

An experimental study was conducted by Kaur and Kaur (2011) to find the effect of concept attainment model of teaching on mathematical achievement of secondary school students. They found that Bruner’s model is more effective than traditional method in the teaching of mathematical concepts. Both male and female students improved through Bruner’s concept attainment model as well as traditional method.

Malini (2011) found out the effectiveness of jigsaw technique in the learning of Mathematics for secondary school students. She adopted pretest-posttest non equivalent control and experimental groups design. The analysis revealed that the students taught through jigsaw technique have better achievement than students taught through conventional method.

Murimo (2013) examined the contribution of parents, economic resources and cultural factors on grade seven students' beliefs and attitudes towards mathematics. No gender differences were found, but age, geo-location, number of siblings, education of parent and possession of economic resources were statistically significant predictors of students' perceived usefulness of mathematics.

An Overview of the Review on Achievement in Mathematics

After reviewing the studies related to achievement in Mathematics, the investigator realised that the studies conducted in this area are focused to find out the effectiveness of different methods/techniques to teach Mathematics. Earlier researchers investigated the effectiveness of different methods such as constructivism (Upadhyay, 2003), linear programming approach (Nirmala et al., 2006), mind mapping technique (Thangarajathi, 2008), inductive, deductive and analytic method (Gulhane, 2008),
cooperative learning method (Pandya, 2010), use of computer technology (Li & Ma, 2010), 5E learning cycle technique (Naik, 2010), learning together technique of cooperative learning method (Kaul, 2010), concept attainment model (Kaur & Kaur, 2011) and jigsaw technique (Malini, 2011) on achievement in Mathematics. In all the cases, the new methods/techniques for improving achievement in Mathematics, which were applied on the experimental group, proved effective. There are some studies which show the correlates of achievement in Mathematics. The positive correlates of achievement in Mathematics are cognitive style (Maria, 1998; Subrata, 2007) and problem solving ability (Umadevi, 2009). Achievement in Mathematics is negatively correlated with test anxiety (Singaravelu, 2009).

From all those studies the investigator could realize that teachers should adopt any good method to teach Mathematics rather than the conventional method. When Sharma (2005) evaluated the methods of teaching Mathematics used by different teachers, he could identify that there were few teachers who were using new methods like the visual aids and other laboratory equipments to make the students understand better. Behera (2009) revealed that those who can verbalise the process of solution are better at problem solving. The reviewed studies inspired the investigator to test the effectiveness of cognitive apprenticeship model on achievement in Mathematics.

2.3 Studies Related to Metacognition

There is an extensive research literature exploring metacognitive process which occurs in controlled learning situations on specific learning tasks. A detailed review of the metacognitive process studied in the research paradigm is presented here.

Delclos and Harrington (1991) found that fifth and sixth graders who received training in problem solving combined with self monitoring solved more complex problems and took less time to solve them than the students those who received only problem solving training.

King (1991) taught fifth-grade students to ask themselves questions designed to prompt the metacognitive processes of planning, monitoring and evaluating as they worked in pairs for problem solving. He found that the students in guided questioning group performed better on a written test of problem solving and on a novel problem solving task than the students in an unguided questioning group.
Berardi-Coletta, Buyer, Dominowski, and Rellinger (1995) studied the effect of process-oriented instruction. The process-oriented instructions induced metacognitive processing by asking students questions designed to focus students’ attention on monitoring and evaluating their problem-solving efforts. In contrast, the problem-oriented instructions focused students’ attention on the goals, steps, and current state of the problem-solving effort. Research showed that college students who have got process-oriented (metacognitive) verbalisation instructions perform better on training and transfer problem-solving tasks than students given problem-oriented verbalisation instructions.

McInerney, McInerney, and Marsh (1997) examined the benefits of training in self-questioning within a cooperative learning context, on college students who received modelling from the instructor and practiced the use of higher order questions to induce metacognitive strategies in cooperative groups. They reported better achievement as a result of the questioning training in the cooperative group as compared to a group who received traditional direct instruction.

King (1997) developed the ASK to THINK-TEL WHY model of peer tutoring to promote high level thinking including metacognition, which also featured training in questioning techniques. Learning partners were trained in communication skills, explanation and elaboration skills, question asking skills and skill of sequencing questions. The results revealed that students learned to use a variety of questions, including review questions, thinking questions, probing questions, hint questions and metacognitive - thinking about thinking questions. Such type of questioning made a significant contribution to the effectiveness of the model in that students constructed more knowledge and increased their awareness of thinking processes.

