CHAPTER – II

REVIEW OF RELATED LITERATURE

The present study aims to assess the effectiveness of remediation in learning of mathematics competencies by elementary school children. Hence, the research conducted related to explore effectiveness of any strategy or on attainment of MLLs needs to be analyse to have clarity on the present status of attaining MLL in mathematics in contexts of rural and urban elementary school goers as well as the review of related literature (includes those expositions made by theoreticians in education and psychology whose work) forms the basis for the instructional strategy developed for the present study. The earlier chapter has gone into a detailed account of the theoretical basis for this study and the empirical support on which they rest. In this chapter, a detailed review has been made of the studies that provide an empirical basis for the present investigation.

A good deal of research has gone into methods and strategies of teaching different subjects, including mathematics. The effects of methods and strategies have been evaluated on a variety of variables. They include personality type, achievement, intelligence, level of thinking, sex, concept attainment, motivation, general mental ability, self-concept attitude towards the subject, towards the subject knowledge, understanding and application aspects of learning, study habits, etc. The methods and strategies that are studied by researchers for their effectiveness include Individualized Instruction, Lecture cum Discussion method, Inductive Discussion, Drill, Auto Instruction, Group Discussion, Ausubel's and Bruner's Strategies, Programmed Learning, Activities and Experiments, Mastery Learning Strategy, Analytic Synthetic methods, etc.

As the present study aims at assessing the diagnosis based remediation on attainment of MLL in mathematics, the studies on remedial teaching have also been mentioned in this chapter. Since this area of research has witnessed a great deal of research activity, one finds several meta-analytical studies covering major aspects of mastery learning. These and the other studies
connected directly with the remediation developed by Carroll and Bloom have been included in the review of literature. Further, the studies conducted by Indian researchers in the area of remedial teaching, for obvious reasons have received a special attention in this chapter.

2.1. Meta-Analytical Studies

Meta-analytical researches are of special significance due to the fact that they have a very large database. The findings from such studies are expected to be more stable and hence generalisable over a large/population. Hence, before looking into the findings of specific studies, it was considered appropriate to review the findings of meta-analytical studies.

Guskey and Gates (1986) conducted a meta-analysis that contained 27 studies addressing five areas students’ achievement, students’ retention, time variables, students’ affect, and teachers’ variables. They found that achievement results were overwhelmingly positive, but varied greatly from study to study. Students in attainment of mastery over taught concepts, at all levels showed increased gains in achievement over those in traditional instruction programmes. Positive effects were larger in elementary stage and junior high school classes than at the high school level. Effects in language, arts and social studies classes were slightly larger than those attained in science and mathematics classes. The studies also in agreement that mastery learning approach helped students to retain what they had learned for longer under mastery learning, both in short term and long term studies, Students were engaged in learning for longer portion of the time they spent in mastery classes and required decreasing amount of corrective time over a series of instructional units. Students developed more positive attitudes toward teaching, higher expectations for students, and greater personal responsibility for learning outcomes.

Guskey and Pigott (1988) conducted a meta-analysis in an attempt to answer several questions about group-base mastery learning. Those questions were how effective is the group-based mastery learning programme? What types of educational outcomes are affected by the use of mastery learning? Do
programmes vary in their effectiveness depending upon the subject matter to which they are applied? Are programmes more or less effective depending upon the grade level or age of the students involved? And does the duration of the study affect the magnitude of the results attained? The authors began with 1000 research articles and narrowed the number to 46 using the criteria of 1) studies must be on applications of mastery learning that were clearly group-based and teacher paced. 2) Studies had to report data on measured outcomes for students in mastery learning and in control classes and 3) The studies had to be free from serious methodological flaws. The 46 studies included in the synthesis contain findings on programme effects on the same five areas addressed by Guskey and Gates (1986) viz., students’ achievement, student learning retention, time variable (including measures of time on task and time spent), students’ affect and, teacher variables. They found that, student achievement was the primary variable of interest in the vast majority of these studies. With regard to students’ achievement, a positive effect was obtained as a result of the application of group-based mastery learning strategies. However, statistically significant differences were found among subject areas, indicating that the effect size differs, depending upon the subject area to which mastery learning was applied. Bloom (1968), suggested that mastery learning would enhance learning in all subject areas with larger effects in mathematics and science. This meta-analysis, however, found more positive effects in language arts than in mathematics and science.

Again, positive effects of mastery learning were seen across all levels of education. The effects appeared to be larger for younger students in elementary classrooms than for older high school or college level students. Only 7 of the 46 studies investigated students’ retention of learned material over a four week to four month period. The results showed that group-based mastery learning strategies do appear to have a positive effect upon students’ retention of the material. The authors suggested that more studies are needed involving short-term retention as well as long-term retention.

Guskey and Pigott's (1988) study has also investigated into three variables related to time viz., time on task, student attendance and attrition rates, and
instructional time. All three of these variables showed positive effects. Remediation time spent by students and instructors significantly decrease as, the student reaches higher instructional units. The authors state that learning rate appears to be an alterable characteristic and mastery learning procedures may be one way slow learners can be helped to increase the rate at which they learn. When investigating student affect the authors found students who learned under mastery conditions generally liked the subject they were studying more, were more confident of their abilities in that subject, felt the subject was more important, and accepted greater personal responsibility, for their learning than students who learned under non-mastery conditions. In the area of mastery and its effects upon teachers it was found in one study that the expectations formed by teachers about students' abilities was increased because many students had far greater achievement than the teacher originally anticipated. It was found that the teachers who use mastery learning and see improvement in student learning outcomes began to feel better about teaching and their roles as teachers. The authors found the effects of mastery learning were positive but not as large as mastery learning advocates had suggested. They suggested further studies in all areas.

Kulik and Bangert Downs (1990) conducted a meta-analysis involving 108 evaluations of mastery learning programmes. The outcome measures used were performance on examinations at the end of instruction, attitude towards instruction, attitude towards content, and course completion. Performance on examinations at' the end of instruction showed positive effects on student achievement although these effects were higher on locally prepared examinations than on nationally standardised test. The majority of studies showed a positive correlation in student attitudes towards instruction and content of mastery learning programmes. When analysing 32 studies related to course completion comparing mastery and traditional classes, only nine studies found a higher completion rate in the mastery class. This reduced effect was found to be related to self-paced mastery learning.

The meta-analysis by Kulik et al (1990), found data that led to the analysis of additional outcomes that the authors did not originally intend to analyse. The
benefits obtained from mastery learning were found to be enduring, not short term. After eight weeks of instruction mastery scores remained consistently higher than those of students in traditional classes. The data showed that the effects of mastery were not uniform on all students in a class; low aptitude students were found to have higher gains than high aptitude students. No significant increase in time on task was found which a contradiction to widely held beliefs was by many authors concerning mastery learning. More positive effects were found in relation to social science than to mathematics and natural sciences. One prediction from the mastery model was that mastery teaching would raise the performance of 95% of the students to a level ordinarily achieved by only the top 5%.

To achieve such an improvement in student performance, an increase in average score of more than two standard deviations would be necessary. The authors found an increase of only 0.5 SD. However, the authors stated after evaluation that mastery programmes have produced more impressive gains than other educational programmes.

2.2. Studies Conducted Abroad

Researches have been conducted to compare the effects of remedial teaching with conventional instruction. Areas focused in these studies are cognitive aspects, cognitive aspect along with the affective aspect, student achievement and time variable, student achievement and motivation, retention, transfer of learning, etc. Some of these teachers have used a modified mastery learning approach. Still others have compared the remedial teaching with certain other strategies for their effectiveness.

2.2.1. Studies on Cognitive Aspects of Learning

(1986), Sullivan (1987), Hadfi (1994), have considered some of the following cognitive aspects in their studies. Academic achievement transfer of learning (savings transfer), retention of achievement, minimum competency test, reading, reading vocabulary and reading comprehension scores, varying degree of instructional alignment on test scores, listening, speaking and writing scores, etc. Among these studies, more number of studies are in favour of mastery learning instructional strategy for being superior to the traditional methods of teaching with respect to the cognitive variables that are mentioned above. However, the studies of Mekin (1978), Reed (1983), Gatipon (1984), Ferris (1985), Becon and Howkins (1985) show no significant difference in the two methods of teaching that were compared. But findings of Hefnes (1985) were neither completely in favour of remedial teaching nor show complete insignificant results. This research study was designed to examine the effectiveness of the mastery learning/competency-based instructional approach in facilitating the retention of achievement in language arts and mathematics. It revealed that there was no significant difference in language arts achievement when experimental group was compared with control group either on the post-test or on the retention test. But in the achievement in mathematics there was a significant difference in favour of the experimental group.

The researchers (Airasian, 1967; Collins, 1969) have conducted studies to compare mastery learning with conventional method of teaching. The studies have used post-test only control group design. It was found from these studies that achievement in terms of percentage of 'A' grade in mastery learning group was significantly higher than the control group. The study conducted by Reese (1976) was designed to examine the effectiveness of remedial teaching with the conventional method of teaching. It followed a pre-test, post-test control group design. The experimental group containing 63 junior college students was taught several units of algebra through remedial teaching. Same units of algebra were taught through conventional method to another set of 64 junior college students of control group. The results indicated that achievement in terms of mean score of the experimental group was significantly higher than that of the control group.
West (1979) employed in his study both post-test only control group and single group pre-test, post-test designs. Twelve grammar units were taught to prospective secondary school English teachers using remedial teaching. Same units were taught to control group through conventional method. Achievement in terms of mean scores of experimental group was significantly higher than that of the control group. In single group pre-test, post-test design, achievement in terms of mean scores was significantly greater. Many students were found to have attained the predetermined mastery standard.

Study conducted by Dunkleberger and Knight (1981), compared two groups, an experimental group (n = 45) and a control group (n = 42). Experimental group received instruction via mastery strategy on introduction to chemistry and physics course for one semester. Post-test matched group/pairs design was used in this study. The findings of the study indicated that achievement in terms of mean score was significantly higher in the undergoing instruction through remedial teaching.