An experiment was conducted by Maqsud (1998) to examine the effects of metacognitive instruction on Mathematics achievement and attitude towards Mathematics of low achievers at a middle school in the North-West province of South Africa. Metacognitive strategies in solving mathematical problems related to four Mathematics topics were individually taught to the members of the experimental group, while the pupils in the control group were taught the four Mathematics topics through the conventional method of teaching. The comparison of pretest and posttest measures of general ability, metacognitive awareness, attitude towards Mathematics,
and Mathematics achievement revealed that the posttest scores of all the four variables for the experimental group are significantly higher than that of the control group.

Zohar (1999) conducted a qualitative study to investigate teachers’ declarative metacognitive knowledge of higher order thinking skills within the educational setting of in-service science teachers’ courses. He found that teachers’ intuitive (i.e. pre-instructional) knowledge of metacognition of thinking skills is unsatisfactory for the purpose of teaching higher order thinking in science classrooms.

In the year 1999, Goldberg began a personal effort to change her classroom through action research, especially in the area of higher order thinking. She gathered data about the aspects of metacognition that might develop naturally in eight and nine year-olds and then translated the data into classroom practices. She compared 26 third graders in her class with the other school's third grade class. In the class, a culture of thinking was created throughout the school day by using several instructional strategies focusing on student self-awareness and planning, monitoring and evaluating within the subject domains of Mathematics, Science and visual arts. Results showed that a child of eight is not likely to use metacognitive categories of planning, monitoring or evaluating during problem solving, although some students who have just turned nine are more likely to monitor their problem solving activities by reviewing their work.

Higgins (2000) attempted to determine the impact of using integrated metacognitive instruction on high school students' achievement, self-efficacy and test anxiety. Forty students in two advanced geography classes in a large suburban high school participated in this study. The study revealed that the treatment group scored higher on an achievement test, higher on self-efficacy scores and lower on test anxiety scores. But there were no significant differences between the two groups. Significant interactions were found between gender and achievement, metacognitive self-regulation and test anxiety. Males had higher achievement scores and females reported higher levels of metacognitive strategy use and higher levels of test anxiety.

Howard, McGee, Shia, and Hong (2001) examined particular metacognitive monitoring and regulatory skills in the context of solving science problems in a computer-based learning environment in order to identify the influence of metacognitive self-regulation and ability levels on problem solving. Participants were
1,502 students in grades five through nine from schools across the United States. They found that the constructs of metacognition and ability, achievement and aptitude operate as independent processes. Results further showed that metacognitive self-regulation is a better predictor of success at problem solving than many standardised measures used in classrooms across the country.

Kayashima and Inaba (2003) proposed a double-loop model of metacognitive activities as their criterion to distinguish metacognitive activities from cognitive activities. Based on this model, they considered difficulties to do metacognitive activities, especially, how to support learner's development of self-regulation skill. So, they also proposed a learning support environment to facilitate development of a learner's self-regulation skill. The study found that the learners provided with opportunities to develop their self-regulation skill gradually learned the skill as a kind of basic cognitive activity by observational learning. Finally, they used the skill as one of the metacognitive skills with computer system's supports.

Reddy and Shantakumari (2004) aimed at i) developing diagnostic tools to identify the LLD of second language learners (English) at Higher Secondary level ii) developing metacognitive Awareness Questionnaire (MCAQ) and iii) to find out the difference between LLD students and normal students in their metacognitive awareness. They found that language proficiency and metacognitive abilities have bi-directional relationship from secondary level of schooling onwards and at HSC level, the students having LLD are in huge proportions and there are close links between language learning difficulties and metacognitive strategic deficits.

De Jager, Jansen, and Reezigt (2005) compared the growth of student metacognition in varying learning environments - direct instruction and cognitive apprenticeship in primary school. In order to measure metacognition, they developed a questionnaire with separate parts for metacognitive skills and metacognitive knowledge. They found that in the direct instruction group and the cognitive apprenticeship group the pupils had higher scores on metacognitive skills and metacognitive knowledge compared to the control group pupils. No clear differences were found between direct instruction and cognitive apprenticeship.