Mathew's (1982) study focused on a four-week unit on World War II of high school social studies, which was taught to students enrolled in a high school history course. The experimental group of classes received. Instruction via a remedial teaching and control group of classes was taught the same unit through lecture discussion approach. The findings of this study are (a) significantly higher scores and lower variance score were exhibited on an end-of-unit summative test for students assigned to the mastery group. (b) Significantly higher number of students in mastery learning group attained a predetermined standard of 90% on an end-at-unit summative test. (c) However, scores on end-of-unit evaluation for mastery learning group were not significant.

The study conducted by Arlin and Webster (1983), used pre-test randomly assigned group design. Dependent variables of the study were student achievement, percentage of students attaining mastery, learning rate, time spent in learning and retention. Findings of this study indicate that achievement in terms of mean score, percentage of students attaining mastery, learning rate, time spent in learning were significantly higher in
Koczor (1984) conducted an investigation with an objective of determining the
degree to which instructional alignment effects post-treatment measures in a
mastery learning setting. Twenty-five fourth grade students were divided into
three groups based on their aptitude (high, average and low). Three post-
treatment measures were prepared. One was maximally aligned with the
teaching material, the second was moderately aligned and the third was
minimally aligned with the teaching materials. There was a linear relationship
between the three levels of aptitude and test scores, which was significant at
the 0.01 level of confidence. The study demonstrated that alignment and
aptitude positively affect student outcomes.

Srivastava (1984) study was designed to answer the following questions (1)
Does instruction in mathematical modeling improve students modeling skills?
(2) Does instruction in mathematical modelling lead to savings transfer in
learning Physics? (3) Does a remedial teaching lead to greater savings
transfer than a non-mastery strategy? Hypotheses were tested related to
acquisition and retention of modeling skills, time taken to master the physics
unit, number of objectives mastered in physics unit, rate of mastery, index of
savings transfer and achievement on the physics mastery test. Findings of
the study supported all the hypotheses favouring positive outcomes.

Tipps (1986) reports a study focused on two groups of students undergoing
reading education. The mastery group received instruction via a mastery
strategy and the non-mastery group received instruction via a conventional
lecture discussion approach. It was hypothesised that the presence of a
remedial teaching would result in significantly higher score in total reading,
reading vocabulary and reading comprehension on the reading section of the
adult basic education post-test. The two groups were compared in terms of
students over 23 years of age, students under 23 years of age, males and
females. Findings of the study showed significant gains in favour of mastery
learning group on all the above dependant variables except for the
comparison between females in the mastery group with the females in the
non-mastery group.
Study conducted by Sullivan (1987) compared the outcomes of mastery mathematics and traditional mathematics instruction among junior high school students enrolled in the general, remedial and resource mathematics classes. Other than the achievement gains, it also considered acceptance by students and teachers, problems connected and cost involved. Mastery mathematics students scored significantly higher than the traditional group. Most students reported a positive experience with mastery mathematics.

The studies reviewed above have compared the remedial teaching with the conventional methods of teaching. These studies have focused on finding out whether the remedial teaching is better than traditional methods of teaching in terms of its effectiveness. The main aim of the mastery learning model is to help all learners learn a learning task completely. Hence, the success of the remedial teaching depends on the success of the strategy in bringing all students to the mastery level. Secondly mastery model emphasises the need for decreasing the individual differences in learning. Hence if most or all of the students reach the mastery standard then variation in achievement scores will be small or finally reach the diminishing point. So there is a need to focus mastery learning research on the attainment of optimum learning specified by the mastery standard.

2.2.2. Studies on Cognitive and Affective Aspect of Learning

Researches have been conducted to compare the cognitive and affective outcomes of the mastery learning with the traditional methods of teaching. Bach (1977), Rakitan. (1977), Strasler (1979), Bauman (1980), Thomson (1980), Schwartz (1980), Dobroski (1981), Madjiman (1982), Pratt (1983), TSE (1983), Kuhn (1986) and Lovillo (1986) studied some of the following cognitive and affective aspects. Cognitive aspects studied are achievement, transfer of learning, students' perceived cognitive development, identification of complements and correct pronoun usage. Affective variables studied are attitude towards (i) the subject taught, (ii) the method of teaching, (iii) the teacher imparting the instruction, (iv) the school anxiety towards the course behavioral problems, teacher morale, classroom problems, classroom cohesion, academic self-concept and students desire to learn through the
Schwartz (1980) found that achievement in terms of mean score was significantly higher and variation in achievement was slightly decreased in the mastery learning group. It was also found out from the study that mastery learning students had a slight increase in attitude towards mathematics whereas the traditional group had a significant decrease in attitude towards mathematics.

Dobroski’s study (1981) was designed to compare traditional approach to conducting instruction with two mastery learning instructional paradigms – the Keller Personalised System of Instruction (PSI) and the Bloom's Learning for Mastery (LFM) model of teaching and learning. The findings suggested that mastery based corrective strategies had a positive effect on student achievement in transposition and psychomotor conducting skills, students rating of increased conducting competence, and; personal attention from the instructor were high in the two mastery treatment groups. Furthermore, the Bloom type – learning for mastery corrective strategy appeared superior to the other two treatment strategies in terms of positive effect on the learning outcomes and attitude of students assigned to that group.

2.2.3. Studies on Affective Aspects of Learning

Strasler (1979) reported that the self-concept of students in the mastery learning group registered a gain.

Husen (1987) advocates redemptive egalitarianism to compensate for unequal opportunities and for equalisation of results. True social justice is possible only by equality of the available process/procedure rather than equality of access. Thus by using mastery learning strategies, a teacher can teach in a manner that will maximise student's learning. This in turn will enable the students to build a positive self-concept of them, which in turn will help them optimise their learning abilities.

From these studies it can be seen that affective consequences of mastery learning strategies seem promising. Some studies have shown that there are
not only effective cognitive consequences and more favourable affective responses from students than their non-mastery counterparts but also that difference was significant. While such findings seem promising, the question arises as to whether these findings are due to Hawthorne effect. It can be seen from these researches that they have been carried out for a short period. Hence, the favourable findings may be attributed to the newness of the treatment. Thus it was not possible to ascertain whether the favourable affective responses are just momentary in nature and would wear off as the remedial teaching proceeds or whether they are permanent in nature that would continue to exist even though the mastery learning is used as a permanent strategy in the classroom instruction.

2.2.4 Studies on Cognitive, Affective and Pre-Entry Level Characteristics

Eckart's (1984) study was to investigate the effectiveness of the mastery group-based instructional system compared to the traditional lecture/discussion method in teaching remedial mathematics at the community college. A mathematics ability test and a test designed to measure the feelings about and confidence in doing mathematics were administered. A statistically significant difference was found between students in the mastery learning class and students enrolled in the control group on the final achievement test. Mastery class had a drop out rate 17% while the control group had a drop out rate of more than 20%. No significant results were found to indicate that any entry characteristic was predictive of final achievement within the two instructional conditions.

2.2.5. Studies on the Cognitive and Pre-Entry Level Characteristics

Studies by Block (1970); Reed (1983) and Quigley (1984) focused their attention on cognitive variable, viz. academic achievement and pre-entry characteristics like IQ, initial reading comprehension, vocabulary level.

Block (1970) studied the effect of different pre-entry levels of achievement on the subsequent learning of units and the final achievement in the groups, for whom the mastery standard was laid down as 85% and 95%, respectively and the groups for whom the mastery standard was not prescribed. He found that
most students in each group (85% and 95%) learnt to approximately the same high level expected of them, thus revealing that their differences in prior achievement were not reflected in the final achievement. These differences played a large role in the learning of the first unit but subsequently decreased in the following units. However, for the group for which the learning standard was not prescribed, the influence was large in their learning throughout the sequence and their final achievement.

Reed (1983) determined whether some of the concomitant variables namely, grade level, grade point average, parents' educational level, previous experience and sex would account for the variance in cognitive achievement of mastery learning group. It was found that only the grade point average could account significantly in the level of variance on the final achievement.

Quigley (1984), attempted to diagnose the factors that would affect the variation in the final test scores of the students. The findings revealed that IQ, initial reading comprehension and vocabulary levels were significant in accounting for their variation. There was no significant difference between experimental group and control group in terms of academic achievement.

Kersh (1990), and Meverrech (1986) reported that mastery learning approach is beneficial for students belonging to lower socioeconomic strata of the society.

Kulik et al. (1990), found that mastery learning programs at various levels of education have positive effects on student attitudes towards course content and instruction that may increase student time on instructional tasks. In addition, self-paced mastery programs often reduce the completion rates in college classes.

Bush (1977) has found that the approaches to setting achievement standards have ranged from arbitrary decisions to careful analyses to future academic and job requirements. According to this study, standards have seldom been empirically validated on actual criterion groups.
2.2.6. Studies on Feedback Aspect of Learning and Time Factor

Wentling (1973) compared mastery learning and non-mastery learning to know how feedback relates to achievement. This study examined four specific areas; immediate cognitive achievement, attitude toward instruction, time spent on instruction, and delayed cognitive achievement. Each group received feedback in one of the three forms; no feedback, partial feedback (knowledge of correctness of response) and total feedback (knowledge of correct response). The findings from this study showed superior achievement for both immediate achievement and long term retention in groups with partial feedback. However, time spent on instruction and attitude toward instruction showed no significant difference. The author states low-ability students spent more time on instruction but within the total feedback treatment the high ability students spent more time than the low ability students.

Pharr (1980) assessed the effectiveness of the delayed feedback of test results on the average time for mastery level of achievement, the retention level and on the ability to predict the second semester performance. He further analysed the data obtained to assess the effect of delayed feedback and student’s pre-entry level skills on the tendency to repeat wrong responses from the first test to the later test. He found that the various delay schedules had no differential effect on the time required for mastery, on the level of achievement and retention and on the ability to predict second semester performance. It was also found that the perseverance of wrong responses was influenced by the student’s pre-entry skills as well as the delayed feedback of test results.