Trainin and Swanson (2005) compared the cognitive and metacognitive performance of students with and without learning disability (LD). Although
achievement levels for both groups were comparable, students with LD scored significantly lower than students without LD in word reading, processing speed, semantic processing and short-term memory. They found differences between groups in self-regulation and duration of study. The results showed that students with LD compensate for their processing deficits by relying on verbal abilities, learning strategies and help seeking.

The relation between intellectual and metacognitive skills in early adolescence was studied by Veenman, Kok, and Blote (2005). The first objective of this study was establishing to what extent metacognitive skill is associated with intelligence. As a second objective, the impact of hints on the execution of metacognitive skills was investigated. First, a standardised intelligence test was administered to a group of first-year secondary school students. Next, these students solved six Mathematics word problems of which three problems were without metacognitive hints and other three were including metacognitive hints. Metacognitive skillfulness was assessed through systematical observation, while learning performance consisted of performance on a Mathematics task and grade point average (GPA). Results showed that without hints metacognitive skillfulness is the main predictor of initial learning, while intelligence additionally entered the regression equation after the presentation of metacognitive hints. GPA also appeared to be predicted by a combination of intellectual and metacognitive skills.

Camahalan (2006) investigated the effects of metacognitive reading programme on reading achievement and metacognitive strategies of students with cases of dyslexia. The findings revealed that the use of metacognitive strategies in learning how to read positively improve the students’ reading achievement.

Panaoura and Philippou (2007) conducted a study aimed to model the development of young pupils' metacognitive abilities in Mathematics in relation to processing efficiency, working memory and mathematical performance. They developed instruments for measuring pupils' metacognitive ability, mathematical ability, working memory capacity and processing efficiency. The initial mathematical self-image was found to depend on the corresponding processing efficiency and its advancement to rely on the development of mathematical performance and the previous working memory ability.
Boulware, Carreker, Thornhill, and Joshi (2007) determined 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 119 third-grade students. The results indicated that the metacognitive reading comprehension instruction significantly improves the academic achievement of third-grade students in the domains of reading comprehension and vocabulary over the other instruction that was offered to the students in the comparison school. The intensity of the study and the systematic instruction of metacognitive strategies led to positive effects for understanding written text, which is the reason for reading.

Houtveen and van de Griff (2007) conducted a study on the effectiveness of metacognitive strategy instruction and instruction time on reading comprehension. Ten year old students in experimental group and control group were tested for metacognitive abilities in reading comprehension before and after implementation of treatment to the experimental group. The teachers of the students in the experimental group were trained in metacognitive strategy instruction and in optimising instruction time for reading comprehension. The learning gains made by the students in the experimental group in metacognitive abilities for reading comprehension turned out to be significantly greater than those made by the students in the control group. In the next school year, the students in the former experimental group and the former control group were again tested for reading comprehension. It was found that the students in the former experimental group had significantly better results on reading comprehension than the students in the former control group.

Bindu (2007) prepared an Apprenticeship-Type Learning (ATL) Model and tested it with the usual instructional methods (i.e. Direct Instruction) found in classrooms. The ATL Model was found more effective than the direct instruction not only for the academic achievement but also for the development of the basic skills required for professions.

Chellamani (2008) conducted a study which revealed that the language teaching and learning highly depend on psycholinguistic principles. Moreover, it was ascertained that students applying metacognitive strategies is mandatory for language acquisition. Language teaching is unlike subject teaching, where the language
learning atmosphere allows students to acquire the language. The investigator found out improvement in students’ performance as well as the spirit in conversing, reading and writing.

Young and Fry (2008) used metacognitive awareness inventory to determine how the metacognitive awareness relates to broad and single measures of academic achievement in college students. Correlations were found between metacognitive awareness and cumulative GPA as well as end of course grades. Scores on metacognitive awareness significantly differed between graduate and undergraduate students.

Ramganesh (2008) made an attempt to determine the effectiveness of metacognitive strategy on enhancing the teaching competency among B.Ed students. Experimental method with single group design was adopted in the study. Results revealed that trainees could strengthen their teaching competency through metacognitive control.

Vrugt and Oort (2008) studied about metacognition, study strategies and academic achievement and found that metacognitive awareness worked as pathways to achievement. Metacognition played important role in selecting achievement goals and study strategies.

Philip and Babu (2008) examined the difference in metacognitive awareness of teacher trainees in Kerala with respect to their gender, marital status and training period. They found that trainees have low metacognitive awareness. Male teacher trainees, unmarried teacher trainees and trainees who have completed teaching practice had better metacognitive awareness than that of their respective counter parts. Further they found that significant difference exists with respect to gender, marital status and training period in terms of metacognitive awareness.