2.2.7. Studies on Time Factor

One aspect of mastery learning that receives much consideration is time. Mastery learning theorists especially Bloom (1971) contend that mastery learning techniques reduce the amount of time needed to achieve mastery. Arlin and Webster (1983) conducted an experiment to test these time claims. Mastery learning students were compared to non mastery students. The variables assessed were achievement time and learning rate. The authors
found significant increases, in learning rate and achievement in the mastery group. In relation to learning rate, mastery students learned 15.75 items per hour as compared to 12.08 items in the non-mastery students. The mastery students spent significantly more time in learning activities than non-mastery students. Mastery students averaged 40.9 minutes per chapter in contrast to 20.8 minutes per chapter in non-mastery students. In summary, these authors state it is possible to significantly raise achievement levels using mastery learning but the time needed for this increase is considerable.

ElFar (1982) conducted a study to evaluate the effect of two diagnostic/prescriptive procedures DPP1 and DPP2, in terms of proportion of students demonstrating the mastery on the mastery test and the time required for students to attain mastery and the achievement retention score on the achievement retention test. The results of the investigation revealed that there was no significant difference between the two experimental groups in the proportion of students who demonstrated mastery on the mastery test, but there were significant differences between the two experimental groups and the control group. Students in treatment T2 spent less time to attain the mastery on the first year algebra course than the students in treatment T1. Students in treatment T1 attained higher achievement retention than students in treatment T2 and T3.

2.2.8. Studies on Mastery Standard

Kiger (1977) tried to determine if there were differences in the achievement scores and number of attempts between two groups of pre-service teachers, when the mastery standard was different for each group, the standard being 80% and 90% respectively. Findings of this study reveal that the two mastery standards do not differ significantly in their effect on the achievement of students. Further, it was found that more attempts were required to pass modules for higher mastery standard group (90% criterion) while the lower mastery standard group (80% criterion) proceeded more rapidly without significantly reducing the knowledge of the content.
D’Albro (1980), tried to identify a mastery standard that would yield the best achievement while requiring the least amount of study time and maintaining the best student attitudes. Mastery standard were 80% fixed, 90% fixed and ascending, i.e. 80% for the first unit and increasing 5% every unit test until 90% was reached. Additional units were graded at 90%). The study showed that setting a high mastery standard or gradually raising the standard did not yield high achievement than a lower standard. In the case of 90% fixed criterion, the study scheduling was less efficient. It was also found that student's attitude toward the course were less positive when they were pushed to meet higher levels of criterion. The findings suggested that 80% fixed criterion could produce the best learning while maintaining the most productive student attitudes and involving the least amount of total study time.

2.2.9. Study on the Sequential Nature of Learning

Airesian (1969) tried to diagnose whether learning hierarchies exist in learning certain content, and also attempted to test the hypothesis that if such learning hierarchies exist, then the learning of a lower level element is necessary for the learning of the related higher-level elements. It was found that learning hierarchies did exist in the learning of certain content as analyzed by two curriculum experts. Further, it was observed that more than 75% of student’s response pattern showed that students who missed lower level elements' in the hierarchy also missed the related high-level elements, thus confirming the hypothesis.

2.2.10. Studies on the Retest Component of Learning

Heikkinen (1984) performed a very specific research study investigating only one aspect of mastery learning viz., repeated testing. Achievement was examined using subjects who were allowed to repeat tests and subjects who were allowed only one attempt at the test. The findings of the study showed no significant correlation between achievement and repeated testing. The author states that cognitive gains obtained from mastery learning are related to a combination of remediation and retesting, not retesting alone.
The following components, namely, feedback, time needed to achieve mastery, mastery standard; sequential nature of learning, pre-familiarization to the remediation before being exposed to it, retest component have been studied in the researches reviewed. On observing these studies, it can be noted that the review on the studies of mastery standard component are limited to three, the feedback component limited to two and time component to four and retest component to two. The reviews on the other components like sequential nature of learning and pre-familiarization to the remedial teaching are limited to only a single study.

On critically analyzing, we can see that mastery standard has been given more focus. The researches have not only compared the achievement in terms of mastery or no mastery requirement but have also gone further based on these results to identify the most suitable mastery standard in terms of cognitive as well as affective and time-consequences.

Feedback of the result of an evaluation is an important factor as it informs the teacher and the learner, the position of the learner on the learning curve. It also helps to detect where the learner has gone wrong so that the teacher can identify the appropriate deficit knowledge that the student requires to learn that concept, or detect the misconception that the student has which obstructs her/his further learning. This feedback may also be utilised by the student to detect and identify for herself/himself the error committed and the cause of this error. Feedback may be given immediately or may be delayed. Further; the duration of the delay may vary. A question that arises here is, how far do the immediate and delayed feedbacks differ in their effect on the remediation? The study of Pharr (1980) provides an answer to this question. His study shows that the various types of delay schedules do not differ significantly in their effects on time, level of achievement, retention and ability to predict the immediate next semester performance. However, they do have influence on the perseveration of wrong responses, thus revealing that the delay in feedback may cause the perseveration of wrong responses, Though this finding throws light on increasing the effectiveness of remedial teaching, it is felt that some more researches are needed to ascertain these findings before
such decisions are taken as to when the feedback has to be provided.

The study of Airasian (1969) throws light on the sequential nature of learning. It shows that by conducting diagnosis for placing the learner at the approximate starting point in the learning of the content and also by arranging the learning experiences in a sequential way and then ensuring that the learner masters each learning task before proceeding to the next learning task of higher level, the excessive time spent in teaching a higher level concept could be saved.

1. Diagnosis of the prerequisite cognitive learning and its remediation before the onset of classroom instruction

Generally during the remedial instruction, which is provided after the initial instruction and formative testing, the student’s difficulty, patterns are detected and appropriate remediation is provided. This difficulty pattern may also include the lack of pre-requisite knowledge pertaining to the content. But a delay in detecting results in students wasting their time during the initial instruction and formative testing which could otherwise have been saved if appropriate measures were taken prior to the onset of instruction. Thus diagnosis of the learner’s place in the learning curve pertaining to that content is necessary before the onset of instruction. This would serve to detect what knowledge the student possesses related to that content. If the student lacks some prerequisite knowledge then appropriate remediation can be provided so that the student, at the onset of instruction is ready “cognitively” to receive the instruction.

2. Arrangement of the learning tasks in a sequential manner

There is a need to arrange the learning tasks in a sequential manner so that the learning of the lower level elements gives way to the learning of the related higher level elements of that content. If the lower level elements are not mastered, then deficit knowledge forms an obstacle in the learning of the related higher-level elements. Hence, it is not possible to learn these concepts even if sufficient time is provided.
3. Diagnosis of the “exact difficulty” of the learner in learning a particular learning task

In remedial instruction, we provide remedial alternatives matched to each of the objectives/items, so when the student makes an error in the test item, a remedial alternative is provided. This alternative may be chosen according to its suitability to the learner, e.g. if the learner prefers to learn in the programmed learning style, he/she is provided instruction in the Programmed Learning Material (PLM) form. But this provision may not solve her/his difficulty in learning the concept, for here, it is not just the method that is inappropriate but, rather the diagnosis is not deep enough to spot out the source which has created the error. Hence, unnecessarily wasting time by trying out alternative ways of teaching would be ridiculous. Therefore, time could be saved if more efforts are put forth to locate the source of the error before choosing the method of presentation.

4. Provision of the Remedial Instruction through the most suitable method of presentation to the learner

There are different ways through which we learn-learning through reading, learning through listening, learning through concrete objects (seeing and manipulating), and learning audio-visual aids like TV and video. Suitability of the method would vary according to one’s abilities, interests, previous experiences and day-to-day experience. It is usually seen that a child prefers to continue learning through the media he/she is familiar with. It could therefore be appropriate to allow her to learn through those media. But as the child grows he/she is exposed to more and more types of media. The learner then makes a distinction in selection of media according to the learning task. An older child may also prefer novel ways of enhancing her learning. Hence it would be appropriate to provide the learners with the type of instruction that suit their needs. However, such a thing is not possible in the real classroom. It is not practically possible to allow each learner to learn in a unique way due to management problems, inadequacy teachers, and lack of adequate facilities for providing instruction through various learning media. Hence, in remedial learners are initially exposed to a uniform instruction with the assumption that
such an instruction would help at least a majority of them to learn in spite of their differences in preference for the media for learning. The remaining learners, who have learnt partially through the initial instruction, are then provided with the type of remedial instruction that they prefer to learn through. Hence, being aware that differences exist in the choice of the learning media, it would be appropriate to provide remedial instruction suitable to the learner so as to enhance his/her learning.

Thus, when all these aspects are given due consideration, they can contribute to reducing the unnecessary extra time that is spent in learning. Researches can focus on the above mentioned suggestive measures and assess whether each of these measures contribute significantly in reducing the time while simultaneously maintaining the standards of mastery learning. Researches can also be planned to identify more of such aspects so as to deal effectively with the time constraint faced in employing remediation.

2.2.11. Studies on the Combination of Remediation and Student Team Learning

Slavin and Karwcit (1984) as well as Mcvarcch (1985) attempted to compare the four strategies namely Conventional Teaching, Mastery Learning Strategy, Student Team Learning and Student Team Mastery Learning Strategy with each other. These strategies encompassed the following components.

(a) Conventional Teaching: This strategy included teacher’s presentation, student’s practice time and a test.

(b) Mastery Learning Strategy: It consisted of teacher’s presentation, formative tests, corrective instruction for non-masters and enrichment activities for masters and summative tests.

(c) Student Team: It involved the teacher’s presentation and practice period during which student teams would have to study cooperatively and assist each other in learning, so as to compete with other student teams in scoring the highest/mean team test score.
(d) Student Team Mastery Learning Strategy: It not only included the teacher’s presentation and practice period as in STL but also included the formative tests, corrective instruction within teams for non-masters and enrichment activities for masters and summative testing as done in mastery learning strategy.

Contradictory to these findings were the reports of the study of Mevarech, which revealed that students who were exposed to remediation significantly outscored those who were not on the computation and comprehension subtests. The study also reported that the Student Team Mastery Learning produced effects on computations but not comprehension, the Student Team Learning did not show significantly effect on either computations or comprehension, the Student Team Learning group surpassed the group exposed to conventional teaching (control group) on only the computation subtest while the Mastery Learning Strategy and Student Team Mastery Learning groups significantly outscored the control group on both the subtests.