A two year longitudinal study was conducted by Desoete (2009) on metacognitive prediction and evaluation skills and mathematical learning among third grade students. In the study, 66 children were assessed in grades three and four with a within-method-and-time design on metacognition and Mathematics. Moreover, half of grade three children were trained in the metacognitive skill of predicting their abilities in solving Mathematics tasks. All children completed Mathematics tests before and
after the training took place. Results showed that there was progress in metacognition and in mathematical skills. Moreover, children in the metacognitive group did better than the children in the control group.

Ozsoy and Ataman (2009) investigated 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 was instructed to improve their metacognitive skills while the students in the control group 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. The results indicated that students in the metacognitive treatment group significantly improved both their mathematical problem solving achievement and metacognitive skills.

In order to improve students’ metacognitive and problem-solving skills, Jacobse and Harskamp (2009) developed a computer programme consisting of word problems and metacognitive hints. The experimental group of grade five (N = 23) practiced with the computer programme, in which the students were free to choose metacognitive hints during problem-solving. The control group (N = 26) did not work with the computer program. Results showed that students using the metacognitive program scored more than the students in the control group on problem-solving posttest and improved their metacognitive skills. Moreover, a relationship between Mathematics performance and hint use was found. These results support the assumption that metacognitive skills can be enhanced by students' free choice of metacognitive hints in a computerised learning environment and the use of hints can increase students' performance in solving word problems.

Desautel (2009) conducted a qualitative case study to explore what practices lead to successful self-reflection and promote metacognitive development in young learners. The students include English language learners of a range of ethnicities, students who receive special education services and general education students. After assessing student metacognitive knowledge with a survey of reading strategies and he began a course of instruction in skills and habits that promote self-reflection and metacognition. These skills and habits included directed goal-setting, the use of
language prompts to articulate mental events, post task written self-reflections and post task oral conversations.

The relationship between self regulation competencies and psychological needs and strength of association with academic achievement of professional students was examined by Sinha and Srivastava (2009). The results showed a positive relationship among self-regulation, psychological needs and academic achievement of the students. Achievement drive, self control and autonomy were emerged as significant predictors of academic achievement.

Ismail, Ngah, and Umar (2010) conducted a study to investigate the effects of mind mapping with cooperative learning and cooperative learning on programming performance, problem solving skill and metacognitive knowledge among computer science students in Malaysia. The results showed that the students in treatment groups have significant positive overall effects in programming performance, problem solving skill and metacognitive knowledge. Finally, the results showed that there are no significant interaction effects between the instructional methods and the students' logical thinking levels for programming performance, problem solving skills and metacognitive knowledge. The study suggested that mind mapping with cooperative learning method is preferred compared to other methods in programming performance, problem solving skills and metacognitive knowledge for students of all logical thinking levels.

Mathewkutty (2010) conducted a study on metacognition skills and vocabulary attainment in English among the students of standard nine. The study revealed that there is i) a positive correlation between the metacognition skills and vocabulary attainment ii) significant difference in the metacognition skills between students of aided and government schools and iii) no significant difference based on gender.

Bosson et al. (2010) conducted a study on the strategy acquisition by children with general learning difficulties through metacognitive training. A sample of 16 children with learning difficulties participated in a three month metacognitive training intervention that alternated between curriculum-related and curriculum-unrelated tasks. The children were indirectly taught cognitive and metacognitive strategies by means of guided prompting. The application of the strategies and the children's
metacognitive knowledge were evaluated through observation of their behaviour and verbalisations. Children showed progress in strategy use and metacognitive knowledge in both types of tasks, but it was only in the more concrete strategies.

Akyol, Sungur, and Tekkaya (2010) examined the differences in the level of seventh-grade Turkish students' cognitive and metacognitive strategy use (rehearsal, elaboration, organisation, critical thinking, and metacognitive self-regulation) in Science and investigated the contribution of cognitive and metacognitive strategy use to students' Science achievement. They also explored the relationships between students' background characteristics (gender, prior knowledge and socioeconomic status), their cognitive and metacognitive strategy use and Science achievement. The statistical analysis revealed significant differences in the level of students' cognitive and metacognitive strategy use. Besides, elaboration, organisation 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 associated with cognitive and metacognitive strategy use and Science achievement.

Kistner et al. (2010) investigated teachers' direct and indirect promotion of self-regulated learning and its relation to the development of students' performance. Twenty German Mathematics teachers with their overall 538 students (grade nine) were videotaped for a three-lesson unit on the Pythagorean theorem. Students' Mathematics performance was tested several times before and after the observed lessons. A low-inferent coding system was applied to assess the teachers' implicit or explicit instruction of cognitive strategies (e.g., organisation), metacognitive strategies (e.g., planning) and motivational strategies (e.g., resource management). High-inherent ratings were used to assess features of the learning environment that foster self-regulation. Results revealed that a great amount of strategy teaching takes place in an implicit way, whereas explicit strategy teaching and supportive learning environment were rare. The instruction of organisation strategies and some features of the learning environment (constructivism, transfer) related positively to students' performance development. In contrast to implicit strategy instruction, explicit strategy
instruction was associated with a gain in performance. These results showed a discrepancy between the usefulness of explicit strategy instruction and its rare occurrence in classrooms.

Kumar (2010) investigated the influence of metacognitive strategies on student achievement. The study consisted of two different treatments: a control group and a metacognitive question group as experimental group. Daily cognitive questions were used for the control group and metacognitive questions were used for the experimental group. The study revealed that the use of metacognitive strategies enhance student achievement and increase participation in Physics classrooms.

Devaki and Pushpam (2011) aimed at the assessment of metacognitive ability of standard eleven students and its association with academic achievement in Chemistry. A sample of 244 students belonging to science group from Coimbatore district was selected as the subjects for the study. Metacognitive inventory constructed and standardised by Schraw and Dennison in 1994, was the tool used. The results revealed that there is significant association between metacognitive ability and academic achievement in Chemistry.

Parvathy and Mohaideen (2011) conducted a study on metacognition of prospective teachers in total and in dimensions such as planning, memory, evaluation, monitoring and achievement in Thoothukkudi district. It was found out from the study that only 20% of the students are having high metacognition in total and 19%, 22% and 5% are having high metacognition in the dimensions of memory, monitoring and evaluation respectively. Nobody from the sample was found to have better metacognition in the dimensions of planning and achievement.

Garrison and Akyol (2013) presented the results of research conducted to develop and validate a metacognitive construct for use in collaborative learning environments. The metacognitive construct was developed using the community of inquiry framework as a theoretical guide and tested by applying qualitative research techniques. The results indicated that in order to better understand the structure and dynamics of metacognition in emerging collaborative learning environments, we must go beyond individual approaches to learning and consider metacognition in terms of complementary self and co-regulation that integrates individual and shared regulation.
Ader (2013) conducted an ethnographic study for the promotion of metacognition, focusing on the teaching practices in secondary Mathematics classrooms of three teachers in UK. With all three teachers, observations of their teaching and interviews regarding their teaching were conducted. The main aim was analysing and substantiating the parallels and differences among the teaching practices, providing an account of the patterns in the teachers' promotion of metacognition and the underpinning factors. An important finding of the study was the differences in the teachers' emphasis on metacognition throughout the stages of the lessons and the activities they used and during their interactions with the students of different achievement levels and progress with the activities.

Yerdelen-Damar and Pesman (2013) explored how gender and socioeconomic status (SES) predicted Physics achievement as mediated by metacognition and Physics self-efficacy. Data were collected from 338 high school students. The result showed that metacognition and Physics self-efficacy could explain gender and SES related differences in Physics achievement. In addition, the study revealed that Physics self-efficacy mediated the relation of metacognition to Physics achievement whereas metacognition did not. This finding means that metacognition contributed to Physics achievement through Physics self-efficacy.

Sekar and Annaraja (2013) conducted a study with the objective of finding out the relationship between metacognition and teaching competency of Mathematics teacher trainees with respect to gender, locality and educational qualification. This study showed that there is no significant difference in knowledge-cognition, regulation-cognition, metacognition and efficacy in teaching competency with regard to gender. Also there is significant relationship between metacognition and teaching competency of Mathematics teacher trainees of college education.