With respect to the type of students that benefit in each of these strategies it was found that Student Team Learning favoured the higher achieving students, whereas the mastery strategies improved the occupational skills of high, medium and low achieving students, however, these differences were found not statistically significant.

As the findings of the two studies Stavin and Kaswcit (1984) and Mevarech (1985) vary with respect to the achievement gains, they do not through much light on the beneficial effects of remediation on the student teams in terms of achievement. However, the study of Mevarech shows that all the types of students (high, medium and low achieving) benefited from the Student Team Mastery Learning when Mastery Learning Strategy components were introduced into the Student Team Learning. Thus Students Team Mastery Learning strategy was found effective for all types of learners but its superiority over each of its component strategies remains unanswered due to the limited number of researchers conducted in this area.
2.2.12. Study on Effects of Mastery Learning Strategy on Students with Differing Intelligence

Kim et al. (1969) while attempting to examine the effectiveness of Bloom’s strategies for mastery learning found that almost as many mastery students below average IQ as control students with above average IQ reached the mastery standard. Mastery learning was most effective for students with below average IQ.

This finding is in agreement to what the mastery learning theory asserts that all learners can learn to the mastery level if provided with adequate facilities for learning.

2.2.13. Study on Effect of Mastery Learning On Achievement and Accountability

The study conducted by Ritchie and Thorkildsen (1994) examined achievement and accountability. This study compared two mastery learning groups. The treatment variance was that one group was aware that they were in a mastery learning programme while the other group was unaware. These authors found a statistically significant difference between the two groups with the informed group showing higher levels of achievement. They theorized this difference may have related to the awareness and the subjects have been more motivated to meet the specific goals. That is the informed group may have altered their attention to the learning environment. Both of these studies challenge claims of mastery learning critics that conclude mastery learning programmes increase achievement solely by increasing instructional time because of remediation.

2.2.14. Study on Mastery Teaching

Another important component of mastery learning is mastery teaching. Okey (1974, 1977) examined the materials necessary in order to teach mastery learning teachers and students’ attitudes toward mastery learning, and student achievement. Significant positive effects were discovered in all areas. Instructors were found to incorporate new teaching strategies into the
classroom that positively influenced both themselves and their students toward the learning process.

2.2.15 School-Based Implementation

Research on implementing mastery learning for the most part endorses the mastery learning method and the claims of the mastery learning developers. Keeping the research in mind, it is necessary to look at school systems that have implemented mastery learning programmes. The information obtained from research and implementation studies can be used to develop restructuring plans in school systems willing to meet the changing world climate.

Levine (1985) suggests some major points for school systems to explore when considering implementing a mastery learning programme. Foremost, the principal must take on the role of instructional leader. Instructional leadership involves an understanding of mastery learning principles, a commitment to preparing and supporting staff, constant awareness, and a system for setting and monitoring goals, directions, and results of the programme. Another important point is planning prior to the implementation of the mastery learning programme. Selecting material that is well organised and conforms to the principles, enables easier transition to the programme for both the student and teacher.

Chicago Mastery Learning Reading Programme (CMLR) is an integral part of language arts instruction in many schools. It was developed by the Chicago Board of Education in order to systematise mastery learning as the instructional approach to reading throughout the city’s schools. CMLR is a kindergarten through eighth grade programme that consists of student workbooks, tests and teacher manuals dealing with word attack, study skills, and comprehension concepts. CMLR is organised on a mastery learning model. It has specific objectives and standards of mastery for each unit along with a model that introduces and reiterates essential prerequisites in logical increments (Levine, 1985). Three schools, one is California, one is Chicago, and one is Missouri, each have successfully implemented this mastery
learning model. Several points emerge from these successful programmes: (1) Mastery learning provides a model of instruction that is effective for a wide range of students, (2) Mastery learning reduces the academic spread between the slower and the faster students and (3) the skills and concepts have been internalised and put to use in other areas of curriculum. Along with academic gains, student attitude and self-image have also improved. With regard to the implementation in these schools it should be noted that the transition was voluntary, the teachers played a role in decision-making and staff development was a major factor.

Arredondo and Block (1990) discuss the integrative efforts necessary to make the connection between educational models and the educational environment. Specifically, they look at the efforts of two school districts that have successfully integrated mastery learning along with thinking skills into their curriculum. Both districts began their integration in the early 1980’s and have spent considerable time deciding on the specific content to be taught and evaluated. Each district has shown considerable increase in achievement while at the same time students have been provided with the basic framework necessary to connect one fragment of instruction with another (Smith, 1989). Arredondo and Block emphasise the need for educators to be knowledgeable about research related to educational methods in order to make distinctions between the many research studies that may be applicable in any one specific instructional interaction.

An innovative approach to a summer school biology course in North Carolina was discussed by Hill and Hounshell (1991). Summer school is conducted for those who failed the course previously. These students generally have a dislike for both school and the course they are required to retake. The schedule for summer school is designed to cover a full academic year in five to six weeks with three to five class hours per day. The school system implemented six teaching strategies in an attempt to increase student achievement, student attitudes, parent attitudes, and student attendance. All students participated in all six teaching strategies. Mastery learning was one of those six and was used to help create successful student objectives, to aid
in individualising instruction to each student, and to stress the importance of
time on task. Students were monitored closely and required to achieve 80%
on all graded work. The results for this combination of six strategies showed
improved achievement, decreased absenteeism and tardiness, and improved
attitudes from students, teachers and parents.

Patterson (1993) discussed the restructuring efforts at a high school in
Colorado based on demands for higher standards and higher student
achievement. This school discarded old policies and practices and adapted
mastery learning standards, stipulated 75% achievement on each unit and
retakes for those who did not meet the 75% requirement. This change in
mastery level led to an eight-period schedule with four 90 minutes periods per
day in order to meet student needs. One of the 90 minute periods was
designated as the encore period in which students could seek assistance in
areas of decreased mastery or work on other areas of study. Because of
restructuring the students are succeeding due to higher expectations and a
schedule that accommodates their needs. Teachers have fewer interruptions
and can ensure all students have a firm understanding of the material covered
in class. Academically, the students were found to achieve higher test scores,
more students were advancing to college since the transition to the mastery
learning programme.

2.2.15.1. Role of Manipulatives

Hodes (1992) compared the effectiveness of imagery instructions and
instructional visuals for fact recall and understanding. Both instructional
methods were helpful in inducing an imagery strategy and in improving
posttest performance; however, for some performance measures,
achievements due to presenting external visuals were larger than for the
imagery instructions.

The number and math symbol cards facilitate the translation of words to
numbers and symbols. This critical connecting step helps students bridge the
gap between the concrete and the abstract. This product is designed for use with partners, in small groups, in centers, or with whole group instruction. Grouws and Cebulla (2000) state that long-term use of concrete materials is positively related to increases in mathematics achievement. In the report, “Improving Student Achievement in Mathematics,” findings suggest teachers use manipulative materials in mathematics instruction regularly in order to provide students hands-on experience that enables them to construct useful meanings for the mathematical ideas they are learning.

Grouws and Cebulla (2000) found that using small groups of students to work on activities, problems, and assignments can increase student mathematics achievement. These researchers noted that using whole-class discussion following individual and group work improves student achievement. Research reflects the importance of whole-class discussion following student work on problem-solving activities. Findings indicate that such discussion following individual and small group work improves student achievement (Grouws and Cebulla, 2000). The use of multimedia learning environments may offer ways to overcome these difficulties (Mayer, 2001). In multimedia learning environments, information presentation can be accomplished by using different representational formats (textual and pictorial) which maybe processed in different sensory channels (auditory and visual). Additionally, information presentation is not restricted to static displays (e.g., diagrams, pictures, written text), but the representations used can involve changes over time (e.g., dynamic visualizations, spoken text).

Ginns, Chandler, and Sweller (2003) showed that imagining procedures (vs. studying text based materials) was only helpful for learners possessing sufficiently high prior knowledge in the domain. This replicates findings of Cooper, Tindall-Ford, Chandler, and Sweller (2001) who found interactions between domain-specific abilities and the type of instruction given. For students who can read, most textbooks are not very helpful when it comes to teaching students how to solve math problems. They typically provide a four-step formula: (a) read the problem, (b) decide what to do, (3) compute, and (4) check your answer. “Read” the problem for understanding is the first step.
Understanding involves a representation of the relationship between numbers, words, and symbols in the problem. This representation provides the basis for deciding what to do to solve the problem. From early on, most students acquire the skills and strategies needed to “read the problem” and “decide what to do” to solve it. Many students who are nonmasters, however, do not easily acquire these skills and strategies. Therefore, they need explicit instruction in mathematical problem-solving skills and strategies to solve problems in their math textbooks and in their daily lives. Problem types should be introduced beginning with the easiest problem type, and, after mastery, move to the next level of difficulty (see García, Jiménez, & Hess, in press, for a taxonomy of the difficulty levels of the four types of addition and subtraction problems for students with mathematical difficulties). Effective visual representations, whether with manipulatives, with paper and pencil, or in one’s imagination, show the relationships among the problem parts. These are called schematic representations (van Garderen & Montague, 2003). Cognitive processes and strategies needed for successful mathematical problem solving include paraphrasing the problem, which is a comprehension strategy, hypothesizing or setting a goal and making a plan to solve the problem, estimating or predicting the outcome, computing or doing the arithmetic, and checking to make sure the plan was appropriate and the answer is correct (Montague, 2003; Montague, Warger, & Morgan, 2000). Good problem solvers use a variety of processes and strategies as they read and represent the problem before they make a plan to solve it (Montague, 2003).

Visualizing or drawing a picture or diagram means developing a schematic representation of the problem so that the picture or image reflects the relationships among all the important problem parts. Using both verbal translation and visual representation, good problem solvers not only are guided toward understanding the problem, but they are also guided toward developing a plan to solve the problem. This is the point at which students decide what to do to solve the problem. They have represented the problem and they are now ready to develop a solution path. They hypothesize by thinking about logical solutions and the types of operations and number of steps needed to solve the problem. They may write the operation symbols as
they decide on the most appropriate solution path and the algorithms they need to carry out the plan. They ask themselves if the plan makes sense given the information they have.