Pishghadam and Khajavy (2013) examined the role of metacognition and intelligence in foreign language achievement on a sample of 143 Iranian English as a Foreign Language learner. The findings revealed that intelligence accounts for 12.2% of the variance in foreign language achievement and metacognition accounts for 17.6% of the variance. Although each of them had a unique impact on foreign language achievement, metacognition outweighs intelligence as a predictor of foreign language achievement.
Carretti, Caldarola, Tencati, and Cornoldi (2014) examined the feasibility of improving text comprehension in school children by comparing the efficacy of two training programmes, both involving metacognition and working memory, but one based on listening comprehension, the other on reading comprehension. The training programmes were implemented by school teachers as part of the class's normal school activities, under the supervision of experts. Their efficacy was compared with the results obtained in an active control group that completed standard text comprehension activities. The results showed that both the training programmes focusing on specific text comprehension skills were effective in improving the children's achievement, but training in reading comprehension generated greater gains than the listening comprehension programme.

**An Overview of the Review on Metacognition**

There is an extensive research literature exploring metacognitive processes as they occur in controlled learning situations on specific types of learning tasks. The investigator summarised the research literature into four main approaches such as i) promoting general awareness by modelling of teachers, ii) improving metacognitive knowledge (knowledge of cognition), iii) improving metacognitive skills (regulation of cognition) and iv) fostering learning environment. In the first approach of promoting awareness, teachers modelled metacognitive skills and different kind of self-reflective exercises to the students. ASK to THINK-TEL WHY model of peer tutoring (King, 1997) and a double loop model of metacognitive activities (Kayashima & Inaba, 2003) are the examples of this approach. In all these models students constructed more knowledge and increased their awareness of thinking process. Vrugt and Oort (2008) found out that metacognitive awareness work as pathways to achievement.

Within improving metacognitive knowledge approach, the investigator could find out many research studies which investigated the effect of different approaches and strategies. The research studies that found the impact of integrated metacognitive instruction (Higgins, 2000), effect of metacognitive strategy training on mathematical problem solving (Ozsoy & Ataman, 2009) and study on metacognitive training strategy acquisition by children with learning disabilities (Bosson et al., 2010) found that the use of metacognitive strategies are effective in developing metacognitive knowledge and achievement among the students.
The third approach aimed to improve metacognitive skills. This approach includes a variety of heuristics that are intended to support reflective activities focusing on planning, monitoring and evaluation (King, 1991; Berardi-Coletta et al., 1995; Goldberg, 1999; Panaoura & Philippou, 2007; Kistner et al., 2010). In all these studies, the investigator could recognise that through the development of metacognitive skills the students’ performance in Mathematics improved. In the fourth type of approach, researchers focused on a powerful teaching environment. These teaching environments fostered self-reflection, improvement and helped students to attribute their success to the use of adequate strategies and self-regulation. McInerney et al. (1997) explored the benefits of training in self-questioning within a cooperative learning context. De Jager et al. (2005) found that the varying learning environment like direct instruction and the cognitive apprenticeship helped in the development of metacognitive skills and metacognitive knowledge.

The investigator could analyse several studies which highlight the relationship of language proficiency and metacognitive abilities (Reddy & Shantakumari, 2004). Different studies were done to find out the effectiveness of metacognitive strategies on improving reading comprehension (Camahalan, 2006; Boulware et al., 2007; Houtveen & van de Grif, 2007) and writing ability (Chellamani, 2008). There are different studies which correlate metacognition with different variables like Intelligence (Vennman et al., 2005), academic achievement (Vrugt & Oort, 2008; Sinha & Srivastava, 2009), academic achievement in Chemistry (Devaki & Pushpam, 2011) and vocabulary attainment in English (Mathewkutty, 2010).

All the above studies revealed that use of metacognitive strategies are effective and it can be applied to our classroom situations. There were no experimental studies done to find out the effectiveness of cognitive apprenticeship model on metacognition especially in the secondary schools in India. So the studies reviewed guided the investigator to develop an instructional material based on cognitive apprenticeship model and test its effectiveness on Metacognitive Outcomes.

2.4 Studies to Related Social Skills

Various researchers and educators seek to evaluate and build students’ social skills within a variety of social contexts. So in this section the investigator briefly describes the research studies conducted in the area of social skills.
Archer-kath, Johnson, and Johnson (1994) conducted a study to find out the impact of group processing with individual feedback in social skills. They trained students in the social skills of praising, supporting, asking for information, giving information, asking for help and giving help. The study revealed that individual feedback in social skills is more effective in increasing student’s achievement than group feedback in social skills.