2.3. Studies Conducted in India

Today, in India, qualitative improvement of education is of great importance and it can be achieved only by improving the quality of instruction. But our educational system is authoritarian in its approach and highly examination oriented. In most of the Indian schools, the instruction is mainly in the form of lecture and is imparted uniformly to all the students irrespective of their differences in learning styles and needs. In spite of being aware of this drawback of our educational system, some parents continue to make efforts in helping their children learn well. Those parents who feel that their children require remediation for further learning impart this instruction in their homes or direct their children to the tutorials where these children are most likely to get an individual attention. This is because the tutor is solely involved in the learning process of an individual child. But it is not appealing to the child because after spending most of the time of the day in school, the child is once again expected to spend an additional time in the tutorials. Because of this, the child is deprived of the other recreational activities, which seems to be a desire for him/her. Such a day-to-day curbing of the natural needs is one among the reasons for the child’s negative attitude towards learning. Learning should be a pleasurable experience but never a painful one. Hence, it would be appropriate if the instruction is restricted to the classroom only and should be enriching and catering to the needs of each learner. Remedial instructions seem to be an effective strategy, which can meet all these problems adequately. It is an individualised instruction within the context of group instruction. Recent part of the students taught through remedial instructions as compared to those taught in conventional classrooms. Bala (1980) has also compared the effects of modern mathematics and traditional mathematics on Piagetian concrete and formal logical thinking. She found that a modern mathematics curriculum facilitated Piagetian cognitive thinking ability to a greater extent than a traditional mathematics curriculum.
Yadav (1984) found that 1. after the experimental treatment, the experimental group of pupils exhibited a significantly higher achievement in mathematics than the control group of pupils and higher gain scores of achievement in mathematics. 2. Different percentile achievement scores of the experimental group of pupils were found to be significantly higher than those of the control group of pupils at post-test stage. 3. The achievement distribution curve in the case of the experimental group of pupils in respect of their post-testing was highly skewed in the positive direction, whereas it was nearing normal in the case of the control group of pupils. There was minimum overlapping in the two curves, showing thereby the large differences in achievement of the experimental and control groups. 4. When the achievement distribution curves in the case of gain scores of experimental and control groups were compared, it was found that the curve in the case of the control group extended to the negative side, which implied that some of the pupils in control group did not show a positive gain. 5. After the experimental treatment, the experimental group of pupils evinced a more positive attitude towards mathematics that the control group of pupils.

Rastogi, S (1983) attempted a study on diagnosis of weaknesses in arithmetic as related to the basic arithmetic skills and their remedial measures and he revealed that basic arithmetic skills could very quickly and conveniently be mastered through the course of self-help in basic arithmetic skills as developed during the study.

Vyas, C.S (1983) attempted a study on development of symbol picture logic programme and to study its effect on mathematics achievement the students of the experimental group who were given a treatment of the SPLP showed better achievement in mathematics than the control group students.

Kaul and Chand (1985) attempted to compare remedial instructions with traditional methods of teaching with respect to academic performance, retention, self-concept, attitude of the subject, and non-verbal and verbal creativity. This study reveals that the remedial instruction is superior to traditional methods of teaching in academic performance, retention, non-
verbal and verbal creativity. However, there was no significant difference in the self-concept and attitude of the students towards the subject.

Das and Barua (1986) studied the effect of remedial teaching in arithmetic among grade IV pupils and they revealed that the major conclusion of the study was that remedial teaching had definitely improved significantly the achievements in arithmetic.

Dutta (1986) attempted on learning disabilities in the reasoning power of the students in geometry-diagnosis and prevention and he found that the experimental groups taught by audio-visual materials and techniques achieved significantly more than the controlled groups taught by conventional methods.

Dubey (1987) found numerical reasoning, numerical facility and visualization of numerical patterns as common factors from numerical reasoning. Number correlates, arithmetic operational sequence and numbers group property were the best predictors of achievement in mathematics. Chaudhri and Vaidya (1988), Deshpande and Bhat (1994) reported that the self-concept of students in the mastery learning group registered a gain. Kapoor (1989) reported that mastery learning approach is beneficial for students belonging to lower socio-economic, strata of the society.

A study on effectiveness of mastery learning programme was conducted by Vaidya (1999), to investigate its effect on the achievement, self-concept and attitude of pupils towards Hindi. The study was conducted on a sample of students of Class VI. He compared remediation with Concept Attainment Model (CAM) and the traditional method. The study indicated that remedial teaching was more effective than CAM and TM in (i) facilitating learn and enhancing the achievement level, and (ii) improvement in self-concept and attitude towards the subject.

Amruthavalli Devi (2008) studied the effectiveness of strategy of teaching mathematics developed by her based on Piaget and Vigotski’s views. She found significant difference between pretest and posttest scores in all the four
variables studied namely mathematical thinking, creative thinking, intelligence and mathematics achievement.

2.4. Studies on Learning Activities Based on Concrete to Abstract Learning Continuum

It may be recalled that the present study aims at developing a remedial teaching based on concrete to abstract learning continuum for the attainment of competencies in mathematics. The study lays an emphasis on the use of concrete materials to teach mathematics concepts. This emphasis is derived from the influence of cognitive theorists on instructional design, which argues that learning should begin with concrete experiences and move toward the abstract. Ashlock (1983), and Bruner (1966), for example, describe the three ways or kinds of knowing viz., enactive, iconic and symbolic. Enactive or concrete experiences are necessary according to Bruner, before the learner can think iconically (pictorially) or symbolically (abstractly). It implies that learning happens on a continuum ranging from concreteness to abstractness. Piaget (1973) described the stages of cognitive development through which children progress sensorimotor, preoperational, concrete operational and formal operational. Concrete operational thinking, which develops by age 7-9 for most children, is the stage of cognitive development of most elementary school children. The cognition of concrete operational children is, according to Piaget, tied to concrete activity. The children at this stage should have concrete objects as a basis for abstract mathematical ideas and concepts, hence the name concrete operational level of learning.

Criticising the formal education, Piaget (1973) stated, "The true cause of failure in formal education is essentially "the fact that one begins language (accompanied by drawings) instead of beginning with real and material action". Dienes (1967) conducted a research that was largely based on Piagetian principles of concept learning in mathematics, and thus was based on the manipulation of concrete materials.

Teaching methods such as Montessori method, are based on the perceived
importance of concrete experience. To the extent that a learning experience involves direct sensory experiences of actual objects, it is said to be a concrete learning experience. On the other hand those involve only the use of symbols, such as words or numbers, are said to be abstract.

Taxonomy of educational objectives in the cognitive domain (Bloom et al., 1956) also includes some reference to abstractness and concreteness in learning. Much more attention was given to them in the work of Hilda Taba (1966), who classified the types of thought processes involved in the classroom discourse according to their abstractness and concreteness. Thought processes that involved giving specific pieces of data, relating, comparing or contrasting them and providing factual explanations were classified as concrete. Making inferences from data, giving inferential explanations, inferring generalisations, drawing analyses, and stating logical relationships among inferences were classified as abstract. Taba seems to be distinguishing between concrete and abstract mainly on the basis of whether the thought unit was factual or inferential.

A somewhat different approach to the conceptualisation of the abstractness/concreteness continuum was adopted by Solomon (1970), who was attracted particularly by Bruner's suggested, iconic level of development. Solomon substituted the term "representational" for iconic and argued that verbal pictures or images are found in similes and metaphors and colourful vocabulary are significant, in rendering classroom discourse more concrete for learners. Solomon devised an observational instrument called the Taxonomy of Image Provocation (TIP) consisting of five major categories as follows.

(a) Concrete without imagery.

(b) Concrete to provoke imagery, where the teacher uses, concrete experiences to provoke imagery of visual, auditory, kinaesthetic, olfactory, or gustatory types.

(c) Representational, where the teacher uses models, pictures, diagrams, maps, etc. to provoke imagery of the above types.
(d) Abstract to provoke imagery where symbols such as language are used in ways that evoke images appealing to senses of the above kinds.

(e) Abstract without imagery.

Imagery was defined by Solomon as a conscious mental representation of a perceivable, absent, or non-existent object, process or concept and was thought to be significant in cognitive development because it is necessary in order to relate an iconic ‘representation’ to that which represents (Solomon, 1970). Solomon tried to advance a continuum of cognitive growth incorporating and adding to the developmental stages of Piaget and Bruner's imagery related stages.

Earlier attempts by Bloom and his colleagues (Bloom et al., 1956), and Taba (1966), to represent the abstract/concrete dimension in thought about educational objectives and classroom behaviour, implied that abstractness/concreteness co-varied with logical complexity such that, as the type of thinking engaged in became more complex, the level of abstraction necessary rose.

Dunkin and Biddle (1974), in reviewing research on this subject, discussed evidence that, particularly among the more complex types of thinking such as synthesis and evaluation, the relationship between the abstractness/concreteness and complexity was negative. That is to say, as the teachers' and students' attention was engaged by more complex logical operations, the content of the discourse became more concrete. Dunkin and Biddle suggested that classroom participants might find operating at high levels of complexity with highly abstract content too difficult and that either the level of complexity or the level of abstraction is lowered to reduce the difficulty.

Solomon and Wood (1970), reported findings concerning the incidence of the various categories of TIP in a sample of 22 elementary' and 49 secondary student teachers in West Virginia. Within the total group there were large variations in the extent to which the five categories were observed but, by far the most common were the abstract with and without imagery categories, with very little difference between the elementary and secondary levels. Imagery
appealing to the visual sense was almost twice as common as the other senses together, whether concrete, representational, or abstract.

In his study, Dunkin (1977) found that the relationship between abstractness/concreteness and logical complexity varied with grade level and subject area. In grade four social studies and mathematics and 10 grade one mathematics, the more complex logical operations of evaluation, classification, comparing and contrasting, conditional inferring and explaining were accompanied by representations and concrete objects more often than were simpler logical operations. In grade 6 social studies and mathematics, the reverse was the case. Dunkin also found that abstract experiences were by far the most frequent in grade 4 and 6, in both subject areas. It was only in grade one in mathematics, the concrete experiences were the most frequent.

2.4.1 Instructional Time

Implementation of remedial teaching in its "real sense" in the "real classroom" involves two opposing expectations.

(a) Provision of sufficient time for learning as proposed by Carroll (1963), and

(b) Implementation of this strategy within the specified duration of time allotted by the school.

Bloom (1968) had perceived the dilemma that would emerge if Carroll’s proposition were followed in the schools. Hence, he suggested that teacher’s initial instruction be supplemented by additional components, which would take care of learning while simultaneously reducing the time spent in learning. These components involve the first formative test (after teacher’s initial instruction), the feedback of the results, the provision of appropriate remediation matching to each learner’s needs, and second formative test (parallel form to first formative test) to see the adequacy of the learning. Bloom stated that those students who have not mastered in the first attempt, be provided with such inputs and such a provision, i.e. feedback, remediation and testing be repeated until all or almost all students reach the mastery level.
While Bloom's strategy could considerably reduce the time spent on learning, it was still experienced through a few researches that the time taken for the repetitive cycles was much more as compared to the school allotted time. Hence, a few researchers felt the need to modify the remedial teaching by restricting the cycles of testing → feedback → remediation. Most of them have restricted remediation to two or three cycles. It appears that these researchers have arbitrarily restricted the number of cycles rather than basing the decision on the type of learners or the content level. As the investigator was interested in determining the total time required for mastery of all the competencies of each unit by all the students, it was decided not to restrict the number of cycles. It was decided to repeat feedback, remediation and testing until all the students mastered all the competencies considered in the study.

2.5. Studies Related to Teacher Classroom Performance and Students Achievement

Prasad (1970) evaluated the professional efficiency of primary school teachers from three angles. Efficiency in classroom teaching, efficiency in organizing co-curricular activities and efficiency in organizing activities related to school community relationship.

Desai and Trivedi (1972) tried to relate the training of teachers in achievement motivation to the pupil academic achievement. Jangaria (1972) made an attempt to investigate the relationship among the classroom behavior training, teacher behavior and pupil adjustment, after having controlled the effect of fourteen teacher factors such as sex, initial teaching ability, halo effect maturation etc. Lulla (1974) conducted an investigation in to the effects of Teacher’s classroom Behavior on pupils Achievement. The study revealed that the pupils who were taught by the teachers trained in using indirect behavior scored higher as compared to their counter parts studying under the teachers who were not provided and training. It was also implied that the indirect teacher behavior may raise the interaction potential of the classroom climate resulting in free communication and open interaction between the teacher and the group of pupils. It was found that such an atmosphere not
only stimulated the learner in learning but also provided a congenital climate to the teacher for conducting his teaching.

Mehta (1974) made an enquiring in to the relationship between teacher’s classroom communication pattern and certain perceptual factors the major findings of the study were as follows. 1) There was no relationship between the age of the teachers and their communication pattern in classrooms. And similar results found between the sex of the teachers and TRR (Teachers Response Ratio), ii) Significant relationship was observed between the qualification of teachers and TQR (Teacher Question Ratio) was observed between the qualification of teachers and TQR (Teacher Question Ratio), iii) No relationship was found between the regency of training and teaching experience with the teachers classroom communication pattern. iv) the teachers teaching in boys school differed significantly from the teachers of the other two types of school on TRR, v) the male teachers were not found to differ from the female teachers significantly regarding i/d, I/D, and TQR. vi) The male teachers differed significantly from female teachers regarding TRR vii) as regards i/d, I/D and TRR, the post graduate teachers did not differ significantly from the graduate teachers on TQR. viii) Teachers having history at the graduate levels as well as at professional level did not have history at both the levels in their communication pattern in actual classroom situation. ix) There was no relationship between the teachers instructional goals perception i/d, TRR and TQR x) Negative relationship was found to exit between teachers instructional goals perception I/D xi) Teachers perception of student was not found to have relationship with their communication pattern in the classroom xii) The multiple correlation co efficient was found to be significant in the case of I/D, T/S (Teacher/Student) TT (teacher talk) and ST (student talk).

Masin (1976) checks listed the teacher behavior to relate if to the hierarchical learning out comes in biology. Malhotra (1976) investigated the interaction among teacher attitude and adjustment, teacher behavior and students linking for teachers. Maheswari (1976) studied the classroom verbal interaction pattern of effective and ineffective teachers and found that effective teachers
involved more creative teaching models. Raijiwala (1976) conducted a study to investigate the effect of training in modifying the teacher behavior (indirect) and its subsequent effect on pupil's adjustment in general and specific to teacher school, peer or father as well as achievement in science. Roka (1976) conducted a study to ascertain whether different types of training in selective verbal behavior patterns helped modify teacher behavior and whether these patterns were related to hierarchical pupil achievement at the levels of knowledge understanding and application in general science. Desai (1977) conducted a study on changing teacher behaviour in the teaching of mother tongue and studying its effects on pupils. The major findings of the study were i) Training in FIACS modified teachers indirect behaviour positively ii) The training and feedback given to the experimental group of teacher affected the academic achievement of the pupils in mother tongue positively iii) the training and feedback affected pupils classrooms trust, peer, and teacher also positively.

Roy (1977) investigated the effect of the three styles of classroom questioning on the hierarchical pupil achievement. Doyle (1977) defined successful teachers are those who maintained high levels of student work involvement and low levels of disruptions in their classrooms. Dasgupta (1977) studied that organization of teaching process and out of school activities have an impact on the efficiency of the teacher. Pillai (1978) investigated the relationship between the patterns of teaching and creative thinking. Raghavakumari (1978) investigated teacher’s attitude and perception and pupil perception. Exemmal (1980) made a comparative study of various models in the teaching biology. Naidu (1980) and Tareen (1980) also studied such a triangular relationship among teacher training teacher behavior or teacher competence and pupil academic achievement. Mathew (1980) found that factor analysis resulted in 12 factors which influenced competency of teachers concern for students, using audio-visual aids, professional perception giving assignments, introducing logical exposition classroom management, use of questions, initiating pupil participation, use of black board, achieving a closure and recognizing attending behavior of students. The effectiveness of teacher
education was assessed by comparing the professional efficiency between the trained and untrained teachers (Sinha, 1980; Vyas, 1991).

Kirkire (1981) made an attempt to analysing the impact of objective based lesson plans on the classroom verbal interaction Behavior of teachers and on the pupils achievement in Mathematics major findings: 1. There was no significance; effect of assignments on the pupils achievement; 2. Teaching with the help of objective based lesson plans did not significantly affect the mean gain achievement; 3. The manner in which the instructional material was used affected the classroom climate; 4. Indirect teacher’s behavior did not help in increasing the achievement level; 5. The settings up of systematic objectives yielded better results; 6. The teacher’s behavior was a stronger function of teachers and the teaching method than that of class groups, and 7. The responsive behavior of teachers was independent of differences between the teachers as well as differences between the classes.

Shah (1981) conducted a study to relate same selected teaching strategies to academic achievement and creative thinking in science. Sundhralakshmi (1981) made an effort to study the effect of instruction strategies on both the classroom climate and pupil attainment. Das, Passi, Jangira and Singh (1982) have conducted a study on effectiveness of different strategies of interaction of teaching skills in developing general teaching competence of student teachers. Nickerson R.S., Perkins D.N. and Smith E.E. (1985) in their study “The teaching of thinking” involved teaching a group of students to plan their problem solving in preparation for an exam they were going to take. Another group of students studied as they normally did for the exam. Students who were in the planning group performed better than those who used their traditional study methods, even though this group reported spending more time in studying than did the students in the planning group. Hence, the study suggests that students need time to practice planning their solutions to problems. Related work on teachers’ routines is teachers’ general knowledge of lesson of structure, which includes the knowledge necessary to plan and teach lesson, to make smooth transitions between different components of a
lesson and to present clear explanations of content (Lein Hardt and Smith 1985).

Suthar (1987) conducted a study on “An investigation into the effect of caste and sex of the primary school teachers upon the pupil’s achievement. The major findings of the study were: 1. the non backward class teachers were more effective than the backward class teachers. 2. The male teachers were more effective than the female teachers. 3. The more experienced teachers were found more effective than the less experienced teachers. 4. The teachers of grade VI were found to be more effective than the teachers for grades V and VII for high effectiveness scores. It was observed that the teachers for grade VII were more effective than teachers for grades V and VI for low effectiveness. 5. Out of 18 interactions, only one turned out to be significant at 0.05 levels in first order interactions and it was caste X experience. The second order and third order interactions were not significant. This was for high effectiveness scores. 6. For low effectiveness scores, out of 18 interactions not a single one turned out to be significant. 7. The caste of the teacher was not a factor that influenced responsibility of the teacher. 8. Sex of the teacher was not a factor that influenced the responsibility of the teacher. 9. The grade of the teachers in which they were teaching affected their responsibility. For high responsibility scores it was found that the teachers of the fifth grade were more responsible than the teachers of sixth grade and the teachers of the sixth grade were more responsible than the teachers of the seventh grade. 10. Out of 18 interactions, two turned out to be significant at 0.01 level in first order interactions and in second order interactions two turned out to be significant at 0.01 level the third order interactions were not significant. The interactions that were significant were sex X grade, caste X experience, caste X sex experience, and sex X experience X grade. 11. The caste of the teachers did not have any effect on pupils’ achievement. 12. Male teachers were found to be more effective than female teachers. 13. The responsibility of the teachers had no effect on pupils’ achievement. 14. The pupils studying under high effective teachers had achieved more than pupils studying under low effective
teachers. The grade of the teachers had no significant effect on pupils’ achievement scores.

Naik (1989) studied on teaching effectiveness and teacher attitude. Panda (1990) studied the impact of some curricular strategies on certain cognitive and non-cognitive traits of the learners. Velmani (1990) found out effects of teachers’ classroom interaction patterns of pupils’ creativity and academic achievement. Kulkarni (1991) had studied the use of drama in improving the teaching learning process. Some of the major findings of the study were: 1. Out of the 80 measures of performance, on 14 performances, the discrepancy was severe, on 48 performances, the discrepancy was severe, on 48 it was moderate, and where as on the remaining 18 performance measures the discrepancy was low; 2. The extent of discrepancy was more in most expected and expected performances, whereas it was low in less expected performances; 3. There was no significant difference between the performance discrepancy of female and science teachers, urban and rural teachers in relation to most of the measures of performance of teachers and 4. It was found that the discrepancy in performance affects the achievement of students, higher the discrepancy, lower would be the achievement.