A programme was implemented in an elementary school by Court (1995) to improve students' social skills, thereby reducing physically and verbally aggressive behaviour and reducing off-task behaviour. The targeted population consisted of second, third and sixth graders in two northern Illinois elementary schools. The behavioural problems were documented through teacher and student surveys, teacher anecdotal records and behavioural observation checklists. Three major categories of interventions used were instruction in cooperative problem solving; instruction in conflict resolution; and implementation of a cross-age mentoring-tutoring program. Post-intervention analyses indicated that the intervention improved student behaviour. Many students were positively influenced by the strategies and their social skills were improved. Students with severe learning and behaviour problems or dysfunctional families were less influenced by this type of intervention than students who were less troubled.

Malecki and Elliott (2002) examined the relationship between students’ social skills and academic achievement in the third and the fourth grade students and confirmed the existence of a significant relationship between these two factors.

Freeman Sullivan, and Fulton (2003) conducted a study on the effects of creative drama on social skills, self concepts and problem behaviour. The findings of this study showed that creative drama does not significantly differ the self concepts, problem behaviour or social skills of the third and the fourth grade students. The result showed that the effects of creative drama activities do not differ by gender.

Lane, Givner, and Pierson (2003) investigated what social skills are important for students’ classroom success. They surveyed 366 teachers from kindergarten through high schools in California. They asked the teachers to select the most important social skills to students’ classroom success from the 30 items listed on the Social Skills Rating System (SSRS). Teachers rated two items related to the
cooperation (i.e. following directions and being attentive) and three items related to the self control (i.e. temper controlling in dealing with peers and adults and appropriate responding to peers’ physical offence) in the SSRS instrument as significantly important for students’ classroom success, regardless of the school level.

The SSRS teacher rated social skills were also used in the study of McClelland and Morrison (2003). They differentiated cooperation and self-control from other social skills and treated them together as a single higher order construct called learning-related skills. They completed a confirmatory factor analysis and found that the emergence of learning-related social skills significantly predicted students’ academic performance both at the beginning of kindergarten and at the end of the second grade.

Copeland (2005) found out the relationship between social skills and academic achievement with archival data on 109 elementary students enrolled in a small rural school district in Arizona, over a three year span. Specific characteristics such as gender, ethnicity and special education vs. regular education categorical information were included. Results indicated a significant positive relationship between various social skills categories and specific achievement skills. There was a research question addressed that which social skills (cooperation, assertion and self-control) best discriminate between students designated in special education and those who were not. He found that cooperation is a significant predictor of whether a student was designated in special education or not.

Dollman, Morgan, Pergler, Russell, and Watts (2007) conducted a study on improving social skills through the use of co-operative learning, in order to develop a positive classroom environment that is conducive to learning. They found that the implementation and use of co-operative learning leads to increase students’ achievement and social skills.

Fetissoff, Kry, and Skilling (2008) conducted a study on improving social skills in elementary students through classroom meetings. The study revealed that students demonstrate a lack of respect, responsibility, cooperation, empathy and self control. Both teachers and parents agreed there was a common thread through home and school, which was that the children were lacking the necessary social skills to successfully and cooperatively work with others.
Schiller (2008) determined the effect of drama strategy for improving academic and social skills among public middle school students. This study showed how drama positively affects self-esteem, student motivation, success and pro-social behaviour in at-risk students.

Usha and Nagalekshmi (2008) studied social skills of primary school children. The objectives of the study were to find out the inter-personal relationships and diplomatic skills of primary school children. The findings showed that urban students have more inter-personal skills and diplomatic skills. Also boys and girls do not differ significantly in over all social skills.

Reddi, Ramar, and Ponnambalam (2009) conducted an experimental study to find the effectiveness of comprehensive social skills strategy in overcoming social skills deficiency of the defiant students. Two matched groups of defiant students were constituted for the experiment. The control group defiant students were given routine treatment during the school hours. The experimental group defiant students were subjected to the experimental treatment. The ten action programme incorporated in the comprehensive social skills strategy was applied to them for the period of three months. The obtained results showed that the comprehensive social skills strategy is effective in developing required social skills in defiant students.

Majeed and Fatima (2009) investigated the differences and relationships between stress with aggression, social anxiety and social skills, across adolescents of Kuwaiti and Indian samples. The results showed that there are differences between the total samples of Kuwait and India in all variables except in social skills. Also the results revealed that there are positive relationships between stress with aggression and social anxiety, but negative relationship with social skills among the total samples of Kuwait and India.