Raju (1994) found that planning, presentation of lesson, closing, evolution and managerial dimensions are the best predictors of teachers’ teaching competency. Verma and Chabra (1996) studied the extent to which the primary school mathematics teachers employ the competencies, knowledge and skills acquired during teacher education programmes in actual school situations in teaching of mathematics. Gupta (1996) Assessed teachers performance on Mathematics and languages and identified areas of deficiencies in these subject. The study revealed that teachers had trouble in solving problems. Pradhan and Mistry (1996) studied the teaching learning process in primary schools and the nature of teacher-student interactions, which are responsible for good and poor results. Dutta (1998) attempted to study into modification of teaching behaviour of upper primary science teachers through verbal interaction analysis feedback and its effect on scholastic achievement of pupils of class VII in Delhi schools.
Sperry, Shannon Kelly (1999) in their study of “The effects of three professional development methods on pre-school teachers use of classroom management skills and the social behavior of at-risk pre-school children, results showed coaching teachers was an effective method for increasing teacher use of classroom management strategies with pre-school children. In addition increased teacher use of was related classroom management strategies was related to positive changes in the social play behavior of pre-school children at-risk for peer rejection. Surendranath Babu (1999) studied the influence of certain Psycho-social variables on teacher competency and has found that primary school teachers of DPEP districts better motivated than the Non-DPEP were counterparts. Teacher motivation, age of teachers, teacher attitude and teacher adjustment factors influence the teaching competency of primary teachers on the DPEP districts. Bhattacharya (2000) studied relationship between intrinsic motivation and teaching competence at primary level.

Luo, Jiali (2000) in the study of graduate teaching assistant’s perception of their instructional roles and classroom management, found that, 1. Graduate teaching Assistants (GTAs) to the nature of courses, course materials and student needs. 2. GTAs experienced problems in their classroom instruction, such as lack of commitment and disagreement on the part of students; 3. When handling classroom problems U.S. GTAs focused more on communication skills, where as international GTAs emphasized prevention and understanding students. 4. U.S. GTAs tended to enhance classroom communication by the proficient use of the language and the criterion of interactive classroom via group work and role paying. In contrast international GTAs were likely to use handouts visual aids, computer solutions and print outs and 4. GTAs relied on their supervisions for guidance in course coverage, potential problems and instructional expectations.

Harilal (2001) had under taken a study of the teaching competencies and student achievement in science of standard V. The findings of the study were: 1) there is a difference in the mean of the competencies of teachers belonging to state (mean = 22.5) and CBSE (unaided) schools (mean = 20.3). 2) The
mean of the total competencies of the teachers in the state and unaided schools found to be 58.92 and 64.26 respectively. 3) The mean of the achievement of students in Government and aided school (mean= 12.53) and that in the Private unaided Schools (mean= 12.51) did not show much difference. 4) the achievement mean of boys (12.84) is found to be greater than that of girls in the Government schools (12.26); 5) The female teachers in both CBSE (mean = 57.5) and state schools (mean = 57.56) have no difference in their pedagogical competencies; 6) There exists some difference in the mean of the total competency of male (mean = 21.85) and female teachers (mean = 22); 7) there is no significant difference in the achievement of students in the state and CBSE schools in Science; 8) there is no significant difference in the achievement of boys and girls in Science of standard V; 9) There exists appositive correlation between the teacher competencies and student achievement in Government schools and Private schools; 10) Demographic variables like age and sex affect the teacher competency; 11) Teacher competency is higher in those teachers coming under the range 1-5 years; 12) It is also found that the competency of teaching Science in standard V is greater for teachers who have low experience up to 5 years and lower for teachers who have more experience of 20-25 years; 13) Teachers whose qualification is B.Sc., B.Ed., have high correlation with their teaching; 14) Teachers whose qualification is B.A., B.Ed., have a very low correlation with the teaching competencies in Science; 15) It is also found that those teachers who have undergone in-service training programmes establish a high correlation with the competencies. 

Sabu (2005) conducted a study on “Influence of Behavioural Problems, Attitude, Stress and Adjustment of Secondary School Teachers on their Teaching Competence”. The study reveals that ‘teaching competence’ depends up on age, experience, behavioral problems, stress and adjustment. Among these, the behavioral problems and the age affect the teaching competence inversely, where as the ‘experience’ and ‘stress’ affects the teaching competence positively. The study also reveals that the teacher adjustment is a factor which significantly affects the teaching competence.
Umer Farooque (2005) conducted a study on “English Language Competency of Teachers and Students’ achievement in English Medium Primary Schools of Kannur District”. The Study reveals that: 1) There is no significant relationship between English language proficiency of teachers and learners’ achievement in EVS; 2) There is a significant relationship between English language proficiency of teachers’ and learners’ achievement in English; 3) There is a significant relationship between English language proficiency of teachers and learners’ achievement in Mathematics and 4) There is a significant relationship between English language proficiency of teachers and overall achievement of students.

Raju (2005) conducted a study on “A Comparative Study of the Teaching Competency of D.Ed. and B.Ed. Trained teachers working in Primary School of Andhra Pradesh”. The major findings of the study were: 1) there is no significant difference in Cognitive based competency between urban and rural primary teachers. 2) There is no significant difference in Performance based competency between urban and rural primary teachers. 3) There is no significant difference in consequence based competency between urban and rural primary teachers. 4) There is no significant difference in an affective based competency between urban and rural primary teachers. 5) There is no significant difference in an overall teaching competency between urban and rural primary teachers. 6) There is no significant difference in teacher competency such as cognitive based, affective based and consequence based competency between male and female primary teachers. 7) There is no significant difference in an overall teacher competency between male and female primary teachers. 8) There is no significant difference in teacher competency such as cognitive based, affective based and consequence based competency between young and old primary teachers. 9) There is no significant difference in an overall teacher competency between young and old primary teachers. 10) There is no significant difference in teacher competency such as cognitive based, affective based and consequence based competency between multigrade and monograde primary teachers. 11) There is no significant difference in an overall teacher competency between multigrade and monograde primary teachers and 12) There is no
significant difference in teacher competency such as cognitive based, affective based and consequence based competency with respect to experience.

2.6. Studies Related to Students Achievement

Some studies were conducted on students' academic achievement at Primary Stage. Hart (1978) in England conducted a project to examine the ability of children between 12 and 15 year old in computation of fractions. The study also tested their ability to solve problems in which the some computations were embedded in real situation.

Sharma (1978) conducted a study on critical study of the achievement in Mathematics by pupils of secondary schools. Gadgil (1979) conducted a study of large failures in Mathematics at S.S.C. examination of March 1977. Shahpur P.N. (1995) conducted a study entitled achievement in secondary school Mathematics. Nagalakshmi (1995) studied the secondary school students of Hyderabad area on their performance in solving problems at the five stage of development namely comprehension, judging, the adequacy of the data, given approximations and generalizations. Wilson (1978) of the situation in the Caribbean before the inception of the Caribbean Mathematics project (CMP) in 1970 suggests that the situation may well be no better in some developing countries arithmetical difficulties of a similar nature can be inferred from a survey of secondary school pupils in Daker made by Vandewile and d’Honldt (1978).

Sen Gupta (1989) had found that the understanding of axioms in Geometry as self evident truths occurs in the course of growth between the age of 5 to 7 and the order in which children understanding axioms is different from the order which the axioms are given, though different children understand different axioms at different ages.

Buch and Sudame (1990) conducted a study on Achievement of Urban primary school children. Govinda and Varghese (1991) were conducted a study on The Quality of basic Education services in India - a case study of primary schooling in Madhya Pradesh. The study made on assessment of
achievement in Mathematics with an intention to develop the competencies under MLLs. Suman Karandikar (1991) conducted a study on MLLs at the Sankar Shikha Samiti. DIET, Bhopal (1991) conducted a project entitled minimum levels learning at primary stage project-2. Similar studies were conducted in different states, Kurien et al. (1991) in Pune. Shailaja Shanbhag (1992) conducted a study entitled “A critical study of the minimum levels of learning in Mathematics at the terminal stage of primary education”. Sengupta, Debjani (1992) conducted a study on child conception of measurement of length. Das (1996) focused his study on the effects of instructional strategy using self learning activity sheets on the problem solving behaviour of class III children leading to mastery level performance. Some of the studies were conducted on MLLs in India. Singh Satvir (1996) conducted a study on determinants of learner achievement at primary stage.

Rawal (1998) has found that in Geometry students fail in understanding and application levels covered by the axioms and their explanations are not based on assumptions made. Gupta V.P. Sharma, Reeta and Singh V.P. (1999) conducted a study on learning achievement of children studying in alternative school of DPEP districts of Madhya Pradesh. Banerjee, Surendranath (2000) had attempted to study on the Mathematical competencies of the primary school dropouts. Manjulatha (2001) conducted a study on academic achievements of the Tribal and Non-tribal pupils of Ranchi city, a study in preference and performance in high school subjects.

Suhashini Tsapa (2002) made an attempt to study on problem solving ability in Mathematics of students of the terminal stage of elementary education. Singh Sri (2003) made an attempt to study an academic achievement of primary school children. Sunil Sumar Singh, Shaheeen Malik, Singh (2003) in the article in “Achievement difference of class II students in Mathematics with regard to area gender and social groups during B.A.S. and M.A.S. in Gonda district. Kothari (1995) developed a strategy based on MLLs to know the effectiveness over students’ performance. Few studies were conducted on academic achievement of Secondary School Students. Thakur (1972) had
undertaken a study of the scholastic achievement of secondary school pupils in Bihar.

Few studies were conducted on Gender difference in academic achievement. Carpenter (1983) in reporting the results of the third Mathematics assessment of the national assessment of Educational progress (NAEP), address issues of sex related differences in Mathematics achievement that males achievement exceeded that of females through at ages 9 and 13 the overall performance of males and females was not significantly different. Fenna and Peterson (1985) explained gender description in Mathematics achievement to high-level cognitive skills in Mathematics. Santosh Sharma (1999) conducted a study on “Influence of gender and Region on the achievement of primary school children”. Pattison and Greve (1984) studied whether sex differences contribute to spatial skills to tackle different types of Mathematical problems. Fennema and Sherman (1977) studies demonstrated that gender differences in Mathematics achievement were substantially reduced when numbers of Mathematics courses are controlled. The 1980 IEA Survey has studied sex difference in Mathematical attainment (Steiner, 1980) noting in its preparatory work that the relevance of different variables in explaining sex differences from country to country. The assessment performance unit surveys found significant difference in performance in several content categories. The girls did significantly ahead in the measure of length, area, volume and capacity as well as in application of number and in rate and in ratio had been noticed by APU (1980). Shuard (1981) analyses the difference of performance between boys and girls in a test given by Ward (1979) to 10 year olds in England and Wales. For overall mathematics performance, Cole (1997), Nowell and Hedges (1998), Wilson and Zhang (1998), and the Office of Educational Accountability (2002) all found that males outperformed females. Research evidence has consistently shown that female students in Hawai‘i outperform males in mathematics. Brandon, Newton, and Hammond (1987), who examined data from the 1982 and 1983 mathematics Stanford Achievement Test (SAT) administered to Hawai‘i public school students in grades four, six, eight, and ten, found that overall, females consistently outperformed males across these grade levels. Brandon and Jordan (1994) examined the 1991
SAT mathematics results for tenth graders in Hawai‘i and confirmed that girls performed better than boys. A majority of studies found that females perform better than males (DeMars 1998, 2000, Garner & Engelhard, 1999; Myerberg, 1996; Zhang & Manon, 2000).

Rumki Gupta (2000) studied gender disparity in madhyamik examination result and he revealed that difference in overall achievements i.e., average percentage of pass of boys and girls of West Bengal is small. Marginally higher percentage of girls passed the Madhyamik Examination than the boys.

Some of the studies were conducted to find difficulties faced by the students in solving problems. Researchers constructed and validated The Diagnostic Tests for this purpose. Mehta (1996) constructed a diagnostic test related to the use of four fundamental rules of arithmetic. Patel (1976) developed a Battery of Diagnostic tests in arithmetic for the Gujarati medium students studying in grades V, VI and VII in greater Bombay. Thakur (1980) constructed diagnostic tests on fractions and decimal fractions for students of Grade V. Similar study was conducted by Angel Shailaja (1987) and Prasad Reddy (2004). Remedial teaching which resulted in significant improvement followed all these studies. Sharma (1969) constructed a diagnostic test in algebra for the students of grade VIII of Uttar Pradesh. Ashar (1972) standardized a diagnostic test in basic algebraic skills for the Gujarati medium students of grades VIII, IX, X from greater Bombay. The trend of errors continued to a greater extent in the higher grades VI and VII. A diagnostic test in the skill of using Geometrical Instruments was developed by the SIE, Gujarat (1969). Wagh (1987) constructed a battery of diagnostic tests in fractional numbers in Mathematics for the students studying in VII standard in Marathi medium schools. Goel, Manisha (1996) conducted a study on arithmetic difficulties among primary grade children.

Pendharkar (1965), Construction and standardization of achievement tests in arithmetic for V, VI and VII for children studying through Marathi as the medium of Instruction in Greater Bombay. Shashikala (1985) conducted a research on an investigation in to the learning difficulties in algebraic
factorization at VIII standard in some selected schools of Bangalore city and try out of a remedial approach.

Researchers conducted some studies to find the academic Achievement of students relating with some factors. Kulwant Kaur (1974) had undertaken an investigation of differences existing among over achieving normal achieving and under achieving 10th class students in higher secondary schools.

Lalithamma (1975) conducted a study on “Some factors affecting achievement of secondary school pupils in Mathematics. Hide Brand and Patricia (1978) have shown positive relationship between educational environment and child’s performance in Mathematics. Soman (1977), in his study found some of affective correlates of Mathematics achievement of secondary school students. Chel (1990) has examined the problem of underachievement in compulsory Mathematics in the Madhyamic examination of west Bengal.


2.7. Studies on Backwardness in Mathematics

Lohithakhan (1961) conducted “An Experimental study of Backwardness of the primary school stage”. Gupta (1972) studied the causes of backwardness in Mathematics and Basic Arithmetic skills found that low achievers in Mathematics had command over basic arithmetic skills. The similar study was conducted by Rastogi (1983), Sumangala (1995) Paranis, Jnana Prabhaodhini (1978) investigated the causes of backwardness in Mathematics of students from standards V-VIII. Iyer (1977) found some factors related to
under achievement in Mathematics of secondary school students. Somasundaram (1980) conducted a study on a comparative study of certain personality variables related to over normal and under achievement in secondary school Mathematics similar studies were conducted by Chopra (1982) and Singh (1986).

Some studies were conducted on feedback. Sastri (1984) had conducted a study of delay of feedback and retention in rational understanding in Mathematics. Similar studies were conducted by Gogate (1984), Shukla (1995) Roy et al. and Saxena et al. (1996) found that the achievement of students is still far from being satisfactory. Ralte (1992) in her study of development of primary education reported that the overall performance of candidates in Mizoram, who had appeared in the primary school scholarship examination was not satisfactory in the achievement in Mathematics, English and General Science.

Jayanth Kumar Sarmah (2000) conducted “A study on the Learning Achievement with special focus on pupil’s evaluation at grade IV in Mathematics in Jorhat district of Assam”. The findings of the study reveal that pupils of tea garden schools lagged behind pupils of urban and rural schools in respect of level of achievement in mathematics. 64.91 percent of the pupils of tea garden area could not achieve even Minimum Levels of Learning (MLL). On the other hand, 36.78 and 22.37 percent of pupils of rural and urban schools failed to reach MLL respectively. Altogether 39.66 percent of total sample pupils scored below MLL in mathematics. Only 3.97 percent of total sample pupils could reach mastery level. The difference in scores was statistically highly significant at 1 percent level between students of urban and rural; urban and tea garden, and rural and tea garden schools. On the other hand there was no significant difference in mean scores obtained by boys and girls of all categories of school.

Dutta (2003) conducted “Achievement survey at the end of Class V” .the findings revealed that the achievement in Mathematics of urban girls was significantly higher than that of rural girls. In rural girls, the performance of
boys was better than the girls and in difference in achievement was significant. The overall performance of boys was better than the girls.

Archana Srivastava (2004) attempted a study on “Study of Effectiveness of Remedial Programme for Improving Disability and Achievement in Mathematics of Class VII Students” the major findings of the study were

- The mental ability of students having mathematical disability was found higher than that of general mathematical ability.

- The increase in achievement in mathematics of the students with mathematical

- Disability was found to be significantly higher than the increase in achievement in mathematics of the students with general mathematical ability after remedial treatment.

- The remedial treatment reduced the mathematical disability of the students significantly.

- The remedial treatment increases the mathematical achievement of the experimental group significantly.

- The remedial treatment increased the mathematics learning abilities of the experimental group significantly.

- The remedial treatment was not found to have different effects on male and female students.

- The remedial treatment and gender were not found to have significant interactive effects on mathematical disability.

- As a result of the interaction effect of Mathematical Disability Remedial Treatment and Gender the girls of the experimental group were found to be significantly higher than the girls of control group on time orientation.
As a result of the interaction effect of Mathematical Disability Remedial Treatment and Gender the boys of the experimental group were found to be significantly higher than the boys of control group on algebraic ability.

Sridhar Rajgopalan, Vyjayanthi Shankar and Poonam bhatta(2004) conducted a study on “An Overview of the Development of Learning Standards for Science and Mathematics Education: KG – 8 . The findings revealed that a) The goal of Mathematics teaching is to develop in children mathematical thinking, teach them procedures and also create a positive attitude towards Mathematics. There is a feeling that the current curriculum focuses mainly on the second of these (i.e. teaching Mathematics procedures). One way of encouraging Mathematical thinking is to build concepts gradually clearly showing the links and patterns underlying different concepts. b) Students should be taught the applications of various concepts so that they are able to apply them efficiently and effectively in everyday life. c) Increased emphasis should be laid on ‘problem solving’ i.e. the children’s ability to tackle problems that are conceptually challenging and which have not experienced before. d) Fraction operations should be de-emphasized and decimal sense strengthened as that is what is used mostly. e) Emphasis on mental mathematics (precise calculation mentally) and estimation (rough calculation) skills, visual and spatial skills (understanding symmetry and shapes) should be increased. f) The basics of statistics should be introduced early.

Dutta (2006) Mid-Term Achievement Survey (MAS) was conducted in Assam in the year 2006 covered 11 districts as per guideline provided from NCERT. Assessment of learning in primary education has a special significant in the context of UEE. It was observed during the project period that students were not able to obtained more than 50% marks during BAS, MAS and TAS in the DPEP period, only in few cases 45% to 50% marks secured by students in BAS and MAS conducted by NCERT.

Uma Devi (2006) attempted a study on “Levels of Scholastic Achievement of Rural Elementary School Children: The role of Class Room teaching Practices”. The major findings of the study were,
• More than 50% of children’s performance was high and very high on scholastic competency test.

• Significant differences were noticed in scholastic competencies based on class, gender and district.

• Fifty five percent of rural elementary children performed well on intelligence test by securing high and average scores.

• Significant differences were noticed in intellectual abilities of children based on class, school type and district.

• Intellectual abilities, academic skills and scholastic competencies of elementary school children were significantly and positively related with each other.

• Children’s attendance is related to academic achievement.

• Parental occupation, education with special emphasis on mother’s occupation and income were significantly related to academic skills, scholastic competencies and intellectual abilities.

Dalip Singh (2007) made an attempt to study on “Learning Achievement of class V students a baseline study” revealed that the present survey-cum-study of learning achievement of Class V students was initiated in 2000. The massive data were collected from 105 districts spread over 27 States and UTs comprising 4787 schools, 10,796 teachers and 88271 students. It was not only limited to assessment of learning achievement of Class V students in curricular areas — Language, Environment Studies and Mathematics but it also studied intensively the school and home factors which influenced the learning achievement.