Berry and O’Connor (2010) conducted a study on behavioural risk, teacher child relationships and social skills development across middle child-hood. The purposes of the study were to examine the growth trajectories of children’s social skills from kindergarten through sixth grade and to investigate the roles of early behaviour problems and teacher-child relationships in children’s social skills. The findings of the study were: the average children showed curvilinear social skills growth from kindergarten to sixth grade, with periods of marked acceleration in the
early and late elementary years. Children with higher quality teacher-child relationship demonstrated greater social skills from kindergarten through sixth grade than their peers with lower quality relationships.

Koenig et al. (2010) conducted a study on promoting social skills development in children with pervasive developmental disorders. A randomised controlled design was employed to evaluate social skills intervention for children with pervasive developmental disorders. The study supported the feasibility of this intervention to families and highlighted challenges for future research in social skills intervention.

Filerman (2011) explored relationship between social skills and academic achievement in African American, Caucasian and Latino third, fourth and fifth grade students. This study examined the differences in teacher and self-rated social skills, reading and mathematics achievement. The results of the current study revealed significant differences in teacher-rated social skills by race/ethnicity and no differences in self-ratings. Significant group differences were found in reading and not in Mathematics achievement. Regression analyses revealed that teacher-rated social skills do not mediate the relationship between race/ethnicity and academic achievement.

Choi and Md-Yunus (2011) explored the changes in children's social skills after a cognitive-social skills model intervention. The intervention was conducted over a period of 12 weeks within a regular preschool setting. Sixteen children including four considered to have low social skills participated in the study. Data analysis revealed that the four children with low social skills demonstrated changes in social skills through positive play behaviours such as asking positive questions, offering suggestions, initiating play episodes and sharing play materials, although they had limited ability to maintain play episodes.

Bhandari (2012) investigated the effect of awareness training model on social skills in relation to psychological hardiness of eleventh graders of commerce stream. The results revealed that awareness training model in commerce had significant positive effect on social skills of eleventh class students. The study also established that psychologically high hardy students scored higher gain scores than psychologically low hardy students for social skills.
Chang et al. (2014) conducted a study to examine the predictors of positive social skills outcomes of an evidence-based parent-assisted social skills program for high-functioning middle school and high school adolescents with autism spectrum disorders. The results revealed that adolescents with higher parent-reported baseline social skills and lower self-reported perceived social functioning demonstrated greater improvement in social skills following the intervention.

Haven, Manangan, Sparrow, and Wilson (2014) examined the associations between parent-child interactions and the development of social skills in 42 children (21 typically developing and 21 with autism spectrum disorders). The findings showed that parent emotional support and cohesiveness between parents and children positively influence children's social skills.

**An Overview of the Review on Social Skills**

After going through the research studies related to the variable social skills, the investigator could find that social skills are related with academic achievement (Malecki & Elliott, 2002; Copeland, 2005; Filerman, 2011). Some studies also revealed that in order to improve students’ achievement, different training techniques in social skills can be adopted (Archer-kath, Johnson, & Johnson, 1994; Dollman et al., 2007). The researcher’s survey on social skills found that among the different social skills, cooperation and self-control are important for students’ classroom success (Lane, Givner, & Pierson, 2003; McClelland & Morrison, 2003). The students’ social skills including cooperation can be improved with the implementation of cooperative learning method in the classroom (Court, 1995; Dollman et al., 2007; Fetissoff, Kry, & Skilling, 2008). Different types of social skills training can be given to the students with emotional and behavioural disorders in order to develop social skills among them (Koenig et al., 2010).

The review on studies conducted on social skills revealed that the research studies were focused on the general cooperative learning method on social skills. The investigator could not find any study related to the impact of cognitive apprenticeship model on social skills. Since cognitive apprenticeship model follows a cooperative learning environment, the studies in that area help in the present study.
Conclusion

The critical review of the studies conducted in the four variables revealed that the research studies were conducted at the higher level of education especially for the variable cognitive apprenticeship. The investigator could not find any study related to achievement in Mathematics, metacognitive outcomes and social skills in the primary or secondary school level inside or outside India. Further, the investigator could not find any study which experiment the effect of cognitive apprenticeship model on any of these variables (together or separately). Therefore after reviewing the related studies the investigator felt that it is needed to test the effectiveness of cognitive apprenticeship model on achievement in Mathematics, metacognitive outcomes and social skills.

The methodology used in this study is presented in the forthcoming chapter.